

EOBD

CODE BREAKER

By Peter Coombes

Covers Over 2700 EOBD/ISO Codes
Including P0, P2, P3 & U-CODES



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INTRODUCTION TO CODE BREAKER

The Code Breaker book has been produced as a reference and explanation for over 2700 EOBD / ISO fault codes. Although it is not intended to be a "Diagnostic" book, it does provide a wealth of guidance for many diagnostic procedures and checks that can be carried out when a fault code is retrieved from a vehicle. The reality is that the EOBD / ISO fault codes are applicable to a wide range of makes and models, therefore the applicable diagnostics and checks will vary with each make and model. However, there are many generic procedures that are applicable to some components, irrespective of which vehicle or system the components are fitted to.

Making use of Chapters 1, 2 and 3

Within the first 3 chapters, we have provided educational information relating to how and why fault codes are activated, along with many notes as to how different vehicle manufacturers apply codes in different ways. I would strongly recommend that you read the first 3 chapters, due to the additional understanding that they provide of how fault codes are applied.

Whilst carrying out the research for this book, we have been able (for most of the fault codes) to locate at least one example of where a fault code is applied by a vehicle manufacturer; in many cases however, some fault codes appear to be only applicable to vehicles used in specific markets. There is of course a trend where technologies and components used in one market place often migrate to other markets, so we cannot assume that some of the more obscure components and systems will not find their way into other markets.

Keeping Up to Date

You will find enclosed, within the protective packaging, an "Update Card"; because this book is unlikely to require a full update for some considerable time, we have decided to provide an "occasional" update service (free of charge); by following the instructions on the card and filling in the appropriate details on the web-site, we will then be able to provide you with any changes or amendments that we produce.

I hope that you find that the Code Breaker book is a useful workshop reference tool and also a means of providing additional information / education to help with the repair and maintenance of motor vehicles.

Peter Coombes



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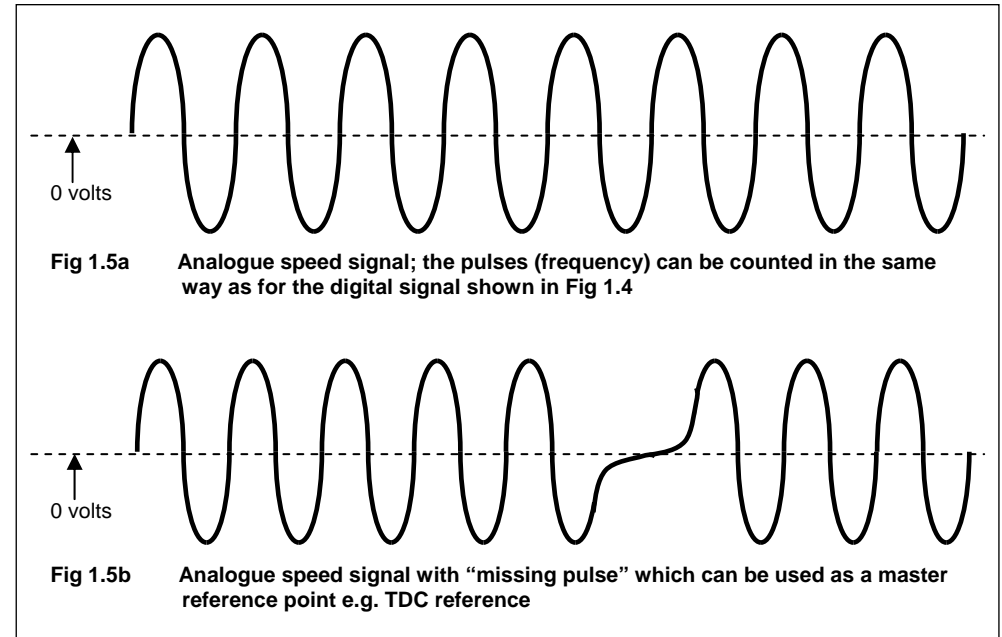
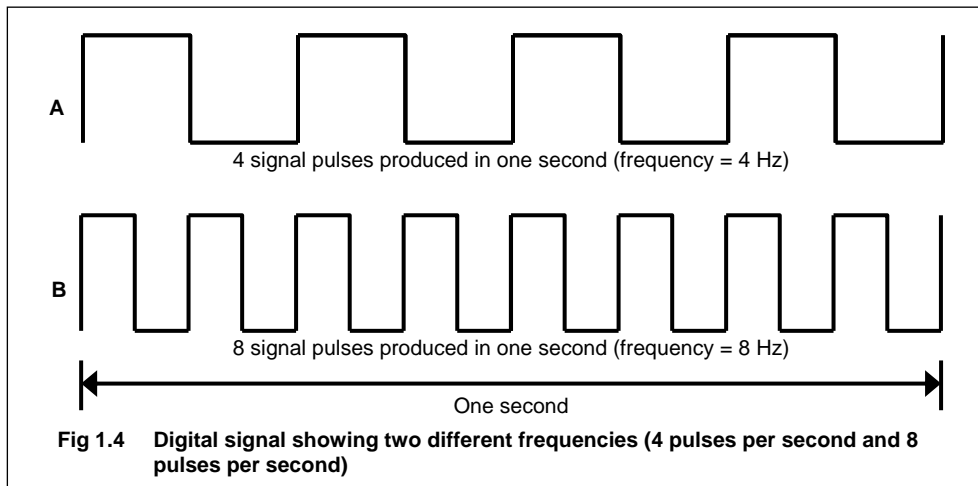
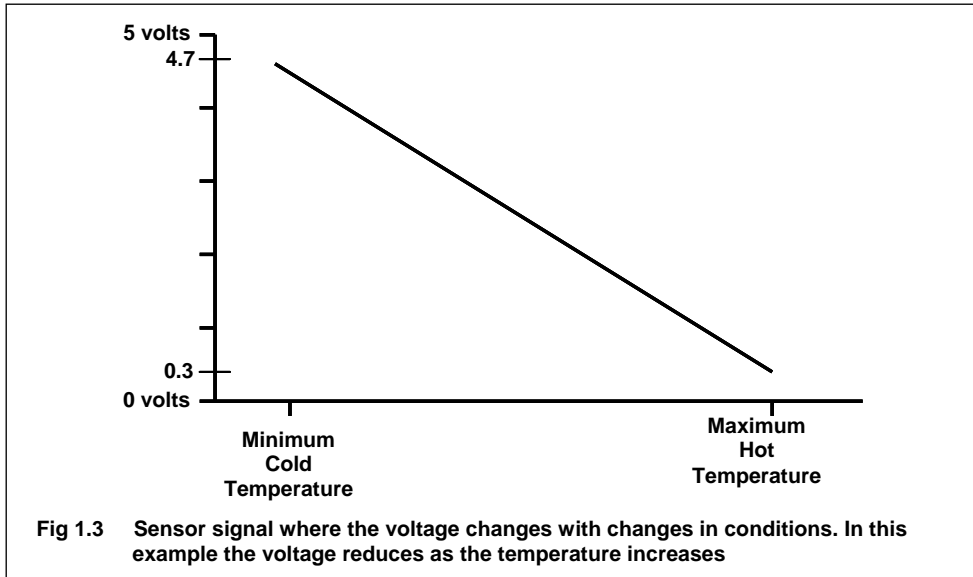
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Chapter 1

UNDERSTANDING FAULT CODES AND FAULT CODE DEFINITIONS

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The control unit monitors a signal to ensure that the signal values remain within a defined operating range for each type of signal e.g. a voltage range or a frequency range; if the signal value is outside of the range, this would then be regarded as a fault. Fig 1.3 shows the voltage range produced by a temperature sensor, which is between 4.7 and 0.3 volts. If the sensor was fitted to a cooling system, these extreme limits of the voltage range could exceed any minimum or maximum temperature for normal engine operation. If the voltage exceeded 4.7 volts or fell below 0.3 volts this would be regarded as a circuit or sensor fault.



3.1.2 Actuator Control Signals

Actuators e.g. motors, solenoids etc, can be operated or controlled by switching on and off the power supply or, making and breaking the earth circuit; this will provide a simple on or off operation. A light bulb is a simple example of where the power supply is switched on (or the earth circuit is completed), for as long as it is required for the light to be "on".

However, actuators are used for many tasks that involve movement of a component to an accurate position (e.g. throttle motor) or for controlling pressure or fluid flow e.g. fuel injector. It is therefore necessary to control the actuator with a varying control signal; the value of the signal will be controlled by the system control unit, which will also monitor the signal to ensure that it is correct.

The process of switching on and off a circuit (as for the light bulb) can also be used to control different actuators e.g. switching on and off a solenoid that could be opening / closing a vacuum valve. The control signal will be a very simple on and off pulse, but it can happen in just a few thousandths of a second. In many cases, the control signal consists of many thousands of very short pulses.

For solenoids and other actuators, it is quite common for the control unit to switch the earth path of the actuator (with the power supply being provided all the time that the engine is running e.g. supplied via a relay); therefore the control signal will exist on the solenoid earth circuit (which will pass through the control unit to earth). A simple actuator signal can therefore be a rapid on / off pulse, with the length or duration of the "on" pulse dictating

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control unit e.g. sensor information is not plausible or does not match the operating conditions indicated by other sensors. It is however also possible that a faulty sensor or, a short circuit to another wire could result in the signal voltage still being within normal operating range.

8.6.2 If available, check the signal value from the sensor using a Live Data facility on the diagnostic equipment (the live data might display a signal voltage value or it might indicate a vacuum / pressure value; alternatively, use a multi-meter or oscilloscope to check the voltage at the control unit signal terminal (it might be necessary to refer to vehicle specific information to identify correct live data values or voltage values).

8.6.3 Check the pressure of the system being monitored by the sensor using a separate vacuum / pressure gauge, and compare the actual pressure with the live data values or the value indicated by the sensor signal. Note that it is advisable to check the sensor values over a wide operating range. If the live data value or signal voltage does not correspond with the actual pressure, this indicates a possible sensor or wiring related fault (refer to sections 8.3 and 8.4). Check that the sensor signal changes smoothly and progressively when the vacuum / pressure changes.

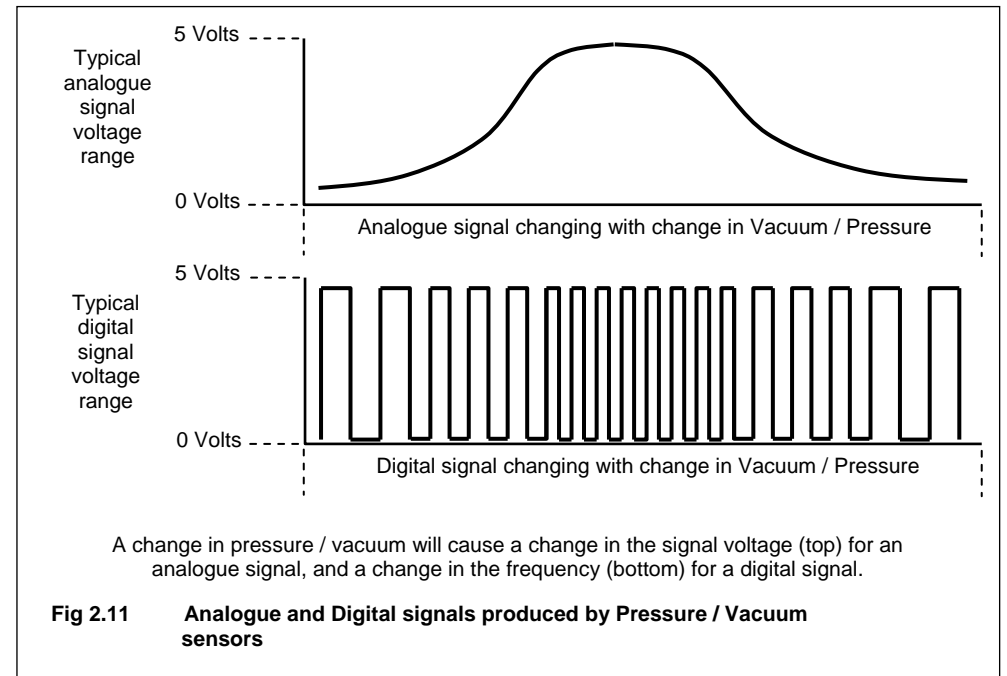
8.6.4 If possible, apply vacuum / pressure to the sensor to check whether the sensor signal changes correctly with the changes in vacuum / pressure.

8.6.5 If the live data value or signal voltage appears to be correct when compared with actual vacuum pressure values, this indicates that the sensor and circuit are probably good; therefore the problem is possibly caused by faults in system being monitored by the sensor; it will be necessary to compare the actual vacuum / pressure with the expected values to establish if the system vacuum / pressures are incorrect.

9. VACUUM / PRESSURE SENSORS (DIGITAL SIGNAL)

9.1 OPERATION

9.1.1 Vacuum / pressure sensors (Fig 2.10) are used to convert pressure and vacuum values into an electrical signal; for digital sensors, the electrical signal is a typical digital on / off pulse where the frequency of the signal changes with changes in vacuum / pressure. Digital vacuum / pressure sensors usually have three wires: an earth connection, a reference / supply voltage and a signal wire (all three wires are usually connected to the control unit). The reference voltage (regulated voltage of typically 5 volts provided by control unit) is applied to the sensor (which contains electronic components); the earth path is also connected to the sensor and to the control unit. The output signal is provided from the sensor electronics to the control unit on the third wire. The electronics produce an output signal where the frequency increases and decreases with the changes in vacuum / pressure (Fig 2.11). The control unit will monitor the frequency on the signal wire and fault codes will generally be activated because the signal frequency is incorrect, or the voltage range of the signal is incorrect (the signal will typically operate within the range of 0 to 5 volts, depending on the reference / power supply voltage).



9.2 CIRCUIT OR CIRCUIT / OPEN

9.2.1 When a fault code definition states “Circuit” without any other information (e.g. low, high), it is likely that control unit has detected an incorrect sensor signal value. However, the control unit might not be programmed to specify the exact nature of the incorrect signal. Although it is likely that an electrical fault exists (refer to sections 9.3, 9.4 and 9.5), it is also possible that the sensor is operating correctly but the information being indicated by sensor is incorrect e.g. the vacuum / pressure value is incorrect compared with information from other sensors (also refer to 9.6). If the definitions states “Circuit / Open”, it is likely that the control unit is not detecting the sensor signal and assumes that there is an open circuit.

9.3 CIRCUIT LOW

9.3.1 When a fault code definition states “Circuit Low”, this will usually indicate that the frequency or voltage at the signal wire terminal (Fig 2.10) is below the normal operating range (refer to Chapter 1 - section 4.2). The fact that the signal is outside the normal operating range indicates a probable circuit or sensor fault, rather than an incorrect vacuum / pressure being indicated.

9.3.2 A “Circuit Low” fault can be caused by an open circuit in the signal wire or the reference / supply voltage wire (Fig 2.10); in both cases the signal or voltage is unable to pass through the circuit back to the control unit.

Chapter 3

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NOTE 1. Check for other fault codes that could provide additional information.

NOTE 3. If a fault cannot be located, it is also possible that the control unit is at fault.

NOTE 2. Communication between control units can pass via a CAN-Bus system; refer to Page 51 for CAN-Bus checks.

NOTE 4. Refer to Page 53 for list of pages that show the ISO standard for component locations e.g. Sensor A - Bank 1.

Fault code	EOBD / ISO Description	Component / System Description	Meaningful Description and Quick Check
P0312	Cylinder 12 Misfire Detected	A common method of detecting misfires is to monitor the signal from engine speed sensor to check crankshaft acceleration / speed during each power stroke; this provides an indication of the power / torque contribution provided by the cylinder (compared to the other cylinders). Any fault with the cylinder, including mechanical faults, fuelling, ignition (petrol engines) or other faults affecting combustion, will affect the power / torque produced by the cylinder. Misfires can also be detected by the oxygen / lambda sensor, due to high oxygen content (unburned oxygen) in the exhaust gas. Also note that there is reference to manufacturers monitoring the strength of exhaust pressure pulses (which will be weak if a misfire exists); a weak pressure pulse is then linked to an individual cylinder by using cylinder identification sensors (cam shaft sensor etc).	The fault code indicates that the contribution from the identified cylinder is different when compared to other cylinders (likely to be a lower contribution but, in some circumstances the contribution could be higher). If the system monitors exhaust pressure pulses, it could have detected a weaker pulse for a specific cylinder). Check ignition (petrol engines), check fuelling and injection timing (as applicable) and check condition of injectors (leaking / dribbling injectors, injector, spray pattern etc). Also check mechanical condition of the cylinder (compression etc), and check for any other aspect of the engine operation that could affect just one cylinder (air leaks etc). It is also possible that there could be an engine position / speed sensor related fault (if necessary, Refer to list of sensor / actuator checks on page 19).
P0313	Misfire Detected With Low Fuel	A common method of detecting misfires is to monitor the signal from engine speed sensor to check crankshaft acceleration / speed during each power stroke; this provides an indication of the power / torque contribution provided by the cylinder (compared to the other cylinders). Also refer to Fault code P0300 and P0312 for additional information relating to misfire detection.	The fault code indicates that there is a random misfire but it is not identifiable to specific cylinders. It is likely that the fault is causing erratic fluctuations of the crankshaft speed (or affecting other monitoring processes), which are not consistent to any one cylinder or group of cylinders. The fault could be related to any aspect of the engine operation including: fuelling, ignition (petrol engines), air leaks, mechanical condition etc, but the control unit has also identified that the fuel level is low. Check fuel level and add fuel if required. Clear fault code. If the same fault is re-activated, check fuel level sensor system (refer to fault code P0461 for additional information).
P0314	Single Cylinder Misfire (Cylinder not Specified)	A common method of detecting misfires is to monitor the signal from engine speed sensor to check crankshaft acceleration / speed during each power stroke; this provides an indication of the power / torque contribution provided by the cylinder (compared to the other cylinders). Also refer to Fault code P0300 and P0312 for additional information relating to misfire detection.	The fault code indicates that the contribution from the identified cylinder is different when compared to other cylinders (likely to be a lower contribution but, in some circumstances the contribution could be higher). If the system monitors exhaust pressure pulses, it could have detected a weaker pulse for a specific cylinder). Check ignition (petrol engines), check fuelling and injection timing (as applicable) and check condition of injectors (leaking / dribbling injectors, injector, spray pattern etc). Also check mechanical condition of the cylinder (compression etc), and check for any other aspect of the engine operation that could affect just one cylinder (air leaks etc). It is also possible that there could be an engine position / speed sensor related fault (if necessary, Refer to list of sensor / actuator checks on page 19).
P0315	Crankshaft Position System Variation Not Learned	The "crankshaft position system" refers to the system used to detect the position / speed of the crankshaft. Note that some systems (usually Diesel engines) could use the signal from the camshaft sensor or the fuel pump position / speed sensor.	The control unit is not fully recognising the crankshaft positions sensor / signal; this is likely to be caused by the fitting of a new sensor or control unit (control unit programme / software could also have been corrupted or erased). It may be necessary to perform a re-initialisation of the control unit (especially if new components have been fitted) refer to vehicle specific information to identify the process. If it is suspected that the sensor is faulty, Refer to list of sensor / actuator checks on page 19.
P0316	Engine Misfire Detected on Start-up (First 1000 Revolutions)	A common method of detecting misfires is to monitor the signal from engine speed sensor to check crankshaft acceleration / speed during each power stroke; this provides an indication of the power / torque contribution provided by the cylinder (compared to the other cylinders). Also refer to Fault code P0300 and P0312 for additional information relating to misfire detection.	The fault code indicates that there is a misfire (on unidentified cylinder or cylinders) immediately after engine start. It is likely that the fault is causing erratic fluctuations of the crankshaft speed, which are not consistent to any one cylinder or group of cylinders. The fault could be related to any aspect of the engine operation but it is likely to be specific to a function or controls on immediate post start conditions e.g. post start glow plug control, lack of fuel enrichment, ignition systems problem (spark plugs etc). Carry out checks on all engine systems including: fuelling, ignition (petrol engines), air leaks, mechanical condition etc. Also check (as applicable) for faults with variable valve timing, EGR and other emission control systems. It is also possible that there could be an engine position / speed sensor related fault (if necessary, Refer to list of sensor / actuator checks on page 19).
P0317	Rough Road Hardware Not Present	Road sensors (usually accelerometers) indicate rough terrain conditions; the sensor information can be used for transmission control and for engine control. The engine speed can fluctuate rapidly when a vehicle passes over rough terrain, which can be regarded as an engine related fault e.g. misfire or reduced cylinder performance because of sudden change in engine speed. If the rough road sensor indicates rough conditions, the engine speed fluctuations will be ignored. Note that some vehicles use the signal from a wheel speed sensor (ABS sensor) to indicate rough conditions (wheel speed will rapidly change when a bump or dip is encountered).	The fault code indicates that a rough road sensor is not fitted or cannot be detected by the control unit; this can occur if the sensor or control unit has been changed and the control unit is not recognising the rough road sensor; it may be necessary to re-initialise the control unit (refer to vehicle specific information). It is possible that a sensor has been changed and not connected correctly to the system / control unit or, it is also possible that a replacement control unit cannot detect the sensor, because the vehicle is not fitted with a sensor and the control unit is configured incorrectly for the vehicle.
P0318	Rough Road Sensor "A" Signal Circuit	Road sensors (usually accelerometers) indicate rough terrain conditions; the sensor information can be used for transmission control and for engine control. The engine speed can fluctuate rapidly when a vehicle passes over rough terrain, which can be regarded as an engine related fault e.g. misfire or reduced cylinder performance because of sudden change in engine speed. If the rough road sensor indicates rough conditions, the engine speed fluctuations will be ignored. Note that some vehicles use the signal from a wheel speed sensor (ABS sensor) to indicate rough conditions (wheel speed will rapidly change when a bump or dip is encountered).	Identify the type of sensor system used on the vehicle e.g. a separate sensor such as an accelerometer or, whether a wheel speed sensor is used. The voltage, frequency or value of the sensor signal is incorrect (undefined fault). Sensor voltage / signal could be: out of normal operating range, constant value, non-existent, corrupt. Possible fault in the sensor or wiring e.g. short / open circuits, circuit resistance, incorrect sensor resistance or, fault with the reference / operating voltage; interference from other circuits can also affect sensor signals. If a wheel speed sensor is used, Refer to list of sensor / actuator checks on page 19. If a separate sensor is used, it may be necessary to refer to vehicle specific information to identify specific test procedures.

NOTE 1. Check for other fault codes that could provide additional information.

NOTE 3. If a fault cannot be located, it is also possible that the control unit is at fault.

NOTE 2. Communication between control units can pass via a CAN-Bus system; refer to Page 51 for CAN-Bus checks.

NOTE 4. Refer to Page 53 for list of pages that show the ISO standard for component locations e.g. Sensor A - Bank 1.