Land Rover
Vehicle Communications
Software Manual

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

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Safety Information

For your own safety and the safety of others, and to prevent damage to the equipment and vehicles upon which it is used, it is important that the accompanying *Important Safety Instructions* be read and understood by all persons operating, or coming into contact with, the equipment. We suggest you store a copy near the unit in sight of the operator.

This product is intended for use by properly trained and skilled professional automotive technicians. The safety messages presented throughout this 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. It is important to perform tests in an appropriate and acceptable manner that does not endanger your safety, the safety of others in the work area, the equipment being used, or the vehicle being tested.

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

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

Read, understand and follow all safety messages and instructions in this manual, the accompanying safety manual, and on the test equipment.

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:

WARNING

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 accompanying safety manual.

SAVE THESE INSTRUCTIONS

Contents

Chapter 1 Using This Manual

This manual contains tool usage instructions.

Some of the illustrations shown in this manual may contain modules and optional equipment that are not included on your system. Contact your sales representative for availability of other modules and optional equipment.

1.1 Conventions

The following conventions are used.

1.1.1 Bold Text

Bold emphasis is used in procedures to highlight selectable items such as buttons and menu options.

Example:

- Select **Engine Management** from the list of options.

1.1.2 Symbols

Different types of arrows are used.

The “greater than” arrow (>) indicates an abbreviated set of selection instructions.

Example:

- Select **Utilities > Tool Setup > Date**.

The example statement abbreviates the following procedure:

1. Navigate to the **Utilities** screen.
2. Highlight the **Tool Setup** submenu.
3. Highlight the **Date** option from the submenu.
4. Press **OK** to confirm the selection.

The solid arrows (e, c, d, b) are navigational instructions referring to the four directions of the directional arrow keys.

Example:

- Press the down d arrow.

1.1.3 Terminology

The term “select” means highlighting a button or menu item and pressing the **Accept**, **OK**, **Yes**, or other similar button to confirm the selection.

Example:

- Select **Reset**.

The above statement abbreviates the following procedure:

1. Navigate to and highlight the **Reset** selection.
2. Press the **OK**, or similar, button.

1.1.4 Notes and Important Messages

The following messages are used.

Notes

A NOTE provides helpful information such as additional explanations, tips, and comments.

Example:

NOTE:
For additional information refer to...

Important

IMPORTANT indicates a situation which, if not avoided, may result in damage to the test equipment or vehicle.

Example:

IMPORTANT:
Do not disconnect the data cable while the Scanner is communicating with the ECM.

1.1.5 Procedures

An arrow icon indicates a procedure.

Example:

To change screen views:

1. Select the **View button**.
   The dropdown menu displays.
2. Select an option from the menu.
   The screen layout changes to the format selected.

Chapter 2 Introduction

The Land Rover Vehicle Communication Software (VCS) allows your scan tool to test multiple vehicle systems: engine, transmission, antilock brake, supplemental restraint, suspension, and others. The tests offered by the software allow for simplified diagnostics and troubleshooting.

The VCS establishes a data link between the scan tool and the electronic control systems of the vehicle being serviced. This data link allows you to view diagnostic trouble codes (DTCs), serial data stream parameters, and freeze-frame information available from the electronic control modules (ECMs) of the vehicle. On models with bi-directional communication, the VCS also lets you perform certain system and functional tests, and provides the ability to switch off the malfunction indicator lamp (MIL) and reset service interval lamps after repairs are made.

The amount and type of information and tests available with the Land Rover VCS varies by the year, model, and equipment options of the test vehicle. With the software you can: interpret electronic control module trouble codes, read input and output signals, perform bi-directional tests, test specific systems and components, check the operation of certain actuators (solenoids, valves, and relays), customize your scan tool function, and record and view data movies.

The first two chapters of this manual overview safety and usage conventions. The remainder of this manual is divided into the following chapters:

- “Operations” on page 6 explains basic scan tool operations, such as identifying the test vehicle, selecting a system for testing, and connecting the scan tool to the vehicle.
- “Testing” on page 12 provides information and procedures for using the scan tool to test specific vehicle control systems.
- “Data Parameters” on page 27 provides definitions and operating ranges for the data parameters that display on the scan tool.
- “Troubleshooting” on page 43 contains information for troubleshooting problems with scan tool-to-vehicle communications.
- “Terms and Acronyms” on page 46 defines common terms and acronyms used throughout this book and in the vehicle communication software on the scan tool.

Chapter 3 Operations

This chapter explains how to begin using the basic scan tool test functions, such as identifying the test vehicle, selecting a system for testing, and connecting the scan tool to the vehicle. The flow diagram below represents the basic operation of the vehicle communication software (VCS).

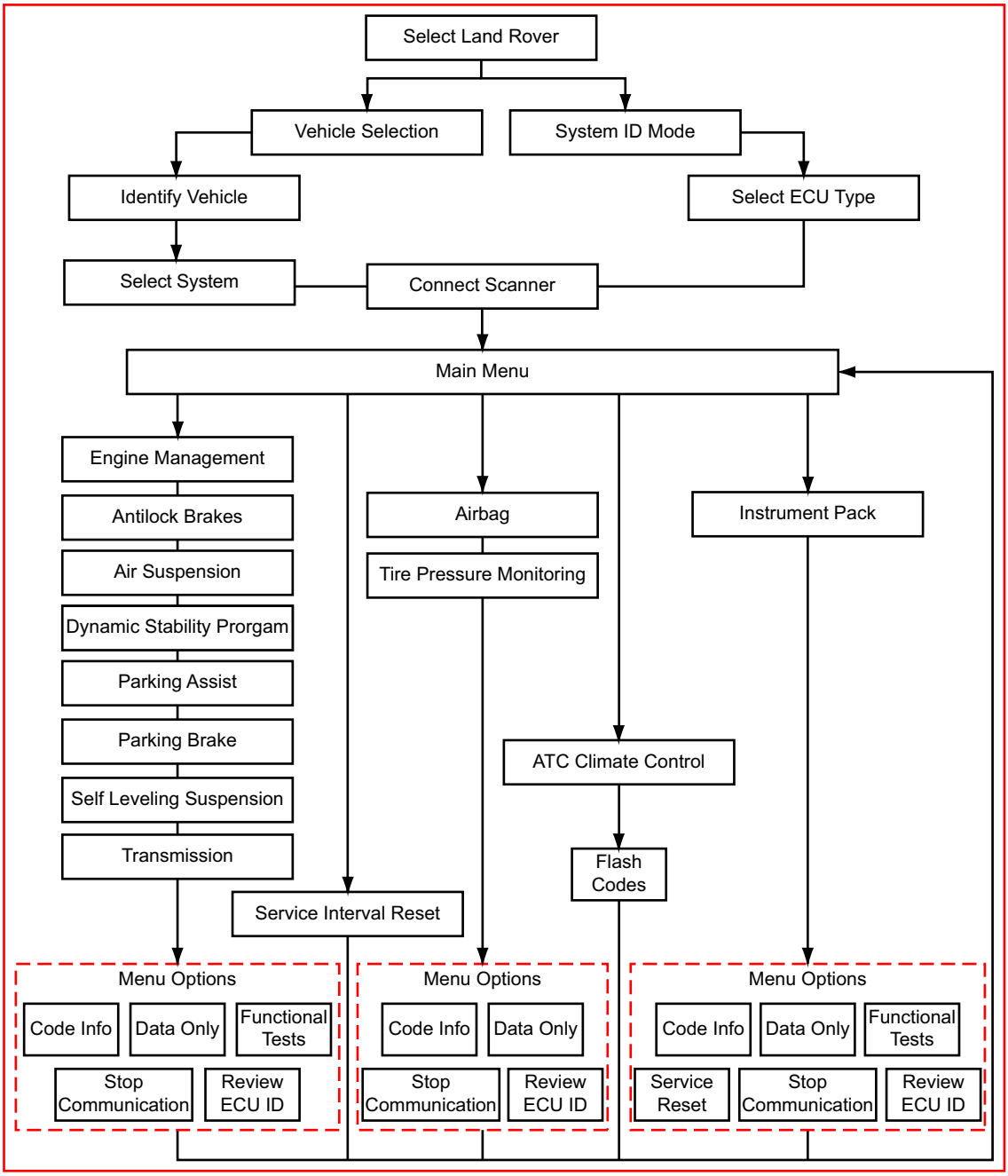

Figure 3-1 *Basic scan tool operational flow*

3.1 Identifying the Test Vehicle

Once the Land Rover database has been opened, a menu that offers two methods to configure the scan tool for testing the target vehicle displays:

- Vehicle Selection—standard method that is used for most diagnostic sessions
- Vehicle ID Mode—alternate method that is used when experiencing communications problems or if the type of electronic control unit (ECU) is unknown.

Brief descriptions for each menu item follow, select from the menu to continue.

3.1.1 Vehicle Selection

With this more common of the two methods, vehicles are identified by entering specific vehicle identification number (VIN) characters into the scan tool. Simply answer a series of questions to configure the scan tool, each response advances the display to the next question. Although specifics may vary slightly based on the year and model of the test vehicle, you are typically asked to provide the following information:

- Model year—tenth VIN character
- Model—fourth VIN character
- Engine—seventh VIN character
- Optional equipment—appears only when necessary, and requires a yes or no response

A confirmation screen that shows all of the vehicle identification data displays once all of the questions have been answered. From the confirmation screen select:

- **Yes** to advance to the Select System menu, see “Selecting a System for Testing” on page 7.
- **No** to move back through the information one step at a time to make corrections.

3.1.2 System ID Mode

This alternative method allows you to begin the vehicle identification by first selecting the system to be tested. Use this option if communication problem arise or the ECU type is unknown.

This procedure is menu driven. Selecting a menu item advances you to the next menu or submenu. Once the scan tool has enough information to determine the identity of the test vehicle based on your menu selections, a connection message displays. The connection message lets you know which data cable adapter and Personality key to use, and where to locate the data link connector (DLC) on the vehicle. Refer to “Connecting to a Test Vehicle” on page 11 for additional information.

3.2 Selecting a System for Testing

Once the vehicle identification is confirmed, the Select System menu displays. These menus are specific to the test vehicle and only systems available for that particular vehicle display. Menu options, which vary depending upon the year and model of the vehicle, may include:

- Engine Management
- Antilock Brake
- Airbag
- Air Suspension
- ATC Climate Control
- Dynamic Stability Program
- Instrument Pack
- Parking Assist
- Parking Brake
- Self Leveling Suspension
- Service Interval Reset
- Tire Pressure Monitoring
- Transmission

Selecting a system may open the system main menu, or open additional menus that involve choosing from options available within that category.

3.3 System Main Menu Options

Main menu options may vary by system, year, and model, but all are similar. Common main menu options ar briefly explained in the following sections. Specific tests available for individual systems, and how to conduct them, are detailed in Chapter 4 "Testing" on page 12. The following choices are available on most system main menus:

- Code Info
- Data Only
- Functional tests
- Stop Communication
- Review ECU ID

3.3.1 Code Info

The code info, or information, menu option retrieves diagnostic trouble code (DTC) records stored in the selected ECU. Selecting opens a list of stored DTCs along with a brief description of each code. The DTC list can be saved or printed to be included with your customer records. Exiting the DTC list opens the Codes exit menu.

Codes Exit Menu

A Codes Exit menu displays when you navigate out of a code list. Typical options are:

- **Resume**—returns to the code list
- **Clear Codes**—erases trouble code records from ECU memory
- **Return To main Menu**—returns to the system main menu

Clear Codes

Depending on the system under test, the Clear Codes feature may appear on the Main Menu (System), Codes Menu, or Codes and Data Menu. Regardless of location, the operation is the same, select and follow any on-screen instructions to delete code records from the ECU.

Clear Codes Tips

Keep the following points in mind when clearing codes:

- Some cleared codes only set again under certain circumstances. Note, print, or save the code list before repairs, and before clearing codes.
- When the error condition still exists, the code may set again.
- If the code clearing operation fails for any reason, the previous codes reappear. Should this occur, return to the menu and repeat the Clear Codes operation.

3.3.2 Data Only

The Data Only menu option retrieves live serial data from the selected ECU. Selecting Data Only opens an additional sub-menu, or Data Groups Menu, of viewing options on some models.

Data Groups Menu

Due to a very large number of data parameters available on some models, parameters are divided into several smaller groups of related data. Reducing the number of data parameters that display increases the screen update rate, so values displayed on the scan tool refresh much faster.

3.3.3 Functional Tests

Functional tests allow the scan tool to control certain ECU operations. Selecting this menu option opens a sub-menu of choices. Often, there is only one type of test is available (usually actuator tests) available on the sub-menu. Possible menu options include:

- Actuator Tests
- Special Functions
- Adaptation.

Actuator Tests

Actuator Tests allow the scan tool to switch certain system components on and off to check their operation. The number of components that can be activated is dependent on the ECU under test and the vehicle itself.

Typically, the scan tool energizes the selected actuator for 30 seconds, then automatically switches it off to prevent overheating or other damage to the component or system. For most actuators, the test can be cancelled at any time by the operator.

Carefully follow all on-screen messages and instructions while performing functional tests.

Actuator Test Tips

Keep the following points in mind while performing actuator tests:

- Often a certain actuator may not be installed on a vehicle, although according to the manuals it should be. Therefore, first check to make sure the actuator is actually present if you fail to hear a reaction during a test.
- Have the engine running only when instructed to do so by the on-screen instructions.
- Always follow the instructions displayed on the screen.
- Some actuators cannot be stopped during the 30 seconds period, wait for the 30 seconds to elapse to end the test.
- With some engines it is very difficult to hear the fuel-injectors click. Use a multimeter or scope to make sure the injectors are activated properly.
- Some actuators are only activated for a short time, instead of 30 seconds. For example, the fuel-injectors are often activated for only five seconds, this is for safety reasons.

Special Functions

These tests are for resetting the ECU default values after select components have been repaired or replaced. Select an item from the menu and the scan tool displays step-by-step instructions.

Adaptation

These tests are for resetting the ECM adaptive values after select components have been repaired or replaced. Select an item and follow the on-screen instructions.

3.3.4 Stop Communication

This selection is used to end the current diagnostic session by opening the communication channel between the scan tool and the ECU. Some systems and ECUs can be damaged or disabled if the data cable is disconnected before communication has properly stopped. Always return to the main menu and select “Stop Communication” before disconnecting the cable.

A confirmation message warns that stored information is lost when communication stops. You must make a selection:

- **Continue**—end the diagnostic session
- **Return**—to go back to the main menu to save data before exiting

Follow any additional on-screen instructions.

3.3.5 Review ECU ID

This selection displays pertinent information such as the part and model numbers and the manufacturer, about the ECU presently communicating with the scan tool.

3.4 Connecting to a Test Vehicle

Once a vehicle has been identified and a system has been selected, a scan tool connection message instructs you to use the vehicle test adapter and a Personality key (if needed) to connect the scan tool for testing. Follow the screen instructions to connect the scan tool to the vehicle.

Each test adapter plugs into a specific vehicle diagnostic connector and attaches to one end of the data cable. The other end of the data cable attaches to the scan tool. Personality keys fit into the OBD-II adapter and allow the scan tool to interpret the data stream information according to the specific configuration of the vehicle DLC.

Chapter 4 Testing

This chapter provides information and procedures for using the scan tool to test specific vehicle control systems. The systems discussed in this chapter include:

4.1 Engine Management

The Main menu options available for testing Land Rover engine management systems include:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.1.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.1.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

Typical Engine Management Data Groups options include:

- **AD Inputs**—displays all of the “adaptive” input sensor signals
- **Driver Demand**—displays all of the throttle control input signals
- **ECM Data**—displays basic configuration data
- **ECM Inputs**—displays a list of switch signal inputs
- **Emissions**—displays all of the exhaust emissions related parameters
- **Fuel System**—displays all of the fuel related parameters
- **Ignition System**—displays all of the ignition related parameters
- **Oxygen Sensors**—displays all of the feedback fuel control related parameters
- **Powertrain**—displays all of the engine related parameters
- **Readiness Data**—displays a diagnostic trouble code (DTC) status report
- **Relays, Switches, Charging & Acc Data**—displays digital, or two-position, parameters.

4.1.3 Functional Tests

Functional tests for the engine ECU include actuator tests.

4.2 Anti-Lock Brakes

The Main menu options available for testing Land Rover antilock brake systems (ABS) include:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.2.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.2.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.2.3 Functional Tests

This functional test for calibrating the steering angle sensor is available from the ABS ECU on some models.

Steering Angle Sensor Calibration

The scan tool guides you through a step-by-step procedure for calibrating the steering angle sensor after repairs or replacement. Follow the on-screen instructions to perform the calibration.

4.3 Airbag

This selection is available on models with airbags and/or a supplemental restraint systems (SRS).

The Main menu options available on Land Rover models with airbags and/or a supplemental restraint systems (SRS):

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.3.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.3.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models.

These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.4 Air Suspension

The Main menu options available for testing Land Rover air suspension systems include:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.4.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.4.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes

it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.4.3 Functional Tests

Functional tests for the air suspension ECU may include actuator tests and special functions. The actuator tests allow you to energize different system components to check their operation. Special functions allow you to make adjustments and calibrate the system, typical options include:

- Air Suspension Height Calibration
- Headlamp Calibration Setup
- Air Suspension Deflation
- Air Suspension Enable
- Suspension Geometry Setup
- Suspension Tight Tolerance Control

4.5 ATC Climate Control

This selection is available on models with an automatic temperature control (ATC) system only. The ATC ECU does not transmit data to the scan tool, but it does display “flash codes” on the system control panel. The scan tool provides information on how to trigger the code display.

4.5.1 Flash Codes

Available flash codes are:

- 11—In car temperature sensor
- 12—Ambient temperature sensor
- 13—A/C evaporator temperature sensor
- 14—Water temperature sensor
- 21—Left solar sensor
- 22—Right solar sensor
- 31—Air blend left potentiometer
- 32—Air blend right potentiometer
- 33—Air outlet (mode) potentiometer

4.6 Dynamic Stability Program

This selection is available on models with a traction control system. Selecting may open a submenu that allows you to select which ECU, such as ABS or steering angle, to test if more than one are used.

The Main menu options available for testing include:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.6.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.6.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.6.3 Functional Tests

This functional test for calibrating the steering angle sensor is available from the dynamic stability control ECU on some models.

Steering Angle Calibration

This functional test guides you through a step-by-step procedure for calibrating the steering angle sensor after repairs or replacement. Follow the on-screen instructions to perform the calibration.

4.7 Instrument Pack

The Main menu options available for testing Land Rover instrument pack systems include:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Service Reset—allows the scan tool to reset the vehicle service reminder lamp interval.
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

This selection is available on models with a traction control system.

4.7.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.7.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.7.3 Service Reset

Resetting the interval for switching on the service reminder lamp on the instrument cluster requires a fully-charged vehicle battery, low vehicle battery voltage prevents the scan tool from resetting the ECU counter. Follow the on-screen instructions to switch the service reminder lamp off after servicing the vehicle.

4.8 Parking Assist

This selection is available on models with a dedicated ECU for the parking assist system, Main menu options available:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.8.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.8.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.8.3 Functional Tests

Functional tests for the parking assist ECU include actuator tests.

4.9 Parking Brake

This selection is available on models with a dedicated ECU for the parking brake system, Main menu options available:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.9.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.9.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.9.3 Functional Tests

Functional tests for the parking brake ECU include actuator tests and special functions. Typical Special Function options include:

- Parking Brake Information
- Module programming
- Longitudinal Accelerometer Calibration
- EPB To Mounting Position (park brake shoe removal or adjustment)
- EPB To The Latching Position
- EPB Unjam Procedure

4.10 Self Leveling Suspension

Main menu options available for testing Land Rover self-leveling suspension systems include:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.10.1 Code Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.10.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.10.3 Functional Tests

The following functional tests are available on Land Rover vehicles with Self-leveling Suspension:

- “Current Suspension Status” on page 24
- “Suspension Calibration” on page 24
- “Transportation Mode” on page 24
- “Suspension Configuration” on page 24
- “Production Flags” on page 24

Current Suspension Status

Displays a report on the present state of the system; whether configured for self leveling, in transportation mode, or calibrated.

Suspension Calibration

This functional test is a step-by-step procedure to calibrate the system that must be completed once it has begun. Use this procedure only when working on a system that is not calibrated, or if a height sensor has been replaced, removed, or otherwise disturbed.

IMPORTANT:
This test operates the air suspension and requires a considerable amount of electrical power, therefore it is recommended to run the engine at idle to avoid draining the battery. However, starting the engine during a test interrupts communications and aborts the procedure, so start the engine before selecting the test.

Transportation Mode

This functional test is used to lock down the suspension on a vehicle that is being transported. This mode should only be engaged on a vehicle that is not being driven.

Suspension Configuration

This functional test is used to program the self-leveling ECU for a coil-spring suspension, rather than the standard air-spring suspension. The configuration should only be changed when the vehicle has been modified.

Production Flags

Production flags indicate whether changes or modifications have been made to the system.

4.11 Service Interval Reset

Although the service reset procedure is actually a functional test, it is on the main menu as a convenience. There are two types of service interval reset, automatic and manual, and availability varies by year and model. Both open a step-by-step procedure as explained below.

4.11.1 Manual Service Interval Reset

A button on the left side of the instrument panel is used to reset the service interval counter to zero. When selected from the main menu, a procedure opens on the screen. Scroll to read the entire procedure and performing the necessary steps as directed by the on-screen instructions. Selecting to continue once finished returns you to the main menu.

4.11.2 Automatic Service Interval Reset

Automatic service interval resetting is a bi-directional communication procedure directed by the scan tool. The scan tool display guides you through the process. A number of instructions that require a response to continue display, including an option to clear any stored codes once the interval has been reset. Follow the on-screen instructions.

4.12 Transmission Systems

Diagnostic information is available for both manual and automatic transmissions. The Main menu options available for testing Land Rover engine management systems include:

- Code Info—displays diagnostic trouble code (DTC) information stored in the ECU
- Data Only—displays live serial data from the ECU
- Functional Tests—allows the scan tool to control certain ECU operations
- Stop Communication—terminates the scan tool to ECU communication link.
- Review ECU ID—displays pertinent information about the ECU

4.12.1 Codes Info

The codes menu option retrieves diagnostic trouble code (DTC) records stored in the ECU. Selecting opens a list of stored DTCs along with a brief description of each code. Exiting the codes list opens the Codes Exit menu. A menu selection must be made to continue:

- Resume—goes back to the code list
- Clear Codes—erases the code list from ECU memory
- Return To Main Menu—goes to the main menu, codes are retained in memory.

Clear Codes

This menu option erases DTC records and other temporary information, such as freeze-frame data, from the vehicle ECU.

To clear codes:

1. Select **Clear Codes** from the Codes Exit menu.
   A message that the ignition must be on with the engine off displays.
2. Select **Yes** to continue, selecting No cancels the operation and returns to the main menu.
   A “clearing codes” message displays followed by a “clear codes complete” message.
3. Select to return to the Main menu.
4. To verify memory has been cleared, select **Codes** from the Main menu.
   A “no codes” in memory message should display. If not, repeat the clear codes procedure.

4.12.2 Data Only

Selecting Data Only from the System Main menu usually opens a list of serial data available from the ECU. However, an additional sub-menu of data viewing options may open on some models. These sub-menus break the data down into smaller packets of related parameters, which makes it easier to find pertinent information and compare readings. A shorter data list also results in a faster screen update rate, so the values being displayed are more current.

4.12.3 Functional Tests

Functional tests for the transmission ECU include actuator tests.

Chapter 5 Data Parameters

The following chapters provide definitions and operating ranges for the data parameters that display on the scan tool.

The scan tool displays all of the operating parameters available from the electronic control module of the vehicle, which provides two basic kinds of parameters:

- Digital (discrete) parameters are those that can be in only one of two states, such as on or off, open or closed, high or low, rich or lean, and yes or no. Switches, relays, and solenoids are examples of devices that provide discrete parameters on the data list.
- Analog parameters are displayed as a measured value in the appropriate units such as voltage, pressure, temperature, time, and speed parameters. These displays as numbers that vary through a range of values in units, such as pounds per square inch (psi), kilopascal (kPa), degrees Celsius (°C) or Fahrenheit (°F), kilometers per hour (KPH), or miles per hour (MPH).

The scan tool displays some data parameters in numbers that range from 0 to 100, 0 to 255, or 0 to 1800 because that is the maximum number range that the control module transmits for a given parameter. However, many parameter readings never reach the highest possible number. For example, you never see a vehicle speed parameter reading of 255 MPH.

The range of a parameter often varies by year, model, and engine, but typical sampled values observed under actual test conditions are in the parameter description when available.

Parameters may also be identified as input signals or output commands.

- Input or feedback parameters are signals from various sensors and switches to the ECM. They may display as analog or discrete values, depending on the type of input device.
- Output parameters are commands that the control module transmits to various actuators, such as solenoids and fuel injectors. They are displayed as discrete parameters, analog values, or as a pulse-width modulated (PWM) signal.

In the following chapters, parameters are presented as they appear on the scan tool screen. Often, the same parameter goes by a different name when used on more than one model, engine, or control system. In these instances, all of the applicable parameter names displayed on the scan tool are listed before the description.

NOTE:
The scan tool may display names for some data parameters that differ from names displayed by a factory tool and other scan tools.

Data parameter descriptions in this manual were created from a combination of sources. For most parameters, basic information was provided by the respective manufacturers, then expanded through research and field testing. For some parameters, no information is currently available.

Always use a graphing meter or a oscilloscope, to further validate the displayed values. If data is corrupted on multiple data parameters, do not assume that the control module may be faulty. This corrupt data may be caused by improper communication between the scan tool and the control module. See the troubleshooting sections of the user manual for the diagnostic tool you are using for more communication problem details.

5.1 Interpreting Pressure Parameters

Parameters that indicate ambient air pressure (barometric pressure) and high or low pressure inside the intake manifold are major input parameters used by the electronic control unit (ECU) to regulate the air-fuel ratio and spark advance in relation to engine load.

The engine control system must measure the atmospheric air pressure and the pressure in the intake manifold to determine engine load and calculate the required fuel metering and spark advance. Three pressure measurements or calculations are necessary:

- Barometric pressure (BARO) is the ambient atmospheric air pressure. The barometric pressure changes with altitude and temperature. At sea level, barometric pressure is normally 14.7 psi, 101.3 kPa, or 29.9 inHg.
- Manifold vacuum is pressure in the intake manifold that is below atmospheric pressure on a running engine. The manifold vacuum is measured in relation to atmospheric pressure. High vacuum is low pressure.
- Manifold absolute pressure (MAP) is a combination of atmospheric pressure and vacuum, or the relative difference between the air pressure outside the manifold and the vacuum inside. MAP is measured in relation to zero pressure (high vacuum).

BARO, manifold vacuum, and MAP have the following relationships (Figure 5-1).

- MAP = BARO – vacuum
- Vacuum = BARO – MAP
- BARO = MAP + vacuum

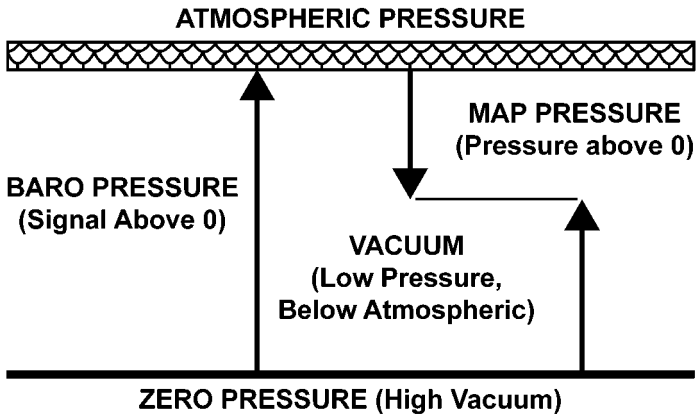

Figure 5-1 *Air pressure relationships*

Turbocharger boost operation also affects manifold pressure. When a turbocharger is providing boost pressure, manifold absolute pressure rises above atmospheric pressure.

Depending on the control system and sensors used on an engine, one or more of the MAP, BARO, or vacuum parameters display on the scan tool. It may also display boost pressure on a turbocharged engine.

Parameters display as both a voltage reading from the sensor and as a pressure measurement in either kilopascal (kPa) or inches of mercury inHg). The preset measurements for all three values are in kPa.

5.2 Alphabetic List of Parameters

A

B

C

D

E

F

I

K

L

M

O

P

R

S

T

5.3 Parameter Definitions

Absolute Throttle Position (%)
Range: **Min.: 0%, Max.: 100%**

Indicates the actual throttle opening as a percentage based on input from the throttle position (TP) sensor signal voltage.

Accelerator Pedal Position D(%)
Accelerator Pedal Position E (%)
Range: **0 to 100%**

Indicates the accelerator pedal position as a percentage. Readings are low at closed throttle and increase as the pedal is depressed. The value should increase smoothly as the accelerator pedal moves from closed to full throttle.

Accel Enrich
Range: **On/Off**

Indicates whether the PCM is momentarily increasing injector pulse width to obtain a richer mixture during acceleration. Normally reads off, reads on only during enrichment.

Accel. Pedal Position Sensor 1 (V)
Accel. Pedal Position Sensor 2 (V)
Pedal Position Sensor 1 (V)
Pedal Position Sensor 2 (V)
Pedal Position, Track 1 (V)
Pedal Position, Track 2 (V)
Range: **0.0 to 5.0 V**

Indicates the voltage signals of accelerator pedal position (APP) sensors 1 and 2. Readings are typically low at closed throttle and increase as the pedal is depressed. The value should increase smoothly as the accelerator pedal moves from closed to full throttle.

Adap Idle (STEP)
Range: **variable**

Indicates the adaptive position of the idle air control (IAC) valve as a step count.

Adaptive Correction Factor Bank 1 (ms)
Adaptive Correction Factor Bank 2 (ms)
Range: **variable**

Indicates the adaptive adjustment the PCM is applying to the fuel-injection pulse width for the indicated cylinder bank. Readings are in milliseconds and represent the additional amount of injector on time being applied.

Air Con
AIRCO Request
Range: **On/Off**

Indicates the state of the A/C compressor clutch.

Air Conditioning Load Compensation
Range: **variable**

Indicates the PCM calculated correction being applied to compensate for the load that the A/C compressor is placing on the engine.

Air Flow (KG)
Range: **variable**

Indicates the flow rate of the intake air entering the engine as kilograms-per-hour. Readings may be taken directly from the mass airflow (MAF) sensor, or calculated by the PCM based on input from other sensors.

Air Flow Meter Sensor Voltage (V)
Air Flow Sensor (V)
Range: 0 to 5.00 V

Indicates mass airflow (MAF), which is the amount of air entering the engine, expressed as voltage. This is the MAF sensor signal, readings should increase along with throttle opening.

Atmospheric Pressure Sensor Voltage
Range: 0 to 5.0 V

Indicates the atmospheric pressure sensor signal voltage. Voltage varies with pressure.

A/T Position Switch
Drive Neut
Range: P-N or -R-DL

Indicates whether an automatic transmission is in park or neutral or in one of the drive ranges. It should read:

- P-N- if the transmission is in either park or neutral.
- -R-DL if the transmission is in any forward gear or reverse.

Bank A Trim (%)
Bank B Trim (%)
Range: variable

Indicates the fuel trim correction being applied to each of the fuel banks on the engine as a percentage. Bank A is always the bank containing the number 1 cylinder in the firing order. Displayed values represent the operation and correction of the fuel mixture on the vehicle. Higher numbers indicate the PCM is commanding a rich mixture correction, which increases fuel injector duration. Lower numbers indicate the PCM is commanding a lean mixture, which decreases fuel injector duration.

Barometric Pressure
Range: 10 to 125 kPa, 400 to 850 mmHg or 0 to 37.0 inHg

Indicates the ECM calculated barometric pressure expressed as kilo Pascal (kPa), millimeters of mercury (mmHg), or inches of mercury (inHg). the value is based on the BARO sensor voltage signal. Readings vary by altitude and ambient weather, expect to see about:

- 100 kPa (29.6 inHg) at sea level
- 60 kPa (17.8 inHg) at 14,000 feet

Compare barometric voltage and barometric pressure readings. Voltage should be high when pressure is high and low when pressure is low. If either, or both, of the readings appear abnormal for the expected local barometric pressure, the sensor signal to the ECM is inaccurate or the ECM calculations are incorrect for some reason.

Battery (V)
Battery Voltage (V)
Range: 0.0 to 16.0 V

Indicates vehicle battery voltage. The reading should be close to normal charging system regulated voltage with the engine running. This is typically 13.5 to 14.5 V at idle. Check the reading against actual voltage measured at the battery or alternator. Check vehicle specifications for exact values.

Brake Switch
Range: On/Off

Indicates the brake switch status.

Calculated Load Value (%)(
Range: 0 to 100%

Indicates the PCM calculated load value as a percentage. Normal readings at idle are 10 to 35%.

Camshaft Position Bank 1 (°)
Camshaft Position Bank 2 (°)
Range: variable

Displays the PCM calculated camshaft position in degrees for the indicated cylinder bank. Bank 1 is always the bank containing the number 1 cylinder in the firing order. Readings are based on an input signal from the (CMP) sensors.

Clutch Switch
Range: On/Off

Displays the clutch pedal switch state being input to the PCM.

Commanded Throttle Actuator Control (%)
Range: 0 to 100%

Indicates the PCM command to the throttle control actuator as a percentage of throttle opening.

Control Module Temperature Sensor Voltage (V)
Range: 0.0 to 5.0 V

Indicates the voltage signal from the PCM temperature sensor. Sensor voltage and temperature are inversely related. A low temperature produces a high voltage signal, and a high temperature produces a low voltage signal.

Control Module Temperature (°)
Range: 0.0 to 5.0 V

Indicates the calculated PCM temperature based on the signal voltage of the temperature sensor.

Coolant Temperature Sensor (V)
Engine Coolant Temperature Sensor Voltage (V)
Radiator Temperature Sensor (V)
Range: 0.0 to 5.1 V

Indicates the voltage signal from the engine coolant temperature (ECT) sensor. Sensor voltage and temperature are inversely related. A low temperature produces a high voltage signal, and a high temperature produces a low voltage signal.

Coolant Temp (°)
Coolant Temperature (°)
Engine Coolant Temperature (°)
Radiator Temperature (°)
Range: variable

Indicates the PCM calculated engine coolant temperature (ECT) in degrees based on the ECT sensor signal. The sensor is a thermistor installed in the engine coolant passages.

Typical readings for a fully warmed engine running at idle are 185° to 220°F (85° to 105°C). A reading of –40°C or –40°F may indicate an open in the sensor or the sensor circuit. A reading above 185°C or 366°F may indicate a short in the sensor or the sensor circuit.

Cylinder 1 Misfire Counter
Cylinder 2 Misfire Counter
Cylinder 3 Misfire Counter
Cylinder 4 Misfire Counter
Cylinder 5 Misfire Counter
Cylinder 6 Misfire Counter
Cylinder 7 Misfire Counter
Cylinder 8 Misfire Counter
Range: actual count

Indicates the misfire counter for the indicated cylinder.

Electr. Controlled Gearbox Present
Range: Yes/No

Indicates whether the vehicle under test has an electronically controlled transmission.

Engine Oil Temperature Sensor Voltage (V)
Range: 0.0 to 5.1 V

Indicates the voltage signal from the engine oil temperature sensor. Sensor voltage and temperature are inversely related. A low temperature produces a high voltage signal, and a high temperature produces a low voltage signal.

Engine Oil Temperature (°)
Range: variable

Indicates the ECM calculated engine oil temperature in degrees based on the oil sensor signal.

Engine Speed (rpm)
Range: 0 to engine max.

Indicates engine speed, which is computed internally by the PCM based on reference pulses from system sensors.

Engine Torque (%)
Range: variable

Indicates relative engine load based on engine speed, the number of cylinders, and manifold airflow. A high number indicates a heavy load; a low number, a light load.

Exhaust Gas Recirculation Target Position (%)
Range: 0 to 100%

Indicates the exhaust gas recirculation valve position that the PCM is attempting to maintain as a percentage of opening.

Fan (%)
Viscous Cooling Fan Pulse Width Modulation Control (%)
Range: 0 to 100%

Indicates the pulse width of the output signal that the PCM is applying to the cooling fan control solenoid valve.

Fuel Cutoff
Fuel Cut-Off Valve
Range: On/Off

Indicates whether the PCM is commanding the fuel injectors to turn off. It reads on when the command is cut fuel (injectors off), and off at all other times.

Fuel Pump
Range: On/Off

Indicates whether power is being supplied to run the fuel pump.

Fuel Rail Temperature Sensor Voltage (V)
Range: 0.0 to 5.1 V

Indicates the voltage signal from the fuel rail temperature sensor. Voltage and temperature are inversely related. A low temperature produces a high voltage signal, and a high temperature produces a low voltage signal.

Fuel Rail Temperature (°)
Fuel Temp (°)
Range: variable

Indicates the ECM calculated fuel temperature.

Fuel Trim 1 (Idle Load) (%)
Fuel Trim 2 (Idle Load) (%)
Range: variable

Indicates the fuel trim correction being applied to each of the fuel banks when the engine is running at idle. Values are displayed as milliseconds. Bank 1 is always the bank containing the number 1 cylinder in the firing order. Higher numbers indicate the PCM is commanding a rich mixture correction, which increases fuel injector duration. Lower numbers indicate the PCM is commanding a lean mixture, which decreases fuel injector duration.

Fuel Trim 1 (Part Load) (%)
Fuel Trim 2 (Part Load) (%)
Range: variable

Indicates the fuel trim correction being applied to each of the fuel banks when the engine is running with a partial load. Values are displayed as a percentage. Bank 1 is always the bank containing the number 1 cylinder in the firing order. Higher numbers indicate the PCM is commanding a rich mixture correction, which increases fuel injector duration. Lower numbers indicate the PCM is commanding a lean mixture, which decreases fuel injector duration.

IAC Adaption 1 (kg/h)
IAC Adaption 2 (kg/h)
Range: variable

Indicates the adaptive correction being applied by the PCM to idle air control (IAC) valves 1 and 2 as airflow volume. Readings are displayed as kilograms-per-hour.

IACV Position (Stp)
Range: 0 to 125 or 0 to 255

Indicates the position of the idle air control (IAC) valve as a step count. Stepper-motor IAC valves have either 125 or 255 positions, and readings vary from 0 to 125 or from 0 to 255:

- 0 means the motor has moved to its outer limit to close the IAC valve.
- 125 or 255 means the motor has moved to its inner limit to fully open the IAC valve.

Ignition Advance (°)
Ignition Timing Advance For Cylinder 1 (°)
Range: variable

Indicates the ignition timing advance being applied in degrees.

Immobilizer OK
Range: Yes/No

Indicates whether the vehicle anti-theft system test is operational.

Injection Pulse
Injection Time (ms)
Range: variable

Indicates the amount of time the PCM commands the fuel-injectors on during an engine cycle as milliseconds. A longer injector pulse width causes more fuel to be delivered. The injector pulse width increases as the engine load increases.

Injector 1 Pulse Width (s)
Injector 2 Pulse Width (s)
Injector 3 Pulse Width (s)
Injector 4 Pulse Width (s)
Injector 5 Pulse Width (s)
Injector 6 Pulse Width (s)
Injector 7 Pulse Width (s)
Injector 8 Pulse Width (s)
Range: variable

Indicates the amount of time the PCM commands the indicated injector on during an engine cycle in seconds. A longer injector pulse width causes more fuel to be delivered. The injector pulse width increases as the engine load increases.

Inlet Air Temp. (°)
Intake Air Temperature (°)
Range: variable

Indicates the intake air temperature (IAT) in degrees. Degree readings are PCM calculated from the IAT sensor signal. Typical ranges are –58°F to 360°F (–50°C to 185°C). Readings should be low on a cold engine and rise as the engine warms up.

Intake Air Temperature Sensor (V)
Intake Air Temperature Sensor Voltage (V)
Range: 0.0 to 5.0 V

Indicates the voltage signal from the intake air temperature (IAT) sensor, which is typically installed in the air cleaner. A 5 V reference signal is applied to the sensor, resistance decreases as temperature increases.

Knock Control
Range: On/Off

Indicates whether the ECM is actively making adjustments to compensate for spark knock. This value is based on knock sensor (KS) signal, it reads:

- On if the sensor indicates knock and a correction is being made
- Off if the sensor does not indicate engine knock

Knock Sensor
Knock Sensor 1 (V)
Knock Sensor 2 (V)
Range: 0.0 to 5.0 V

Indicates the voltage signal of the knock sensor (KS). The normal range is 0.8 to 1.0 V, higher voltage indicates increased knock. A bank is specified when there are separate sensors for each cylinder bank. Bank 1 is always the bank containing the number 1 cylinder in the firing order.

Lambda Adaption Factor Bank 1 (%)
Lambda Adaption Factor Bank 2 (%)
Range: variable

Indicates the adaptive adjustment made to the fuel injector pulse width for the indicated cylinder bank. A lower reading indicates the PCM is decreasing the pulse width from programmed values, and higher readings indicate a PCM increase to the pulse width.

Lambda Control Status Bank 1
Lambda Control Status Bank 2
Range: variable

Displays the operating status of fuel banks 1 and 2 and indicates whether the vehicle is operating in open or closed loop. Possible readings are:

- Closed Loop—Normal closed loop
- Closed Loop-Fault—The indicated O2S signal is not switching
- Open Loop—Normal open loop
- Open Loop Driving Condition—Open loop because of driver action or other circumstances
- Opn Loop Waiting—Conditions needed to enter closed loop have not been met
- Open Loop System Fault—Open loop with O2S problem or primary side coil failure

When a fuel bank status is open loop the ECU ignores the main O2S signal. When a fuel bank status is closed loop the ECU uses main O2S feedback to make corrections to fuel injection duration. With a warm engine running at idle, these parameters should indicate closed loop.

At 2500 RPM with no load, these parameters should also indicate closed loop. Deceleration could cause these parameters to indicate open loop during fuel cutoff.

Manifold Absolute Pressure Sensor Voltage (V)
Range: 0 to 5.0 V

Indicates the intake manifold absolute pressure (MAP) sensor signal voltage. Voltage varies with manifold pressure, typical reading are:

- Low when absolute pressure is low (high manifold vacuum).
- High when absolute pressure is high (low manifold vacuum).

Manifold Absolute Pressure Sensor (pressure)
Range: variable

Indicates the ECM calculated a manifold absolute pressure (MAP), which is based on the MAP sensor signal voltage. When MAP is displayed in kPa, the reading should be approximately 100 to 102 with the engine off and manifold pressure is close to atmospheric pressure at sea level. When the engine is running and manifold vacuum is high, the kPa reading drops. On a turbocharged engine, the reading rises above 100 as boost is applied.

When MAP is displayed as inches of mercury (inHg), the reading should be about 29.9 with the engine off and the manifold close to atmospheric pressure at sea level. When the engine is

running with high manifold vacuum, the MAP reading in drops. On a turbocharged engine, the reading rises above 30 as boost is applied.

Table 5-1 *MAP voltage to pressure relationship*

Voltage	High					Low	
MAP (kPa)	70	60	50	40	30	20	10
MAP (inHg)	21	18	15	12	9	6	3
MAP (mmHG)	533	457	381	305	229	152	76

Compare the MAP voltage and MAP pressure readings displayed on the scan tool. Pressure should be high when voltage is high, low when voltage is low. If the readings appear abnormal for the apparent engine load, the sensor signal to the ECM may be inaccurate or the ECM calculations may be incorrect for some reason.

Mass Air Flow (g/s)
Range: variable

Indicates the flow rate of the intake air entering the engine as grams-per-second (g/s). Readings may be taken directly from the mass airflow (MAF) sensor, or calculated by the PCM based on input from other sensors.

O2 Sensor 1 (V)
O2 Sensor 2 (V)
O2 Sensor Before Cat 1 (V)
O2 Sensor Before Cat 2 (V)
O2 Sensor Upstream 1 (V)
O2 Sensor Upstream 2 (V)
Range: 0 to 4.98 V

Indicates the signal voltage of the exhaust oxygen sensor (O2S) before the catalyst. The O2S is the primary sensor that indicates whether the engine is running rich or lean. The voltage signal typically ranges from 0 V to 1 V (0 to 1000 millivolts - mV).

A bank is specified when there are separate sensors for each cylinder bank. Bank 1 is always the bank containing the number 1 cylinder in the firing order.

A high signal indicates a rich exhaust; a low signal indicates a lean exhaust. In normal operation, the O2S voltage ranges from 100 to 1000 mV. The O2S must be hot (above 500°F or 260°C), and the system in closed loop before the ECU responds to the sensor signal.

During closed loop operation oxygen sensors should range from 100 mV to 900 mV. A lean condition causes both sensors to read below 400 mV, while a rich condition causes readings above 600 mV. At 2500 RPM O2S readings should switch between high and low at least six times every ten seconds.

O2 Sensor After Cat 1 (V)
O2 Sensor After Cat 2 (V)
O2 Sensor Downstream 1 (V)
O2 Sensor Downstream 2 (V)
Range: 0 to 4.98 V

The output of the downstream (after the converter) oxygen sensor for the indicated cylinder bank as millivolts. Bank 1 is always the bank containing the number 1 cylinder in the firing order.

Sensor voltage fluctuates slowly over a long period of time due to the oxygen storage capability of an efficiently operating catalyst. If the voltage fluctuates rapidly on a hot catalyst, low catalyst efficiency may be the cause.

O2 Sensor Heater After Cat 1
O2 Sensor Heater After Cat 2
O2 Sensor Heater Before Cat
O2 Sensor Heater Before Cat 1
O2 Sensor Heater Before Cat 2
Range: On/Off

Displays the state of the heater circuit for the indicated oxygen sensor. Reads on when the heater is on, and off at all other times.

O2 Sensor Heater Upstream 1 (%)
O2 Sensor Heater Upstream 2 (%)
O2 Sensor Heater Downstream 1 (%)
O2 Sensor Heater Downstream 2 (%)
Range: variable

Indicates the state of the heater circuit for the indicated oxygen sensor as a percentage.

O2 Ready 1
O2 Ready 2
Range: Yes/No

Indicates whether the oxygen (O2) sensor for the indicated cylinder bank is warmed up, operational, and providing a reliable signal to the PCM.

Relative Throttle Position (%)
Range: Min.: 0%, Max.: 100%

Indicates the relative throttle opening calculated by the PCM as a percentage of throttle opening.

Secondary Air Pump
Range: On/Off

Indicates the operating state of the secondary air valve.

Secondary Air Valve
Range: On/Off

Indicates the commanded position of the secondary air pump.

Sensor Power Supply Monitor (V)
Range: 0 to 5.0 V

Indicates the voltage available on the sensor reference circuit at the control module.

Target Idle Speed (rpm)
Range: variable

Indicates the target idle, which is the idle speed the PCM is attempting to maintain.

Target Ignition Angle (°)
Range: variable

Indicates the target ignition advance in degrees, which is the spark advance that the PCM is attempting to maintain.

Target Intake Air Flow (g/s)
Range: variable

Indicates the target flow rate of the intake air entering the engine that the PCM is attempting to maintain as grams-per-second (g/s).

Throttle (%)
Throttle Position (%)
Throttle Position Sensor (%)
Throttle Pot (%)
Range: Min.: 0%, Max.: 100%

Indicates the ECM calculated throttle opening as a percentage based on input from the throttle position (TP) sensor signal voltage.

Throttle (V)
Throttle Position Sensor (V)
Range: 0 to 5.0 V

Indicates the throttle position (TP) sensor signal voltage, which determines throttle opening. The full range of the TP sensor voltage readings available to the PCM is 0 to about 5.1 V and readings are usually:

- about 0.5V, closed throttle, engine at idle
- about 4.0V, full throttle, engine under heavy acceleration

Throttle Pos Sensor adaptation (%)
Range: Min.: 0%, Max.: 100%

Indicates the adaptive value the PCM is applying to the throttle position (TP) sensor in order to maintain the desired throttle opening.

Vehicle Speed
Road Speed
Range: 0 to vehicle max.

Indicates the PCM calculated vehicle speed in miles-per-hour or kilometers-per-hour based on the vehicle speed sensor (VSS) signal.

Viscous Cooling Fan Pulse width Modulation Control (%)
Range: 0 to 100%

Indicates the pulse width of the output signal that the PCM is applying to the viscous cooling fan control solenoid valve.

Viscous Fan Control Valve Duty Cycle (%)
Range: 0 to 100%

Indicates the duty cycle of the viscous cooling fan control solenoid valve.

Appendix A Troubleshooting

A.1 Communication Problems

Land Rover vehicles have few problems communicating with the scan tool. Nevertheless, an electronic control unit (ECU) may fail to communicate with the scan tool. Problems with the wiring or other circuit parts on the vehicle may also prevent communication with the ECU. A vehicle that fails to perform a test may be displaying a symptom of another driveability problem.

A.1.1 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. Check for pin-to-pin continuity between the D-shaped connectors at either end of the data cable with an ohmmeter.

A.1.2 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 (MIL).

Turn the ignition on and verify that the MIL 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 repair manual for the specific vehicle under test to troubleshoot the MIL and its circuitry. Common causes of MIL 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.

A.1.3 Testing the Diagnostic Connector — 16-pin DLC

All 16-pin OBD-II/EOBD data link connectors (DLCs) may look the same, but most function differently because each vehicle manufacturer interprets the requirements differently. In addition, there may be differences between models and years, and different communication protocols may be used for different systems on the same vehicle. The following table provides general DLC pin information, refer to a wiring diagram for the specific vehicle to troubleshoot DLC problems.

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.	

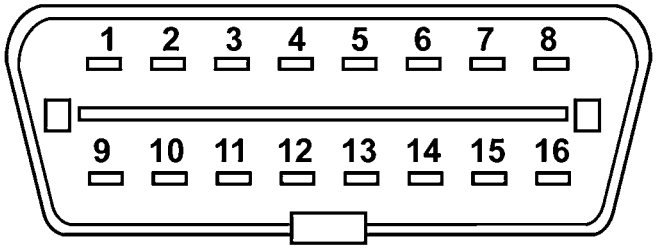

Figure A-1 *Contact designation for vehicle connector mating end view*

NOTE:
These point apply to pins 4 and 5:

- *The DL-16 Adapter with the S7 key, does not 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 the ground pin of the scan tool. The same problem arises when the OBD-II connector is used with the K2A key.*
- *On some vehicles that have "ground" connected to pin 5 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 DLC is optional. Pin 5 of the DLC should be used as signal ground and may be used as a power ground.*
- ***Possible work around:** 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 wired 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.

Appendix B Terms and Acronyms

This appendix defines common terms and acronyms used throughout this book and in the vehicle communication software on the scan tool.

B.1 Terms

The following terms are used throughout this manual to explain certain operations and displays:

code	A numerical code, generated by the vehicle control system to indicate a fault has occurred in a particular subsystem, circuit, or part.
cursor	The arrow that appears on menus and some other displays. In most displays, the cursor moves as you scroll.
fix	To lock a single line of the display in a fixed position on the screen to prevent it from scrolling. Data readings remain live while the parameter categories are fixed.
Flash code	A type of vehicle control system that has no serial data. Any trouble codes the control system set are extracted either by flashing the malfunction indicator lamp (MIL) or using a special break-out box.
frame	One complete data package, or transmission cycle, from an electronic control module (ECM) that provides serial data of control system operating parameters.
hold	To capture and hold a single data frame for review or printing.
movie	A vehicle data record whose length depends on the number of selected data parameters.
menu	A list of vehicle tests or programs from which a selection can be made.
parameter	A measured value of control system input or output operation. Parameters include voltage signals, as well as temperature, pressure, speed, and other data provided by the electronic control module.
release	To unlock a fixed line and allow it to scroll.

B.2 Acronyms

The following acronyms are used in diagnostic trouble code definitions displayed by the scan tool or used in this manual.

ABS	Antilock Brake System
A/C	air-conditioning
AIR	secondary air injection
APP	accelerator pedal position
ATF	automatic transmission fluid
B+	battery positive voltage

BARO	Barometric pressure
CAN	controller area network
CARB	California Air Resources Board
CAT	catalytic converter
CKP	crankshaft position
CMP	camshaft position
CO	carbon monoxide
CO2	carbon dioxide
Cyl	cylinder
DLC	data link connector
DOHC	dual overhead camshaft
DOT	Department of Transportation
DTC	diagnostic trouble code
ECM	engine control module
ECT	engine coolant temperature
ECU	engine control unit
EEPROM	electrically erasable programmable read only memory
EFI	electronic fuel injection
EGR	exhaust gas recirculation
EOBD	European on-board diagnostics
EPROM	erasable programmable read only memory
FTP	fuel tank pressure or federal test procedure
HC	hydrocarbon
HD	heavy duty
Hg	mercury
HO2S	heated oxygen sensor
Hz	Hertz
IAC	idle air control
IAT	intake air temperature
IC	integrated circuit
inHg	inches of mercury
KS	knock sensor
LCD	liquid crystal display
LED	light-emitting diode
LEV	low emission vehicle
LSD	limited-slip differential
MAF	mass airflow
MAP	manifold absolute pressure
MIL	malfunction indicator lamp
mm	millimeter

mmHg	millimeters of mercury
MPI	multipoint fuel injection
MPSI	multipoint sequential fuel injection
NHTSA	National Highway Traffic Safety Administration
O2S	oxygen sensor
OBD	onboard diagnostics
OBD-II	onboard diagnostics two, EPA standardized diagnosis
OHC	overhead camshaft
PCM	powertrain control module
PNP	park/neutral position
PWM	pulse-width modulation
SAE	Society of Automotive Engineers
SFI	sequential fuel injection
SOHC	single overhead camshaft
SRS	supplemental restraint system
TCC	torque converter clutch
TCM	transmission control module
TP	throttle position
TSB	Technical Service Bulletin
ULEV	ultra low emission vehicle
V	Volts
VIN	vehicle identification number
VSS	vehicle speed sensor
WOT	wide open throttle