

# OBDIIC&C Display

**Owners Manual. Software Version 030118V01F**

## Introduction

If you have had your Insight for a while, you may have heard of the OBDIIC&C device. It's an Insight-specific PIC-based OBD2 diagnostic code reader and information display and control unit. OBDIIC&C stands for 'Onboard Diagnostics Command & Control'. (You may also want to think of it as an OBD2 reader that has Command and Control functions.)

OBDIIC&C is designed and built by me, Peter Perkins, a multi Insight owner and electronics enthusiast from the UK.

You can find me at [www.thehybridexpert.co.uk](http://www.thehybridexpert.co.uk)



*The hand-built Insight-specific OBDIIC&C unit in its bespoke 3D printed case.*

I am a regular contributor to the main Insight discussion forum at [www.insightcentral.net](http://www.insightcentral.net) and have built up a considerable following for my technical posts and devices built specifically for the Insight.

Normal OBD2 code readers such as the ScanGauge, and cheap Elm327 based devices, can read only basic OBD2 information and a very limited list of engine-only parameters. This is because they talk to the car only on the standard OBD2 K-Line.

The OBDIIC&C is a dedicated PIC18f2620 microprocessor based design, and communicates with the Gen 1 Honda Insight using special protocols and extra data lines to enable the full range of vehicle parameters to be displayed. It uses a simple but bright 20x4 LCD backlit screen for general data display. The full list of information available is huge, and includes numerous extended engine and IMA (Integrated Motor Assist) system parameters that other device owners can only dream of seeing.

## So how does OBDIIC&C help an Insight driver?

In normal operation, the OBDIIC&C can display any eight or sixteen user-selected parameters from the over

250 available. It refreshes these onscreen continuously, at over four times per second.

This allows the driver to closely monitor things like IMA system efficiency, IMA battery state of charge, IMA battery temperature, IMA battery voltage and IMA battery current. These tell you a lot about the condition of your battery pack and allow the driver to make intelligent choices with regard to driving style, in order that they get the best fuel economy, best performance or perhaps preserve the battery pack life.

You can also monitor enhanced Honda engine data, including aspects like fuel injector pulse width, air/fuel ratio, engine coolant temperature and air intake temperature.

The device also includes a lean burn green led light to show when the engine is in the lean burn, ultra-efficient mode. Just keeping this hypnotic green light on as much as possible when driving, can significantly improve your fuel economy and enhance your hypermiling technique.

The OBDIIC&C also displays vehicle error codes, and it checks for stored codes every time you turn on the ignition. These error codes are displayed on screen and you can then note them, clear them or ignore them before setting off.

The Insight has a fairly insensitive engine temperature gauge display on the standard instrument cluster, so the OBDIIC&C provides backup monitoring and an audio/visual alarm if the coolant temperature goes over 102 degrees C. It's a lightweight aluminium engine after all, and the head gasket does not take kindly to overheating.

The OBDIIC&C has lots of other functionality built in, and an extensive menu system to select or modify options, values, flags and functions. A few special features worth mentioning are the device's ability to manipulate the IMA battery state of charge, control the IMA battery cooling fan, and clear codes from various sub computers in the car like the EPS (electric power steering unit), ABS (anti-lock braking unit), SRS (airbag system), TCM (CVT control module), etc.

The OBDIIC&C can also act as a host for IMAc&c P&P (Integrated motor assist command and control, plug and play). This is another Insight specific device made by myself which gives the driver full manual control over the IMA motor system. This allows assist and regeneration to be commanded or controlled at will. It's similar to Mike Dabrowski's famous MIMA system.

The OBDIIC&C device can count Ah (ampere hours) in and out of the battery pack to give you an indication of your battery's capacity and condition. It can also display a % efficiency figure which is a percentage ratio calculation of the watt hours in/out of the battery over

time. The Insight uses a nominal 4Ah 80-20% capacity window to ensure long life from the 6.5Ah Panasonic Nimh cells. A full battery in good condition should be able to provide around 3.5ah during an assist-only test run. OBDIIC&C can now also provide several Ah & Wh counting parameters to monitor assist and regen activity and IMA function.

### OBDIIC&C functions list

1. Read, display and clear standard OBD2 codes.
2. Continuously display and refresh eight or sixteen user-selected extended parameters from the over 250 available in the car's computer systems.
3. Control the IMA battery fan - high, low & off.
4. Test the IPU Fan.
5. Set the IMA Battery SOC (state of charge) level to 75, 60 or 40%.
6. Display extended data ECM, MCM, ABS, SRS, EPS and TCM error sub codes.
7. Clear ECM, MCM, ABS, SRS, EPS and TCM error codes.
8. Display a VTEC flag showing valve operation.
9. Display a green lean burn led light and flag showing efficient engine operation.
10. Display battery fan flag showing high, low, off status.
11. Hosts the addon Ima&c P&P system for full manual control of IMA motor functions.
12. Log parameter data at 4hz or 0.5hz via a serial USB cable to Excel spreadsheet for analysis.
13. Engine coolant temp visual and audible alarm.
14. Count Ah & Wh in/out of the battery to calculate capacity, efficiency and condition of pack.
15. Activate the SCS (service connector signal) to flash out computer module sub codes via the standard dashboard display.
16. Perform consistent and accurate timing for acceleration tests giving reliable data for comparisons.
17. Display the ECM and MCM software version numbers.
18. Closely monitor the EGR (exhaust gas recirculation) valve to help diagnose the common "herky jerky" problem.
19. Display data from external I2C sensors, such as the DS18B20 and Melexis MLX90614 temperature measuring devices.
20. Change display units to suit location and country of use.
21. Adjustable display backlight.
22. Adjustable display contrast.
23. Support for compatible HD44780 based 20x4 parallel interface LCD, OLED and VFD displays.
24. Display OBDII system readiness codes.



*The OBDIIC&C unit operating on the dashboard.*

In use, the OBDIIC&C is normally permanently plugged into the Insight's OBD2 port. It starts up and goes to sleep automatically as you turn the car ignition on and off. It's controlled by a simple five-way button joy switch.

Future development plans include more functions, key programming, and a Bluetooth connection dongle to display data on a suitable Android phone running a special OBDIIC&C app.

I release new software for the OBDIIC&C several times a year, and owners can update their gauges to get extra functionality and features using a laptop and simple USB/serial pic programmer. The software change log and firmware update procedure is described in detail later in this document.

If you want a hand-built and cased OBDIIC&C for your own car, contact me at [150mpg@gmail.com](mailto:150mpg@gmail.com) for current pricing.

I also sell the bare printed circuit board for the device. It's even possible to build it on strip board for very little

cost, as the schematic and software for the gauge are available free to download from the OBDIIC&C thread. The gauge circuit board is a simple through-hole design, and anyone reasonably competent at soldering should be able to build it.



Rear view of the OBDIIC&C printed circuit board.

### Development background

There is a huge amount of information about the development and technical details of the OBDIIC&C gauge on the [www.InsightCentral.Net](http://www.InsightCentral.Net) forums in the threads below.

[OBDIIC&C Old development forum thread](#)

[OBDIIC&C New development forum thread](#)

The parts list, helpful links and tips can be found in the below Google documents spreadsheet.

[OBDIIC&C Google parts list spreadsheet](#)

[OBDIIC&C Pcb schematic](#)

### OBDIIC&C instructions for use

The OBDIIC&C is a sophisticated feature-rich device, and to get the best out of it please read this manual thoroughly. Changes to parameters and functions from the previous software version in the appendices are highlighted in **magenta**. Please note these carefully.

Before plugging in your OBDIIC&C, please check it, the cable, and the Obdii plug for damage or any other obvious problems.

### Startup, Splash screen display

```
OBDIIC&C 030118 U01F
9600b IMAC&C CONTROL
DTC 32MHZ PIC18F2620
Efficiency % 9.96
```

OBDIIC&C plugged in, ignition off and waiting to start.

Plug the OBDIIC&C plug firmly into the OBD2 socket in your car and turn on the vehicle ignition. The OBDIIC&C will attempt to communicate with the car and start up. It will display the above splash message on screen giving the firmware date, version number and IMA efficiency %. (See the top of this document for the version number covered by this manual) It will also beep, flash the red LED, and continue to try and start for some time whilst also displaying a communication warning message.

If the gauge is unable to start you can **press** the button to force it to start to enter the developer mode and gain access to the menu system etc..

If the LCD display contrast is poor, the text is pale or too dark; you may need to adjust the contrast control on the PCB. Remove the back from the OBDIIC&C and adjust the contrast pot (RV1) gently with a small screwdriver before proceeding.

### Obd codes display

```
OBDCodes U=Skp D=C1r
P0118 P0113 P1519
P1259 P1523 P1644
P0000 P0000 P0000
```

Obd codes showing six active problems.

If any OBD or DTC (Diagnostic Trouble Codes) are stored, the OBDIIC&C will display them (maximum nine) during the startup sequence and wait for user input. Pushing the button **up** exits the Obd code display and proceeds to the readiness code display. Pushing the button **down** clears any stored Obd codes and resets the readiness tests. (Remember, it can take several journeys and engine cycles for the readiness codes to complete) Do not reset Obd codes or DTCs unless you also want to clear the readiness tests. The Obd codes display on startup may be enabled or disabled in the configuration menu.

### Readiness tests

```
0=TestOk MissF =0
Fuel =0 Comp =0
Cat =1 O2Sens=1
O2Heat=1 EgrSys=1
```

Readiness tests results displayed.

The OBDIIC&C now displays the seven readiness test status flags for three seconds. They are misfire, fuel system, components, catalyst, O2 sensor, O2 heater and EGR system. '1' means the test is incomplete, and

'0' means it is complete. After three seconds, the OBDIIC&C moves onto the main parameter display screen. If you missed the status of the tests, simply press **up** when the gauge is displaying the main screen, and it will restart. The readiness codes display on startup may be enabled or disabled in the configuration menu.

### Main Parameter display



```
Bvo 157   Ect+20
Ban-0.0   Iat+20
Bte+17    Fin 0.00
Soc 67.4  Afr 0.0
```

*The eight parameters on the primary display.*

The main user-selectable parameter display is the central feature of the OBDIIC&C gauge. Here the gauge will display your eight or (sixteen chosen parameters if in the alternating display mode) in two columns of four. You can select from a list of over 250 different parameters. The gauge communicates with the car and updates these parameters four times a second, and provides an addictive information source for the driver. The parameters are selected based on the vehicle system you wish to monitor (e.g. ECM, MCM, TCM) and the country your vehicle was sold in. Differences in the programming of the OEM computers mean that different regions use different parameter codes to retrieve the same information.

### Display Flags

The far right column of the main display mode is used to show auxiliary information flags. These appear at different times and indicate when a specific system is operating as per the list below. On first installation you must set the gauge to the correct county mode UK1, US1, US2 using the menu system or the flags will not work correctly, this is explained in the menu section.

### General information flags on right of display

V = Vtec operational

f = Battery cooling fan slow

F= Battery cooling fan high

L= Lean burn mode

B = Brake Pressed (Bottom Right)

C = Clutch Pressed (Bottom Right)

The OBDIIC&C button has five functions at this point.

**Up** Reboots the gauge and reloads stored configuration information from the Eeprom.

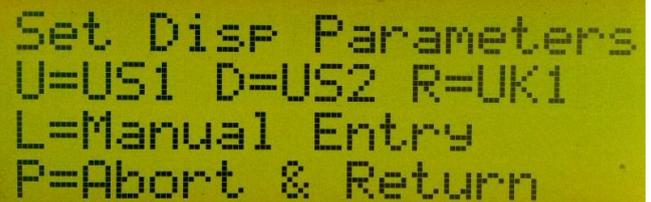
**Down** enters the IMA sub mode.

**Right** enters the Ah, Wh, Time mode.

**Left** enters the parameter selection mode.

**Centre** push enters the menu system.

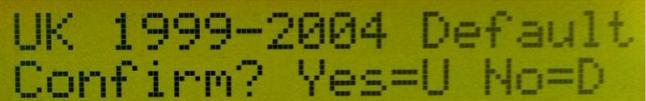
### Parameter selection (Left)



```
Set Disp Parameters
U=US1 D=US2 R=UK1
L=Manual Entry
P=Abort & Return
```

*Parameter selection initial screen.*

First this gives a menu with a 'Reset to default parameters' option. You can select US1 1999-2004, US2 2005-2006, UK1 1999-2004 or **press** to move onto the manual parameter selection described below. The gauge will restart if you reset the parameters, and they will be saved for future use. This feature can be used as a quick way of changing from the UK1 (firmware flash default) to a US1 or US2 parameter set.



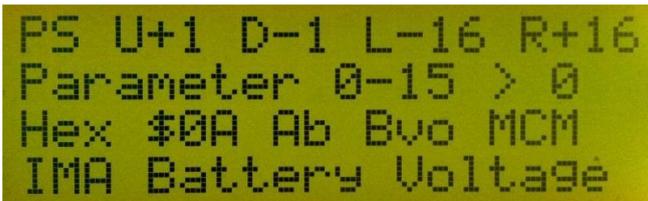
```
UK 1999-2004 Default
Confirm? Yes=U No=D
```

*Parameter default selection confirmation screen.*

### Manually Selecting Parameters

Manually selecting display parameters is probably the most difficult part of OBDIIC&C operation. Take care when selecting them, and please pay particular attention to the convention and restrictions on parameter placement. The eight default primary parameters are normally an equal mixture of four ECM (Engine) ones on the right, and four MCM (IMA) ones on the left of the screen. In order to allow the OBDIIC&C to retrieve information efficiently, you should keep the same type of parameters in the same column i.e. MCM on the left and ECM on the right. This also applies if you use the extended 16 parameter secondary alternating display option.

The eight primary display parameters are arranged on the display with parameter zero at the (top left), and parameter seven at the (bottom right). If you decide to setup the secondary alternating sixteen parameter display, these second eight parameters are arranged in the same way but with number eight (top left) to number fifteen (bottom right).



Screen showing parameter 0 with type \$0A selected.

At the end of line three in the image above you can see "MCM". This means the parameter on display is an MCM (IMA) parameter. This will change as you step through the available parameters. The list below shows you what each abbreviation means.

MCM = Insight 1999-2006 MCM (IMA) parameter

UK1 = UK Insight 1999-2004 ECM parameter

US1 = US Insight 1999-2004 ECM parameter

US2 = US Insight 2005-2006 ECM parameter

TCM = Insight 1999-2006 TCM (CVT) parameter

MIS = Miscellaneous parameter

#### Primary 8 Parameter Display Screen Positions

Display Line 1 = parameter 0 & 1

Display Line 2 = parameter 2 & 3

Display Line 3 = parameter 4 & 5

Display Line 4 = parameter 6 & 7

#### Secondary 16 Parameter Display Screen Positions

Display Line 1 = parameter 8 & 9

Display Line 2 = parameter 10 & 11

Display Line 3 = parameter 12 & 13

Display Line 4 = parameter 14 & 15

#### Parameter List

The current parameter list appears in appendix C. As mentioned, parameters are divided up into computer modules, regions and years. For example, if your car is a US 2004 model, and you want an ECM parameter, you must ensure you scroll through the parameters list until you reach the "US1" 1999-2004 ECM section.

Once you press **left**, the OBDIIC&C will display the currently selected parameter for position 0 on the screen. You can now scroll through the available parameters for that position using the button.

**Up** Increases the parameter by 1

**Down** decreases the parameter by 1

**Right** Increases the parameter by 16

**Left** decreases the parameter by 16

**Press** confirms the currently displayed parameter as the one you wish to select for this display position and moves onto the next display position.

You continue to select parameters and move through all sixteen display positions. Once you have made your selections, the final **press** will save the data and restart the OBDIIC&C gauge. Note you must select or skip parameters 8-15 even if you are only using the primary display mode.

#### Special parameters

The parameter list contains a number of special entries. These relate to i2c type temperature sensors and Ah/Wh/Time/Loop counting.

Temperature sensors can be connected to the i2c expansion port on the back of the OBDIIC&C PCB for monitoring of remote, user-specified parts of the car e.g. the exhaust manifold or the IMA motor. The special sensors required are either the Melexis infrared MLX90614 or the generic ds18b20 type. Further information on this external sensor function can be found on the forum by searching for the specific sensor types. i.e. MLX90614 or ds18b20.

Worthy of note are:

#### "Ah-","Calc AhIn - AhOut = " Param 0xFD

This parameter shows the value of the accumulated AhIn (Regen Ah) minus the AhOut (Assist Ah).

#### "Wh-","Calc WhIn - WhOut = " Param 0xFE

This parameter shows the value of the accumulated WhIn (Regen Watt Hours) minus the WhOut (Assist Watt Hours).

#### "Wh%","WattHr In/Out %Ratio" Param 0x2E

This parameter shows the % value of the accumulated WhIn (Regen) versus the WhOut (Assist). It provides a reference value for battery/ima efficiency that can be plotted or noted over time. A higher percentage indicates a better system efficiency. If your battery has high internal resistance (IR) or poor capacity and recalibrations this figure will be lower. The efficiency % information is available as a selectable parameter (\$2E), on the Ah/Wh/Time screen, and on the splash screen at startup.

#### Bad Parameters (Formerly XXXX)

Selecting incorrect parameters will not harm the OBDIIC&C or the car, but will result in the display showing a 4 digit hexadecimal number on screen at that parameter position, as the car will not recognise or respond to the information request. The hex number displayed is the parameter you selected for that position, and that the gauge has tried to access unsuccessfully. Most US users, when they first plug the

gauge into the car, will see four different hex numbers displayed for all the ECM parameters on the right of the screen, as they are set to UK by default. US users must change them to the US ones they wish to display.

#### Ah Wh Time counting display (Right)

```
Ah/Wh/Time 00:08:54
AI 0.00 AO 9.69
WI 0 WO 154
Efficiency % 10.09
```

*Ah/Wh and elapsed time display screen.*

This Ah/Wh (Ampere & Watt hour) counting section displays the total charging Ah, discharge Ah, and the total Wh in and out of the pack since the last reset. It measures the battery current once a second and displays a running total for each value. Because the OBDIIC&C gauge does not a crystal controlled primary oscillator the timing is only accurate to approximately +/- 1 second per hour.

The cumulative Ah/Wh can show you the capacity of your pack when used with the IMAC&C controls to command assist or regeneration. The Ah/Wh/Time factors can be reset with button actions. Ah/Wh/Time are available as normal display parameters for inclusion on the primary display screen.

The system WhIn versus WhOut efficiency Wh% is also now displayed on the bottom line. This gives a good indication of system and battery health. A higher percentage is better. See also the Wh% parameter.

**Note Ah/Wh & % counting takes place only when the display is active in the main eight parameter display screen mode. Counting is not officially supported in the extended 16 parameter alternating display mode. The 'Bam' and 'Bvo' parameters must be active on the main parameter screen for Ah/Wh counting to function correctly.**

**Up** Reset Time counter

**Down** No function

**Right** Reset Ah Counter

**Left** Reset Wh Counter

**Press** Exit the Ah/Wh/Time mode

#### IMA Mode (Down)

```
Ima Soc&Fan Override
%SOC 75.1 Fan Off
U=75% D=40% R=60%
L=Fan Speed P=Exit
```

*IMA mode menu.*

This mode gives access to the IMA SOC (State of charge) and battery fan control functions.

The battery SOC is able to be set at three different levels, 40% low = **Down**, 60% medium = **Right**, and 75% high = **Up**. Use the buttons to select the value you require.

This feature is useful if you have grid-charged the car from a low SOC and want to set the SOC to 75% before driving off, therefore avoiding the car force-charging already full cells. This function is also used to compensate for those with bigger capacity packs, as they can simply repeatedly reset the SOC to 75% for as long as their pack lasts.

**Left** toggles the battery fan between off, low, and high modes.

The fan is normally automatically controlled by the BCM, but this override feature is especially useful for those in hotter climates, or who are pushing the car and IMA system hard. It can also be used to test the fan, as it is very difficult to hear operating in normal day-to-day running. Setting the fan to fast makes it easier to hear. Note the battery fan setting is retained in memory when the gauge shuts down and the fan can be reactivated automatically on restart according to the AutoBatFanFlag in the main menu.

#### Main Menu System (Press)

There are at over ninety variables, functions and flags in the menu system. Most can be changed by the user to provide different options, functions or sub-modes. A lot are self-explanatory, but some of them require additional hardware such as IMAC&C P&P installed. You should not activate or change them unless you are certain how they operate.

```
Menu U/D/L/R/P X00
Temp Cent or Far F00
Speed Mph or Kph F00
AMPS Hack Value U64
```

*Initial menu screen. The top line is the active item.*

The most important things to remember about the scrolling menu system are 1) that the top line of the display is the active item and 2) that the numbers beside each menu entry are \$ hexadecimal base 16.

Button presses will act on the item displayed on line 1. You should scroll through the menu using **up/down** until the flag, variable or command you are looking for is on the top line. Once you have your selection on the top line we can proceed. **Press** will exit the menu system, store your data and restart the gauge.

To change a flag **F** value press **right**.

To change a variable **V** value press **right**.

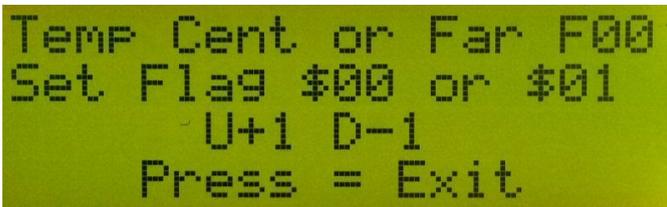
To activate a command (function) **C** press **left**.

### Example change item value (Flag or Variable)

On the right of the menu list are hexadecimal numbers, 00 etc. These are the stored value for the item on that line. If we look at 'Temp' we see that the number is F00, this means it's a flag (0 or 1), and the default for all gauge temperature readings is centigrade mode (F00).

Let's assume we want to change the temperature display from centigrade to fahrenheit.

Scroll down until 'Temp Cent or Far' is on the top line, then press **right** and the screen should change to the below.



```
Temp Cent or Far F00
Set Flag $00 or $01
  U+1 D-1
Press = Exit
```

*Menu Adjust Parameter Value mode.*

The above now tells us we can change this parameter using the button presses shown. **up** adds one to the value, **down** takes one away from the value, **right** adds sixteen(\$10) and **left** subtracts sixteen (\$10).

**Press** enters a confirmation screen..

If you make a mistake adjusting the value, then when you are on the confirmation screen, **Up** confirms your selection and returns to the menu list, **down** restores the previous value from the Eeprom storage.

### Other Menu Options

There now follows an explanation of every menu item in the order they appear on the gauge. Pictures are only used for some items, as most are straightforward flag **F** or variable **V** changes, done in exactly the same way as the temperature example above.

### Remember.

*If the entry is a **Flag** it should be set as 00 or 01.*

*If the entry is a **Variable** it should be set according to the data below.*

*If the entry is a **Command/Function** press left to activate it.*

The XX value shown with each item is the gauge hexadecimal \$\$ default value.

### "Menu U/D/L/R/P " X00 Reserved

The menu system header text.

### "Temp Cent or Far" F00 Flag

Temperature display centigrade 00 or fahrenheit 01.

### "Speed Mph or Kph" F00 Flag

Speed display Mph 00 or Kph 01.

### "Amps Hack Value " V64 Variable

This is a **variable** and is used with the current hack board to compensate for the reduction in current levels detected by the car when the current hack is working. So if you have installed the +30% current hack this value has to be changed to 143 decimal, (\$8F) in hexadecimal gauge speak. The amp calculation routines will then correctly adjust the calculations. The formula for working out this value for other % current hacks is. Multiplier = 1 +( % / (100-%) ) Where % is your increase value.

### "But Beep OnOff " F01 Flag

Button beep on 01 or off 00.

### "Alarm Beep OnOff" F01 Flag

Alarm beeps on 01 or off 00.

### "Data Log OnOff " F00 Flag

Data-logging mode on 01 or off 00..

When active the gauge outputs the parameter data as a serial 9600,8,N,1 data stream via the logging port, for import into a specially crafted Excel spreadsheet with macro. This feature requires a serial to USB lead and specialised software ([Plx-Daq](#)) installed on the receiving computer. Please refer to the data-logging thread on the forum for more details. Note: enabling the logging feature adds extra load to the OBDIIC&C processor, so it should not be enabled unless logging is taking place.

### "Data Log 1hz/4hz" F00 Flag

Data logging can take place at a user selectable 0.5Hz (00) (Default) or 4hz (01) if you want more samples.

**"Car Type Flag " V01 Variable**

On first running the gauge users should set this **variable** to match their country and car year.

**UK1** 1999-2004 (01) Default

**US1** 1999-2004 (02)

**US2** 2005-2006 (04)

**"Readiness OnOff " F01 Flag**

Startup readiness codes display on (01) or off (00). When on the readiness codes are displayed for three seconds during the gauge bootup sequence.

**"Scs Flash OnOff " F00 Flag**

Controls the SCS (Service Connector Signal) line. Enabling this option (01) causes the dashboard error lights to flash out the error sub codes for each system: IMA, SRS, EPS, ABS, TCM, etc. Note this feature is dependent on the brown SCS wire being present at your Obdii port. Unfortunately, on some cars (including UK ones) it is not, so this feature will not function. If you have IMAC&C P&P installed, then this can also activate the SCS signal.

**"AutoCharge OnOff" F00 Flag**

Auto charge mode on (01) resets the battery state of charge to 75% (four times) if it is less than 70%. This is for those who have grid-charged their cars with the ignition off to 100% capacity (most people). It ensures the top 20% of the SOC is burnt off (5% at a time over 4 resets) to bring the battery actual SOC into line with the OEM displayed SOC. It also prevents a freshly grid-charged battery being forced charged beyond 100% by an OEM system which thinks the battery SOC is low.

**"Auto75%Soc OnOff" F00 Flag**

Auto75%Soc mode on (01) continuously sets the battery state of charge to 75%. This is intended for those with non-standard large capacity packs and independent BMS (Battery Management Systems) systems. It prevents the OEM system force-charging or reducing assist performance. It should not be used in standard cars.

**"AutoBatFan OnOff" F00 Flag**

Auto bat fan mode on (01) will turn the battery fan on at a level stored in the next menu location "*Bat Fan Status*". Activating the fan manually from the IMA menu stores the value for use later. Default is off 00

**"Bat Fan Status " VFF Variable**

Stores the current battery fan status and is used by the previous menu entry "*AutoBatFan OnOff*".

(FF = Fan Off) ( 01=Fan High) (02=Fan Low)

This variable should not need adjusting manually.

**"Obd Codes Skip " F00 Flag**

Startup Obd codes display 00 or skip 01.

**"Max Assist OnOff" F00 Flag**

Enable (01) the IMAC&C P&P maximum assist kick down (Kers) mode. It is available only to those with IMAC&C P&P fitted. When active, the OBDIIC&C monitors the throttle potentiometer position, when it is pressed beyond 90% it engages maximum assist for as long as the throttle is pressed and the battery is able to sustain it. This is great for overtaking and maximum acceleration, as the standard system does not allow maximum IMA power in all gears, nor does it sustain maximum power beyond about 3 seconds at any one time. This also works with the CVT model and gives very sprightly acceleration. Default is off 00.

**"IMAC&CMode OnOff" F00 Flag**

This flag (01) is used to enable IMAC&C P&P support and should only be used when the official IMAC&C P&P joystick is fitted to the car and wired to the OBDIIC&C i2c expansion port. Default is off 00

IMAC&C P&P specific error flags that appear on the far right of the main OBDIIC&C display include:

- T or t = IMAC&C communications timeout
- C = IMAC&C checksum error

Please refer to the separate Imac&c P&P instruction manual for detailed information on IMAC&C functionality and full operating instructions.

**"Alt Disp OnOff " F00 Flag**

Turns on the extended 16 parameter display mode. Alternating 8/16 display mode on 01 or off 00.

**"Alt Disp Delay " V05 Variable**

This variable determines the delay between swapping the pages in the 16 parameter display mode. Increasing the value increases the time each page is on screen and vice versa. Values should be between 02 and 15.

**"LCD Bright +/- " V64 Variable**

This variable controls the lcd backlight brightness. The value can be set anywhere between 00 Off and FF full brightness. The backlight is controlled by a pic hardware pwm driver and transistor on the pcb. This variable has no effect on OLED (Organic Light Emitting Diode) or VFD (Vacuum Fluorescent Displays).

**"VFD Bright +/- " C01 Command/Function**

This function cycles the brightness of VFD displays only. There are 4 levels Off=00, 01, 02 & 03. This function should not be used with LCD or OLED displays or the display will crash necessitating a power cycle reset to restore function. Confirmation will be requested to use this function.

#### "OBDIICC But Test" C01 Command/Function



```

Obdiic&C Button Test
Selec U/D/L/R/P=Exit
Adc Data = 255
Key Press = 5
  
```

*Button test screen.*

This enables the user to test the OBDIICC 5 way button function. It reports raw adc (Analog digital converter) values and a decoded key press value for button pushes. The expected Key values are:

Adc > 234 = Key 5 = No button pressed.

Adc > 106 & Adc <150 = Key 4 = Left pressed

Adc > 63 & Adc <107 = Key 3 =Down pressed

Adc > 191 & Adc <235 = Key 2 = Right pressed

Adc > 149 & Adc <192 = Key 1 =Up pressed

Adc <64 = Key 0 = Button pressed

#### "IMAC&C Joy Test " C01 Command/Function



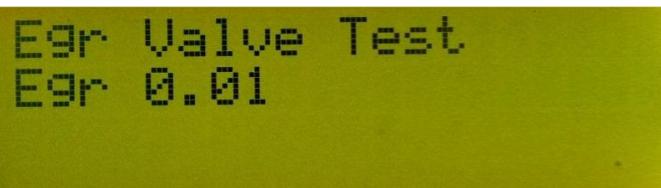
```

IMAC&C Joystick Test
X-Axis = 141
Y-Axis = 140
Button = 0
  
```

*Joystick test screen.*

This enables the joystick test mode. You should move the joystick smoothly and slowly up/ down / left / right in turn. The X and Y Axis values should change steadily and cover a range of approximately 0-255. The dead stick zone reading in the centre should be between 115 & 155 for both axis. Pressing the joystick in should give a reading of 1 for 'Button'.

#### ."Egr Valve Test " C01 Command/Function



```

Egr Valve Test
Egr 0.01
  
```

*Egr valve test screen.*

This activates the EGR test and displays the EGR valve internal feedback potentiometer voltage with a very fast refresh rate. It is useful for those with the common 'herky jerky' symptoms to watch for readings that jump around erratically, indicating the presence of the worn EGR feedback sensor issue. **Press** exits this function.

#### "Performance Test" C01 Command/Function

This function activates the acceleration tests. These are timed to the nearest 1/10 of a second, and use the vehicle VSS (Vehicle Speed Sensor) and PIC internal timer to calculate the results. **Press** exits this function.

Use Up/Down/Right/Left to select your test start and finish speeds. When the test is activated, the gauge waits for the car to reach or move past the start speed, it then starts the timer. When the target speed is reached, timing is stopped and the result displayed. Rolling start tests should be performed with the car accelerating hard past the start speed.

This system enables accurate comparisons timings to be made after modifications have been made, or allows comparisons between different vehicles. An online shared Google spreadsheet is available for people to add their results. It presently shows quite a number of interesting vehicles times and results. More are welcome.

[Performance testing thread](#)

[Performance spreadsheet](#)

#### "IMAC&C Inc Value" VOF Variable

**Use extreme care adjusting this variable.**

This variable allows you to change the IMAC&C Up/Down assist/regen step ratio. When you click the IMAC&C joystick Up or Down it engages a set level of assist or regen and holds it until cancelled. Normally there are four or five steps up and down equal to approximately 25/50/75 & 100% assist or regen. Adjusting this variable allows you to narrow or widen the gap between assist or regen levels whilst also giving you more or less steps respectively. The default value is 15 Decimal (\$0F Hex) It must be set to between 1 and 30 Decimal.

Setting a value of 1 would give about 100 tiny 1% power steps in both directions. Setting it to 30 would halve the number of assist or regen steps from 4 to 2 in each direction, but would increase the steps to approx 50% in terms of assist or regen % power..

#### "Backup Config " C01 Command/Function

This function backups up the users complete parameter and configuration settings into the pic onboard Eeprom. It should be used once a user has their gauge working correctly and as they wish. If you then make further

changes or mess up the configuration it can be restored very quickly. Confirmation is requested to use this function.

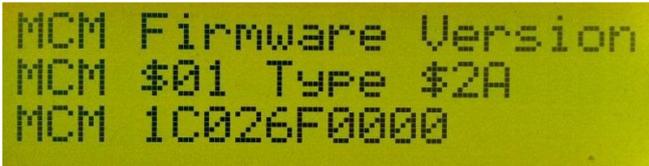
#### "Restore Config " C01 Command/Function

This function restores the users complete parameter and configuration settings from the pic onboard Eeprom. Confirmation is requested to use this function.

#### "Splash Scr OnOff" F01 Flag

Splash screen on 01 or off 00

#### "MCM Version Numb" C01 Command/Function



```
MCM Firmware Version
MCM $01 Type $2A
MCM 1C026F0000
```

*Mcm firmware version display.*

This function displays the MCM internal software firmware revision number on the third line of the display.

#### "ECM Version Numb" C01 Command/Function

This function displays the ECM internal software firmware revision number on the third line of the display.

#### "Display SRS Dtc " C01 Command/Function

This function displays the stored SRS (Safety Restraint System) subcodes and associated text problem description for all SRS codes. Each code is displayed in turn and you can move onto the next code if any by using up/down/left or right. **Press** exits this function. If the SRS light is on this is the function to use.

#### "Clear SRS Dtc " C01 Command/Function

Clears the currently stored DTC codes for this module. Note if the stored errors are permanent or the fault is still present then DTC codes will return immediately. You have to fix the problem before clearing the errors.

#### "Display ABS Dtc " C01 Command/Function

This function displays the stored ABS (Antilock Braking System) subcodes and associated text problem description for all ABS codes. Each code is displayed in turn and you can move onto the next code if any by using up/down/left or right. **Press** exits this function. If the ABS light is on this is the function to use.

#### "Clear ABS Dtc " C01 Command/Function

Clears the currently stored DTC codes for this module. Note if the stored errors are permanent or the fault is still present then DTC codes will return immediately. You have to fix the problem before clearing the errors.

#### "Display EPS Dtc " C01 Command/Function

This function displays the stored EPS (Electronic Power Steering) subcodes and associated text problem description for all ECM codes. Each code is displayed in turn and you can move onto the next code if any by using up/down/left or right. **Press** exits this function. If the EPS light is on this is the function to use.

#### "Clear EPS Dtc " C01 Command/Function

Clears the currently stored DTC codes for this module. Note if the stored errors are permanent or the fault is still present then DTC codes will return immediately. You have to fix the problem before clearing the errors.

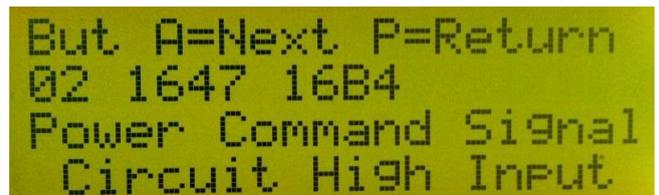
#### "Display TCM Dtc " C01 Command/Function

Not available yet.

#### "Clear TCM Dtc " C01 Command/Function

Clears the currently stored DTC codes for this module. Note if the stored errors are permanent or the fault is still present then DTC codes will return immediately. You have to fix the problem before clearing the errors.

#### "Display MCM Dtc " C01 Command/Function



```
But A=Next P=Return
02 1647 16B4
Power Command Signal
Circuit High Input
```

*Display MCM Dtc function.*

This function displays the stored IMA (MCM Motor Control Module) subcodes and associated text problem description for all MCM codes. Each code is displayed in turn and you can move onto the next code if any by using up/down/left or right. **Press** exits this function. If the IMA light is on this is the function to use.

#### "Clear MCM Dtc " C01 Command/Function

Clears the currently stored DTC codes for this module. Note if the stored errors are permanent or the fault is still present then DTC codes will return immediately. You have to fix the problem before clearing the errors.

#### "Display ECM Dtc " C01 Command/Function

Not available yet.

**"Clear ECM Dtc " FC01 Command/Function**

Clears the currently stored DTC codes for this module. Note if the stored errors are permanent or the fault is still present then DTC codes will return immediately. You have to fix the problem before clearing the errors.

**"Mdm VComp Value" V0A Variable**

This function can be used by those who are voltage hacking and have added extra sticks/voltage to the system to enable the gauge to display the correct mdm voltage. A value of \$0E (14) gives a multiplication factor of 1.4 x MDM VPIN voltage which is equivalent to using a 40k resistor in the VPIN input circuit. \$0D (13) gives a multiplication factor of 1.3. Default is \$0A (10) = no multiplication or compensation.

**"BrakeClutch Skip" V00 Variable**

**Use with extreme care...**

This variable controls the IMAC&C P&P Brake and Clutch switch checks. With a default value of 0 (zero) pressing the brake or clutch disengages IMAC&C P&P control and reverts to IMA OEM function.

A value of 01 skips the Brake switch check, so pressing the brake will no longer disengage IMAC&C.

A value of 02 skips the Clutch switch check so pressing the clutch will no longer disengage IMAC&C.

A value of 03 skips both the Brake & Clutch switch checks, so pressing the brake or clutch will no longer disengage IMAC&C.

**"12V VComp Value " V64 Variable**

This function uses a multiplication factor to increase the detected ECM and MCM 12V system voltage parameters. Voltage drops in the vehicle wiring loom means the system voltage at the ECM and MCM is not the same as the actual 12V battery voltage. This multiplication factor is an effort to rectify that problem and bring the detected values in line with the actual voltage.

The formula is  $V = (\text{Detected voltage} * \text{multiplication factor}) / 100$ .

The default is \$64 (100) = no compensation.

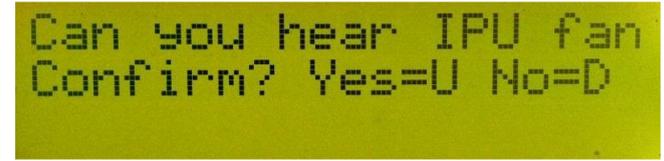
**"Loop Delay Value" V0A Variable**

This variable \$0A (10) = 10ms is a delay necessary between information requests sent to the cars computers to allow them to respond correctly. If you see missed parameters on the display screen you can try increasing this value. If you want faster gauge refreshes you can tweak this value down until you start to get parameter communication errors.

**"BlueTooth OnOff " V00 Flag**

This flag controls bluetooth serial data output. It is for use during development only at present.

Off 00 or On 01.

**"IPU Fan Test " C01 Command/Function**

*Ipu Fan Test function.*

This function turns on the IPU fan blower for testing. You should listen carefully near the IPU compartment whilst it is activated. You should be able to hear the fan running if it is ok.

**Other items in the menu list.**

Other items in the menu list are reserved or for debugging viewing onl. You cannot change them.

**Additional notes and troubleshooting tips**

Certain display parameters, internal functions and flags are linked. For example, the AFR (Air/fuel Ratio) parameter is linked to the operation of the green lean burn LED. So the AFR parameter must be one of your selected parameters if you wish the green lean burn LED to operate. Likewise, the ECT (Engine Coolant Temperature) must be a selected parameter if you want the red LED temperature warning light and audible alarm to operate.

Problems with the gauge are generally caused by incorrect user settings, or a poor connection at the car ODB2 socket.

If the gauge is completely blank and does not beep or respond in any way, then check the wires linking the gauge to the car. Open the OBDIIC&C case and check the connections for the cable on the OBDIIC&C PCB, and in the plug at the other end of the cable.

The pins in the OBDII plug can sometimes be forced back into the plug housing, resulting in bad connections. If this occurs, open-up the plug, push the pins forward and then super glue them in place.

The OBDII socket in the car is protected by a fuse; if this is blown the gauge will not receive any power.

Users with a PIC programmer can reflash the device firmware to return it to normal if it gets corrupted.

A hexadecimal number on the display e.g \$001A means the car is not responding to that parameter request. This is usually caused by users selecting parameters from the wrong car region or year. Some cars

occasionally require parameters from different zones or years than you would expect to operate correctly.

The OBDIIC&C uses a precision internal timer to calculate Ah/Wh in/out of the IMA battery. When the gauge is heavily loaded such as when logging data, or controlling the IMAC&C manual IMA control system it can slow down to the point that Ah/Wh calculations become inaccurate.

Failure of the gauge to shutdown correctly on ignition off is sometimes caused by users turning off the car when it is not in the normal parameter display mode, or turning the car back on again before the gauge has shut down correctly. (Shutdown takes about 10 seconds.) If this occurs, either turn the car back on again, allow the gauge to initialise, then turn the ignition off again, or unplug the gauge until the next time you need it.

The OBDIIC&C gauge is covered from the date of purchase by a three-year, return to base warranty. If it fails in normal use, I will just send out a new unit on receipt of your broken one. The warranty does not cover accidental damage caused by dropping it, etc.

### Firmware updates

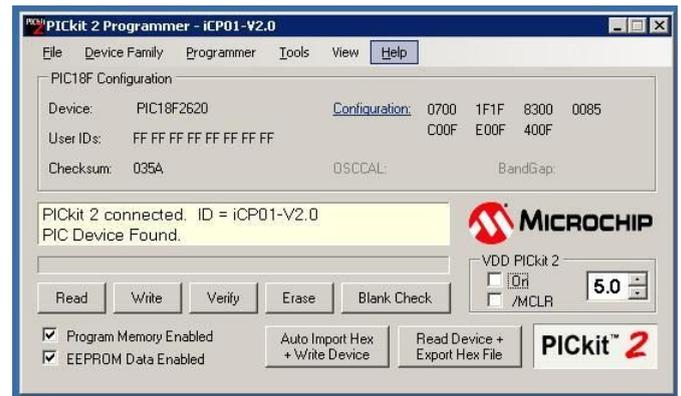
The OBDIIC&C can be updated with new firmware quickly and simply by the user. The procedure requires a USB pic programmer and suitable computer running the PICkit 2 programming software.

The programmer recommended is the (icp01). It can be ordered, and the software required downloaded from this webpage link.

#### [Pic icp01 programmer](#)

On the back of the OBDIIC&C PCB in the bottom right corner is a sil 0.1" 5 pin connector J2, labelled "ICSP". It has a small "1" near the bottom right pin. If you have the official 3d printed OBDIIC&C case there will be a cutout in the back of the case over this connector. The pic programmer plugs into a USB port on your computer, and connects to the 5 pin connector on the back of the OBDIIC&C. The red stripe of the programmer cable connects to pin "1" on the PCB.

Once the programmer is connected to the OBDIIC&C, and the software is running on your computer, the gauge may try to start up if the VDD PICkit 2 option is ticked in the PICkit 2 software. This is normal. Now check communication with the gauge by using the programming software Tools menu, and the option "Check Communication". The programmer should flash and the device type 18F2620 should appear as shown.



*PICkit 2 software screenshot.*

Make sure the options "Program Memory Enabled" and "EEPROM Data Enabled" are ticked.

Now open the File menu and select "Import Hex". Find the new OBDIIC&C firmware hex file you have downloaded and select it. You should see the message "Hex file successfully imported". Now press the Write button and the new firmware will be uploaded to the OBDIIC&C. If all goes well you should get a green "Programming Successful" message.

If you wish to backup your current software and data before upgrading, use the Read and Export options in the PICkit 2 software to save it

If the firmware update fails check your connections and try re-downloading the hex file. Check the [www.insightcentral.net](http://www.insightcentral.net) forum for further advice.

### Finally

I hope you enjoy using the OBDIIC&C as much as I do. It took hundreds of hours to research, design and build. It is a product specifically built for our fascinating cars, and I hope it helps you get the best out of yours.

Comments and feedback on it, these instructions, or any of my devices are always welcome. Please use the [www.insightcentral.net](http://www.insightcentral.net) forum OBDIIC&C threads for all general questions, feature requests or problems. There are lots of experienced users of my devices in the Insight community, and they are always willing to help on the forum with their experience and knowledge.

**Peter Perkins 03/01/2018**

## \*\* Appendix A0 \*\* Main Menu List \*\*

"Menu U/D/L/R/C "	\$00 Flag	"Clear SRS Dtc "	Func
"Temp Cent or Far"	\$00 Flag	"Display ABS Dtc "	Func
"Speed Mph or Kph"	\$00 Flag	"Clear ABS Dtc "	Func
"Amps Hack Value "	\$64 Variable	"Display EPS Dtc "	Func
"But Beep OnOff "	\$01 Flag	"Clear EPS Dtc "	Func
"Alarm Beep OnOff"	\$01 Flag	"Display TCM Dtc "	Func
"Data Log OnOff "	\$00 Flag	"Clear TCM Dtc "	Func
"Data Log 1hz/4hz"	\$00 Flag	"Display MCM Dtc "	Func
"Car Type Value "	\$01 Variable	"Clear MCM Dtc "	Func
"Readiness OnOff "	\$01 Flag	"Display ECM Dtc "	Func
"Scs Flash OnOff "	\$00 Flag	"Clear ECM Dtc "	Func
"AutoCharge OnOff"	\$00 Flag	"Mdm VComp Value"	\$0A Variable
"Auto75%Soc OnOff"	\$00 Flag	"BrakeClutch Skip"	\$00 Variable
"AutoBatFan OnOff"	\$00 Flag	"12V Comp Value "	\$64 Variable
"Bat Fan Status "	\$FF Variable	"Loop Delay Value"	\$0A Variable
"Obd Codes Skip "	\$00 Flag	"BlueTooth OnOff "	\$00 Flag
"Max Assist OnOff"	\$00 Flag	"IPU Fan Test "	Func
"IMAC&CMode OnOff"	\$00 Flag	"Spare Menu Entry"	
"Alt Disp OnOff "	\$00 Flag	"Spare Menu Entry"	
"Alt Disp Delay "	\$05 Variable	"Spare Menu Entry"	
"LCD Bright +/- "	Func & Variable \$64		
"VFD Bright +/- "	Func & Variable \$01		
"OBDIICC But Test"	Func		
"IMAC&C Joy Test "	Func		
"Egr Valve Test "	Func		
"Performance Test"	Func		
"IMAC&C Inc Value"	\$0F Variable		
"Spare Menu Entry"			
"Spare Menu Entry"			
"Backup Config "	Func		
"Restore Config "	Func		
"Splash Scr OnOff"	\$01 Flag		
"MCM Version Numb"	Func		
"ECM Version Numb"	Func		
"Display SRS Dtc "	Func		

**\*\* Appendix A1 \*\* Software Change Log \*\***

- 1) V09 Added readiness codes toggle display option to configuration menu 2.
- 2) V10 Bug fix in logging code.
- 3) V11 Fixed shutdown issue.
- 4) V11 Added reset default parameters option.
- 5) V11 Added lcd backlight start 50%.
- 6) V11 Added Selectable 4hz/0.5hz logging rate.
- 7) V11 Added red led blip timer overflow warning.
- 8) V11 Reduced readiness code display time.
- 9) V11 Internal speed tweaks.
- 10) V12 Processor speed increase from 8 – 32 MHz.
- 11) V12 Parameter error display changed from XXXX to hex value.
- 12) V12 Logging speed data rate increased to 38,400 8,N,1
- 13) V12 Database errors corrected.
- 14) V12 Joy Button Function improved.
- 15) V12 IMAC&C P&P support improved.
- 16) V01B Complete software rewrite and many additional features including SRS,ABS,EPS Diagnostic code reading..
- 17) V01C Bug fixes and added several new parameters and functions.
- 18) V01D Bug fixes and added % efficiency to splash screen.
- 19) V01F Bug fixes and brake and clutch flags added.

**\*\* Appendix B \*\* OBDIIC&C Specifications \*\***

Supply voltage 12V DC

Operating current maximum 300mA

Sleep current 5mA

18F2620 Processor speed 32 MHz

Insight specific OBD2 control device with 20x4 LCD  
backlit screen

Adjustable screen brightness and contrast

Red and green indicator LED's

Audible piezo beeper

Five-way joy button control

Eight or sixteen parameter, user-selectable display

250 parameters

Engine coolant temperature alarm

EGR system monitor

Sub-module error code clearing

Battery SOC and fan control

Performance testing mode

Data logging to Excel spreadsheet

IMAC&C P&P manual IMA control interface

Advanced user functions and capabilities

Flash upgradeable by the user

Regular software updates

**\*\* Appendix C \*\* Parameter List \*\***

\* Insight 1999-2006 29/09/2016 \*

**\* Ima (Mcm) 1999-2006 Parameters \***

"Wam", "W Phase Amps +/-310A" 0x00  
 "Vam", "V Phase Amps +/-310A" 0x01  
 "Uam", "U Phase Amps +/-310A" 0x02  
 "Tam", "Total Phase Amps " 0x03  
 "Mam", "MDM Amps +/-250A "0x04  
 "Mdv", "MDM Voltage " 0x05  
 "Ikw", "IMA Request Kw " 0x06  
 "Eto", "Engine Torque " 0x07  
 "Mte", "MDM Temperature " 0x08  
 "Dte", "DC-DC Temperature " 0x09  
 "Bvo", "IMA Battery Voltage " 0x0A  
 "Mor", "Motor Speed Rpm " 0x0B  
 "Soc", "IMA Battery Soc 16Bt" 0x0C  
 "Bam", "IMA Battery Amps " 0x0D  
 "Bte", "IMA Battery Avg Temp" 0x0E  
 "Hvi", "IMA HV Insulation " 0x0F  
 "Msv", "MCM System Voltage " 0x10  
 "Spd", "Vehicle Speed Km/Mph" 0x11  
 "Soc", "IMA Battery Soc 8Bit" 0x12  
 "Mto", "IMA Motor Torque Nm " 0x13  
 "Isb", "IMA Standby Signal %" 0x14  
 "Alf", "Assist Limit Flag " 0x15  
 "Rlf", "Regen Limit Flag " 0x16  
 "Bfs", "Battery Fan Slow Flg" 0x17  
 "Bff", "Battery Fan Fast Flg" 0x18  
 "Imt", "IMA Trgt Amps 0-255A" 0x19  
 "Hvc", "HV Contactor Status " 0x1A  
 "Bpc", "Bypass Contactor St " 0x1B  
 "Iml", "IMA Lamp Stat On/Off" 0x1C  
 "Mpo", "MPI Fan OnOff Status" 0x1D  
 "Mpf", "MPI Fan FastSlow Sta" 0x1E  
 "Mdf", "MDM Fail Flag Status" 0x1F  
 "Dci", "DC-DC Inhibitor Stat" 0x20

"Igh", "Ignition Hold Relay " 0x21  
 "Igr", "Ignition Hold Return" 0x22  
 "Abs", "ABS Action Status " 0x23  
 "Scs", "SCS Line Status " 0x24  
 "Hvr", "HV Contactor Return " 0x25  
 "Bpr", "BP Contactor Return " 0x26  
 "D40", "IMADTC Data 16 Bytes" 0x27  
 "D50", "IMADTC Data 16 Bytes" 0x28  
 "D60", "IMADTC Data 08 Bytes" 0x29  
 "MCM", "MCM Version Number " 0x2A  
 "Wat", "IMA Power Watts " 0x2B  
 "Tim", "Internal Timer " 0x2C  
 "Lop", "Internal Loop Count" 0x2D  
 "Wat", "WattHr In/Out %Ratio" 0x2E  
 "XXX", "Spare DataBase Entry" 0x2F

**\* Ecm 1999-2004 UK Parameters \***

"Rpm", "Engine Speed Rpm " 0x30  
 "Spd", "Vehicle Speed Km/h " 0x31  
 "Brf", "Brake Switch " 0x32  
 "Acs", "Air Con Switch " 0x33  
 "Vtf", "Vtec Oil Switch " 0x34  
 "Stf", "Starter Switch " 0x35  
 "Clf", "Clutch Switch " 0x36  
 "Nef", "Neutral Switch " 0x37  
 "Scs", "SCS Open or Shorted " 0x38  
 "Fpf", "Main Fuel Pump Relay" 0x39  
 "Acc", "AirCon Clutch Switch" 0x3A  
 "Mil", "MIL Light On Off " 0x3B  
 "Vts", "Vtec Solenoid Status" 0x3C  
 "Rfs", "Radiator Fan Status " 0x3D  
 "Dcf", "DCDC Control Status " 0x3E  
 "Aff", "AFRatio Feedback Con" 0x3F  
 "Imo", "Immobiliser Run/Ban " 0x40  
 "Ect", "Engine Coolant Temp " 0x41  
 "Iat", "Eng Air Intake Temp " 0x42

"Map", "MAP Pressure Kpa "	0x43	"Spd", "Vehicle Speed Kmh "	0x65
"Bar", "BAR Pressure Kpa "	0x44	"Brf", "Brake Switch "	0x66
"Tps", "Throttle Position % "	0x45	"Stf", "Starter Switch "	0x67
"O1c", "1st O2 Sensor Cur ma"	0x46	"Vtf", "Vtec Oil Switch "	0x68
"Esv", "ECM System Voltage "	0x47	"Vts", "Vtec Solenoid Status"	0x69
"Sov", "Soc Voltage 0-5V "	0x48	"Acs", "Air Con Switch "	0x6A
"Eld", "Electronic Load Amps"	0x49	"Acc", "AirCon Clutch Switch"	0x6B
"Egr", "Egr Valve Feedback "	0x4A	"Imo", "Immobiliser Run/Ban "	0x6C
"Stf", "Short Term Fuel Trim"	0x4B	"Mil", "MIL Light On Off "	0x6D
"Ltf", "Long Term Fuel Trim "	0x4C	"Clf", "Clutch Switch "	0x6E
"Fin", "Fuel Injector ms "	0x4D	"Nef", "Neutral Switch "	0x6F
"Spk", "Spark Advance Degree"	0x4E	"Scs", "SCS Open or Shorted "	0x70
"Knk", "Knock Retard Degrees"	0x4F	"Fpf", "Main Fuel Pump Relay"	0x71
"Iac", "Idle Air Control Vlv"	0x50	"Dcf", "DCDC Control Status "	0x72
"Afr", "AFR Air Fuel Ratio "	0x51	"Ima", "IMA Standby "	0x73
"Evp", "Evap Purge Control "	0x52	"Stc", "Starter Control "	0x74
"Mil", "MIL Lamp Status 2 "	0x53	"Ids", "Idle Stop Control "	0x75
"Fue", "Fuel System Status "	0x54	"Rfs", "Radiator Fan Status "	0x76
"Lod", "Engine Load 0-100% "	0x55	"Ect", "Engine Coolant Temp "	0x77
"O2v", "2nd O2 Sensor Volts "	0x56	"Iat", "Eng Air Intake Temp "	0x78
"O2h", "2nd O2 Sensor Heater"	0x57	"Map", "MAP Pressure Kpa "	0x79
"Cyl", "Misfired Cylinder "	0x58	"Bar", "BAR Pressure Kpa "	0x7A
"Itq", "IMA Motor Torque Nm "	0x59	"Tps", "Throttle Position % "	0x7B
"Bbp", "Brake Boost Pressure"	0x5A	"O1c", "1st O2 Sensor Cur ma"	0x7C
"Etq", "Engine Torque "	0x5B	"Esv", "ECM System Voltage "	0x7D
"Ikw", "IMA Request +/-9.9kw"	0x5C	"Sov", "Soc Voltage 0-5V "	0x7E
"Rev", "Reversing Light "	0x5D	"Eld", "Electronic Load Amps"	0x7F
"Ima", "IMA Standby "	0x5E	"Egr", "Egr Valve Feedback "	0x80
"Stc", "Starter Control "	0x5F	"Stf", "Short Term Fuel Trim"	0x81
"Ids", "Idle Stop Control "	0x60	"Ltf", "Long Term Fuel Trim "	0x82
"ECM", "ECM Version Number "	0x61	"Fin", "Fuel Injector ms "	0x83
"Tpr", "Throttle Position R "	0x62	"Spk", "Spark Advance Degree"	0x84
"Tpv", "Throttle Position V "	0x63	"Knk", "Knock Retard Degrees"	0x85
		"Iac", "Idle Air Control Vlv"	0x86
		"Afr", "AFR Air Fuel Ratio "	0x87
		"Evp", "Evap Purge Control "	0x88
<b>* Ecm 1999-2004 US Parameters *</b>			
"Rpm", "Engine Speed Rpm "	0x64		

"Evs", "Evap Bypass Solenoid" 0x89  
 "Evc", "Evap CVS Valve Stat " 0x8A  
 "Ftp", "Fuel Tank Pressure " 0x8B  
 "Mis", "MIL Lamp Status 2 " 0x8C  
 "Fue", "Fuel System Status " 0x8D  
 "Lod", "Engine Load 0-100% " 0x8E  
 "O2v", "2nd O2 Sensor Volts " 0x8F  
 "O2h", "2nd O2 Sensor Heater" 0x90  
 "Itq", "IMA Motor Torque Nm " 0x91  
 "Bbp", "Brake Boost Pressure" 0x92  
 "Etq", "Engine Torque " 0x93  
 "Ikw", "IMA Request +/-9.9kw" 0x94  
 "Rev", "Reversing Light " 0x95  
 "ECM", "ECM Version Number " 0x96  
 "Tpr", "Throttle Position R " 0x97  
 "Tpv", "Throttle Position V " 0x98  
 "XXX", "Spare DataBase Entry" 0x99  
 "XXX", "Spare DataBase Entry" 0x9A  
 "XXX", "Spare DataBase Entry" 0x9B

**\* Cvt (Tcm) 1999-2006 Parameters \***

"Rpm", "Engine Speed Rpm " 0x9C  
 "DrR", "Drive Pulley Rpm " 0x9D  
 "DiR", "Driven Pulley Rpm " 0x9E  
 "SeR", "Secondary Shaft Rpm " 0x9F  
 "Spd", "Vehicle Speed Kmh " 0xA0  
 "SeK", "Secondary Shaft Kmh " 0xA1  
 "DrK", "Driven Pulley Kmh " 0xA2  
 "Tps", "Throttle Position % " 0xA3  
 "Map", "MAP Pressure Kpa " 0xA4  
 "Pnp", "PNP Switch Status " 0xA5  
 "Atr", "ATR Switch Status " 0xA6  
 "XXX", "Spare DataBase Entry" 0xA7  
 "Atd", "ATD Switch Status " 0xA8  
 "Atl", "ATL Switch Status " 0xA9  
 "Scs", "SCS Open or Shorted " 0xAA

"Brf", "Brake Switch " 0xAB  
 "Mod", "Mode S Switch Status" 0xAC  
 "Caa", "Cas Solenoid A Stat " 0xAD  
 "Inh", "Inhibitor Solenoid " 0xAE  
 "Cab", "Cas Solenoid B Stat " 0xAF  
 "Sin", "S Indicator Status " 0xB0  
 "Din", "D Indicator Status " 0xB1  
 "Col", "Cooling Control " 0xB2  
 "Fbl", "Feedback Learn Compl" 0xB3  
 "Lcc", "Learn Condition " 0xB4  
 "Sam", "Starter Clutch Amps " 0xB5  
 "Ect", "Engine Coolant Temp " 0xB6  
 "Iat", "Eng Air Intake Temp " 0xB7  
 "Dra", "Drive Pulley SolAmp " 0xB8  
 "Dia", "Driven Pulley SolAmp" 0xB9  
 "Rat", "CVT Drive Ratio " 0xBA  
 "XXX", "Spare DataBase Entry" 0xBB  
 "XXX", "Spare DataBase Entry" 0xBC  
 "XXX", "Spare DataBase Entry" 0xBD  
 "XXX", "Spare DataBase Entry" 0xBE  
 "XXX", "Spare DataBase Entry" 0xBF

**\* Ecm 2005-2006 US Parameters \***

"Rpm", "Engine Speed Rpm " 0xC0  
 "Spd", "Vehicle Speed Kmh " 0xC1  
 "Brf", "Brake Switch " 0xC2  
 "Stf", "Starter Switch " 0xC3  
 "Vtf", "Vtec Oil Switch " 0xC4  
 "Vts", "Vtec Solenoid Status" 0xC5  
 "Acs", "Air Con Switch " 0xC6  
 "Acc", "AirCon Clutch Switch" 0xC7  
 "Imo", "Immobiliser Run/Ban " 0xC8  
 "Mil", "MIL Light On Off " 0xC9  
 "Clf", "Clutch Switch " 0xCA  
 "Nef", "Neutral Switch " 0xCB  
 "Scs", "SCS Open or Shorted " 0xCC

"Fpf", "Main Fuel Pump Relay" 0xCD  
 "Dcf", "DCDC Control Status " 0xCE  
 "Ims", "IMA Standby " 0xCF  
 "Stc", "Starter Control " 0xD0  
 "Ids", "Idle Stop Control " 0xD1  
 "Rfs", "Radiator Fan Status " 0xD2  
 "Ect", "Engine Coolant Temp " 0xD3  
 "Iat", "Eng Air Intake Temp " 0xD4  
 "Map", "MAP Pressure Kpa " 0xD5  
 "Bar", "BAR Pressure Kpa " 0xD6  
 "Tps", "Throttle Position % " 0xD7  
 "O1c", "1st O2 Sensor Cur ma" 0xD8  
 "Esv", "ECM System Voltage " 0xD9  
 "Sov", "Soc Voltage 0-5V " 0xDA  
 "Eld", "Electronic Load Amps" 0xDB  
 "Egr", "Egr Valve Feedback " 0xDC  
 "Stf", "Short Term Fuel Trim" 0xDD  
 "Ltf", "Long Term Fuel Trim " 0xDE  
 "Fin", "Fuel Injector ms " 0xDF  
 "Spk", "Spark Advance Degree" 0xE0  
 "Knk", "Knock Retard Degrees" 0xE1  
 "Iac", "Idle Air Control Vlv" 0xE2  
 "Afr", "AFR Air Fuel Ratio " 0xE3  
 "Evp", "Evap Purge Control " 0xE4  
 "Evs", "Evap Bypass Solenoid" 0xE5  
 "Evc", "Evap CVS Valve Stat " 0xE6  
 "Ftp", "Fuel Tank Pressure " 0xE7  
 "Mis", "MIL Lamp Status 2 " 0xE8  
 "Fue", "Fuel System Status " 0xE9  
 "Lod", "Engine Load 0-100% " 0xEA  
 "O2v", "2nd O2 Sensor Volts " 0xEB  
 "O2h", "2nd O2 Sensor Heater" 0xEC  
 "Itq", "IMA Motor Torque Nm " 0xED  
 "Bbp", "Brake Boost Pressure" 0xEE  
 "Etq", "Engine Torque " 0xEF  
 "Ikw", "IMA Request +/-9.9kw" 0xF0

"Rev", "Reversing Light " 0xF1  
 "ECM", "ECM Version Number " 0xF2  
 "Tpr", "Throttle Position R " 0xF3  
 "Tpv", "Throttle Position V " 0xF4

**\*Miscellaneous Parameters \***

"Mea", "Melexis Ambient Temp" 0xF5  
 "Me1", "Melexis Object1 Temp" 0xF6  
 "Me2", "Melexis Object2 Temp" 0xF7  
 "Amb", "I2c Ambient Temp Sen" 0xF8  
 "Ahi", "Ah Count In Regen " 0xF9  
 "Aho", "Ah Count Out Assist " 0xFA  
 "Whi", "Wh Count In Regen " 0xFB  
 "Who", "Wh Count Out Assist " 0xFC  
 "Ah-", "Calc AhIn - AhOut =" 0xFD  
 "Wh-", "Calc WhIn -WhOut =" 0xFE  
 "END", "\* End Of DataBase! \*" 0xFF

**\*\* Appendix D1 \*\* DTC Lists \*\*****IMA MCM Codes.****1 (P1647) POWER COMMAND SIGNAL CIRCUIT LOW INPUT**

- Signal line short
- ECM failure

**2 (P1647) POWER COMMAND SIGNAL CIRCUIT HIGH INPUT**

- Signal line open
- ECM failure

**3 (P1647) ENGINE TORQUE SIGNAL CIRCUIT LOW INPUT**

- Signal line short
- ECM failure

**4 (P1647) ENGINE TORQUE SIGNAL CIRCUIT HIGH INPUT**

- Signal line open
- ECM failure

**5 (P1647) MODE SIGNAL CIRCUIT 1 LOW INPUT**

- Signal line short
- ECM failure

**6 (P1647) MODE SIGNAL CIRCUIT 1 HIGH INPUT**

- Signal line open
- ECM failure

**7 (P1647) MODE SIGNAL CIRCUIT 2 PROBLEM**

- Signal line open
- Signal line short
- ECM failure

**8 (P1577) HIGH VOLTAGE DETECTION SIGNAL CIRCUIT PROBLEM**

- Battery module switch open
- High Voltage harness failure
- Battery module switch failure

**10 (P1576) MOTOR DRIVE MODULE VOLTAGE SIGNAL CIRCUIT LOW INPUT**

- Signal line short
- Signal line open
- VREF line failure
- Sensor failure

**11 (P1576) MOTOR DRIVE MODULE VOLTAGE SENSOR SIGNAL CIRCUIT HIGH INPUT**

- Signal line open
- Ground line open
- Sensor failure

**12 (P1576) MOTOR DRIVE MODULE VOLTAGE PROBLEM**

- Motor drive module voltage sensor failure
- Motor control module failure

**13 (P1649) ABS OPERATION SIGNAL CIRCUIT PROBLEM**

- Signal line open
- Signal line short
- ABS control unit failure

**19 (P1581) MOTOR POWER INVERTER MODULE CURRENT SIGNAL CIRCUIT LOW INPUT**

- Sensor failure
- Supply line open
- Signal line short

**20 (P1581) MOTOR POWER INVERTER MODULE CURRENT SIGNAL CIRCUIT HIGH INPUT**

- Sensor failure
- Sensor GND line open

**21 (P1581) MOTOR POWER INVERTER MODULE CURRENT SIGNAL CIRCUIT PROBLEM**

- Sensor failure

**23 (P1586) MOTOR POWER INVERTER MODULE CURRENT/BATTERY CURRENT SIGNAL CIRCUIT PROBLEM**

- Motor power inverter module current sensor failure
- Battery current sensor failure

**24 (P1582) MOTOR CURRENT U PHASE SIGNAL CIRCUIT LOW INPUT**

- Signal line open or short
- Supply line open
- Sensor failure

**25 (P1582) MOTOR CURRENT U PHASE SIGNAL CIRCUIT HIGH INPUT**

- Sensor failure
- Ground line open

26 (P1583) MOTOR CURRENT V PHASE SIGNAL CIRCUIT LOW INPUT

- Signal line open or short
- Supply line open
- Sensor failure

27 (P1583) MOTOR CURRENT V PHASE SIGNAL CIRCUIT HIGH INPUT

- Sensor failure
- Ground line open

28 (P1584) MOTOR CURRENT W PHASE SIGNAL CIRCUIT LOW INPUT

- Signal line open or short
- Supply line open
- Sensor failure

29 (P1584) MOTOR CURRENT W PHASE SIGNAL CIRCUIT HIGH INPUT

- Sensor failure
- Ground line open

30 (P1585) MOTOR CURRENT SIGNAL CIRCUIT PROBLEM

- Motor current sensor failure
- Motor control module failure

32 (P1572) MOTOR DRIVE MODULE TEMPERATURE SIGNAL CIRCUIT LOW INPUT

- Signal line short
- Sensor failure

33 (P1572) MOTOR DRIVE MODULE TEMPERATURE SIGNAL CIRCUIT HIGH INPUT

- Signal line open
- Signal GND line open
- Sensor failure

36 (P1573) DC-DC CONVERTER TEMPERATURE SIGNAL CIRCUIT LOW INPUT

- Signal line short
- Sensor failure

37 (P1573) DC-DC CONVERTER TEMPERATURE SIGNAL CIRCUIT HIGH INPUT

- Signal line open

- Signal GND line open
- Sensor failure

38 (P1438) MOTOR DRIVE MODULE OVERHEATING SIGNAL CIRCUIT PROBLEM

- Signal line open
- Motor driver module failure

39 (P1438) MOTOR DRIVE MODULE OVERHEATING

- Motor power inverter module failure
- Motor power inverter module Fan failure
- Motor driver module failure

40 (P1439) MOTOR DRIVE MODULE SHORT CIRCUIT SENSOR PROBLEM

- Signal line short
- Motor driver module failure

41 (P1439) MOTOR DRIVE MODULE SHORT CIRCUIT

- 3 phases high voltage line short
- Signal line open
- Motor driver module failure

42 (P1565) MOTOR COMMUTATION SIGNAL PROBLEM

- Sensor failure
- Harness failure

43 (P1647) ENGINE SPEED SIGNAL CIRCUIT PROBLEM

- Signal line failure
- ECM failure

44 VEHICLE SPEED SIGNAL CIRCUIT PROBLEM

- Signal line failure

46 (P1443) HIGH VOLTAGE CONTACTOR / BYPASS CONTACTOR STAYS ACTIVATED

- High voltage contactor failure
- Bypass contactor failure

49 MOTOR CONTROL MODULE INTERNAL CIRCUIT PROBLEM

- Motor control module failure

50 (P1638) MOTOR CONTROL MODULE INTERNAL CIRCUIT PROBLEM

- Motor control module failure

## 51 MOTOR CONTROL MODULE INTERNAL CIRCUIT PROBLEM

- Motor control module failure

## 57 (P1440) IMA SYSTEM PROBLEM

- 3 phases high voltage line open
- Motor driver module failure
- Harness failure
- Motor control module failure
- Motor power inverter module failure

## 58 CHARGE/DISCHARGE BALANCE PROBLEM

- Idle control system of PGM-FI failure

## 59 (P1444) HIGH VOLTAGE SHORT CIRCUIT

- High voltage line failure
- High voltage circuit failure

## 62 (P1445) BYPASS CONTACTOR PROBLEM

- High voltage line failure
- Bypass contactor failure
- Motor control module failure

## 63 (P1448) BATTERY MODULE OVERHEATING (BATTERY MODULE FAN PROBLEM)

- Battery module fan failure
- Battery module fan control relay failure
- Battery condition monitor module failure
- Harness failure
- Blocking of battery module air duct

## 64 (P1648) BATTERY CONDITION MONITOR MODULE COMMUNICATION SIGNAL CIRCUIT PROBLEM

- BATSCI 1 line failure
- BATSCI 2 line failure
- Motor control module failure
- Battery condition monitor module failure

## 65 (P1580) BATTERY CURRENT CIRCUIT PROBLEM

- sensor failure
- Harness failure

## 66 (P1568) BATTERY MODULE INDIVIDUAL VOLTAGE INPUT PROBLEM

- Battery module failure
- Battery condition monitor module failure

## 67 (P1568) BATTERY MODULE TEMPERATURE SIGNAL CIRCUIT PROBLEM

- Battery module failure
- Battery condition monitor module failure

## 70 (P1568) BATTERY CELL TEMPERATURE SIGNAL CIRCUIT PROBLEM

- Battery module failure
- Battery condition monitor module failure

## 72 (P1449) BATTERY MODULE OVERHEATING

- Battery module failure
- Battery condition monitor module failure

## 73 (P1449) BATTERY CELL OVERHEATING

- Battery module failure
- Battery condition monitor module failure

## 74 (P1449) BATTERY MODULE INDIVIDUAL VOLTAGE INPUT DEVIATION

- Battery module failure
- Battery condition monitor module failure

## 75 (P1648) MOTOR CONTROL MODULE COMMUNICATION SIGNAL CIRCUIT PROBLEM

- Signal line failure
- Battery condition monitor module failure
- Motor control module failure

## 77 (P1447) BATTERY MODULE DETERIORATION

- Battery module failure

## 78 (P1449) BATTERY MODULE DETERIORATION

- Battery module failure

## 79 (P1635) BATTERY CONDITION MONITOR MODULE PROBLEM

- Battery condition monitor module failure

**\*\* Appendix D2 \*\* DTC Lists \*\*****ABS Codes.****11-01 RIGHT FRONT WHEEL SPEED SENSOR OPEN OR SHORT**

- Signal line open
- Signal line short
- Sensor failure

**12-01 RIGHT FRONT WHEEL SPEED SENSOR FAILURE**

- Too much gap between pulsar and sensor
- Pulsar failure
- Sensor failure

**13-01 LEFT FRONT WHEEL SPEED SENSOR OPEN OR SHORT**

- Signal line open
- Signal line short
- Sensor failure

**14-01 LEFT FRONT WHEEL SPEED SENSOR FAILURE**

- Too much gap between pulsar and sensor
- Pulsar failure
- Sensor failure

**15-01 RIGHT REAR WHEEL SPEED SENSOR OPEN OR SHORT**

- Signal line open
- Signal line short
- Sensor failure

**16-01 RIGHT REAR WHEEL SPEED SENSOR FAILURE**

- Too much gap between pulsar and sensor
- Pulsar failure
- Sensor failure

**17-01 LEFT REAR WHEEL SPEED SENSOR OPEN OR SHORT**

- Signal line open
- Signal line short
- Sensor failure

**18-01 LEFT REAR WHEEL SPEED SENSOR FAILURE**

- Too much gap between pulsar and sensor
- Pulsar failure
- Sensor failure

**21-01 RIGHT FRONT PULSAR FAILURE**

- Pulsar failure

**22-01 LEFT FRONT PULSAR FAILURE**

- Pulsar failure

**23-01 RIGHT REAR PULSAR FAILURE**

- Pulsar failure

**24-01 LEFT REAR PULSAR FAILURE**

- Pulsar failure

**31-01 RIGHT FRONT INLET SOLENOID VALVE FAILURE**

- Control line open
- Control line short
- Solenoid valve failure

**32-01 RIGHT FRONT OUTLET SOLENOID VALVE FAILURE**

- Control line open
- Control line short
- Solenoid valve failure

**33-01 LEFT FRONT INLET SOLENOID VALVE FAILURE**

- Control line open
- Control line short
- Solenoid valve failure

**34-01 LEFT FRONT OUTLET SOLENOID VALVE FAILURE**

- Control line open
- Control line short
- Solenoid valve failure

**35-01 RIGHT REAR INLET SOLENOID VALVE FAILURE**

- Control line open
- Control line short
- Solenoid valve failure

**36-01 RIGHT REAR OUTLET SOLENOID VALVE FAILURE**

- Control line open
- Control line short
- Solenoid valve failure

**37-01 LEFT REAR INLET SOLENOID VALVE FAILURE**

- Control line open
- Control line short
- Solenoid valve failure

- Lateral Acceleration Sensor
- 38-01 LEFT REAR OUTLET SOLENOID VALVE FAILURE
- Signal line open
  - Signal line short
  - Sensor failure
- 41-01 RIGHT FRONT WHEEL LOCK
- Modulator unit failure
  - Too much gap between pulsar and sensor
  - Pulsar failure
  - Sensor failure
- 42-01 LEFT FRONT WHEEL LOCK
- Modulator unit failure
  - Too much gap between pulsar and sensor
  - Pulsar failure
  - Sensor failure
- 43-01 RIGHT REAR WHEEL LOCK
- Modulator unit failure
  - Too much gap between pulsar and sensor
  - Pulsar failure
  - Sensor failure
- 44-01 LEFT REAR WHEEL LOCK
- Modulator unit failure
  - Too much gap between pulsar and sensor
  - Pulsar failure
  - Sensor failure
- 51-01 ABS PUMP MOTOR FAILURE
- ABS pump motor failure
  - Ground line open
  - Control line open
- 52-01 ABS PUMP MOTOR RELAY OPEN CIRCUIT
- Control line open
  - Control line short
  - Motor relay failure
- 53-01 ABS PUMP MOTOR RELAY SHORT CIRCUIT
- Motor relay failure
  - Control line short
  - Control line open
  - ABS pump motor failure
- 54-01 FAIL-SAFE RELAY FAILURE
- 61-01 BATTERY VOLTAGE FAILURE
- Battery failure
  - AC generator failure
- 62-01 BATTERY VOLTAGE HIGH
- Battery failure
  - AC generator failure
- 71-01 WRONG SIZE OF TIRE
- Wrong size of tire
- 81-01 ABS CONTROL UNIT FAILURE
- ABS CONTROL UNIT FAILURE

**\*\* Appendix D3 \*\* DTC Lists \*\*****EPS Codes.**

11 Difference of high voltage and lower voltage on the torque sensor

- Open in harness
- Short to ground in harness
- Open in torque sensor
- Circuit failure in ECU

**TEST CONDITION**

- Continuously

**FAIL-SAFE ACTION**

- Assist stops

**CONDITIONS FOR CANCELLING FAIL-SAFE ACTION**

- None

**CONDITIONS FOR CANCELLING DTCs**

- DTC clear

**INDICATOR STATUS**

- EPS Indicator ON

**SYSTEM CHECK CYCLES**

- 1 [ms] cycle

15 TORQUE SENSOR OPEN OR SHORT

- Short in harness
- Short to ground in harness
- Short between power line and signal line in harness
- Open in harness
- Circuit failure in ECU

**TEST CONDITION**

- Continuously

**FAIL-SAFE ACTION**

- Assist stops

**CONDITIONS FOR CANCELLING FAIL-SAFE ACTION**

- None

**CONDITIONS FOR CANCELLING DTCs**

- DTC clear

**INDICATOR STATUS**

- EPS Indicator ON

**SYSTEM CHECK CYCLES**

- 1 [ms] cycle

16 A problem with average of voltage for torque sensor VT3 and VT6

- Open or Short in harness
- Increased contact resistance in waterproof connector for torque sensor

- Increased contact resistance in ECU connector
- Circuit failure in ECU

**TEST CONDITION**

- Continuously

**FAIL-SAFE ACTION**

- Assist stops

**CONDITIONS FOR CANCELLING FAIL-SAFE ACTION**

- None

**CONDITIONS FOR CANCELLING DTCs**

- DTC clear

**INDICATOR STATUS**

- EPS Indicator ON

**SYSTEM CHECK CYCLES**

- 1 [ms] cycle

17 A problem with the voltage for torque sensor 12V power source Vcc1

- Short to 12V power line in torque sensor
- Short to ground in harness
- Open in harness

**TEST CONDITION**

- Continuously

**FAIL-SAFE ACTION**

- Assist stops

**CONDITIONS FOR CANCELLING FAIL-SAFE ACTION**

- None

**CONDITIONS FOR CANCELLING DTCs**

- DTC clear

**INDICATOR STATUS**

- EPS Indicator ON

**SYSTEM CHECK CYCLES**

- 1 [ms] cycle

18 A problem with the voltage for torque sensor 5V power source Vcc2

- Short to 5V power line in torque sensor
- Short to ground in harness
- Open in harness

**TEST CONDITION**

- Continuously

**FAIL-SAFE ACTION**

- Assist stops

**CONDITIONS FOR CANCELLING FAIL-SAFE ACTION**

- None

**CONDITIONS FOR CANCELLING DTCs**

- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- 1 [ms] cycle

## 22 Excessive change of the vehicle speed sensor signal

- Open between ECU and Meter vehicle speed signal line
- Meter vehicle speed unit failure
- Vehicle speed sensor failure
- Circuit failure in ECU

TEST CONDITION

- Initially +right before IG OFF(0)

FAIL-SAFE ACTION

- VGS control stops after DTC detected

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS indicator keeps ON or blinks

SYSTEM CHECK CYCLES

- BG100[ms]

## 23 A problem with the engine speed signal circuit

- ECU failure
- Open between ECU and Engine speed signal line
- Circuit failure in ECU

TEST CONDITION

- Continuously (10 [ms] cycle)

FAIL-SAFE ACTION

- EPS assists above 10[km/h]

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS indicator keeps ON or blinks

SYSTEM CHECK CYCLES

- 10 [ms] cycle

NOTE

- The diagnosis shouldn't be done with the high voltage (If charge the battery at 16 [V] or more, ACG-L signal shows HIGH, it's a wrong detection.)

## 37 A problem with the motor voltage

- Open in ground between ECU and Motor
- Circuit failure in ECU

TEST CONDITION

- Initially Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Initially 1 [ms] cycle

## 41 A problem with the motor voltage

- Short in motor line
- Short in harness between EPS ECU and motor relay
- Short in harness between motor and motor relay
- Short to power line in motor line

TEST CONDITION

- Continuously

FAIL-SAFE ACTION

- Fail-safe relay contact voltage comes over 5.5[V] and motor is out of operation

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- Assist stops
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Continuously

## 42 A problem with the motor driven current

- Short in motor line
- Short in harness between EPS ECU and motor relay
- Short in harness between motor and motor relay

- Short to power line in motor line

TEST CONDITION

- Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Continuously

43 A problem with the motor driven current

- Short to power line in motor line
- Short in motor line
- Short to power line between EPS ECU and motor line
- Short in harness between motor and motor relay

TEST CONDITION

- Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Continuously

45 A problem with the motor driven current

- Open / Short in motor line
- Open / Short in harness between EPS ECU and motor relay
- Open / Short in harness between motor and motor relay
- Open / Short to power line in motor line

TEST CONDITION

- Continuously

FAIL-SAFE ACTION

- Assist stops

- The motor runs down gradually

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Continuously

46 A problem with the motor relay (relay stuck ON or stuck OFF)

- Motor relay failure
- Short in motor line
- Short between motor line and power line
- Short in motor relay
- Short in power line for motor relay
- Short to ground in motor relay

TEST CONDITION

- Initial+Continuously when Fail-safe relay ON

FAIL-SAFE ACTION

- Assist stops or EPS is out of operation

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Initially + Continuously when Fail-safe relay ON

47 A problem with the motor relay

- Continuity for motor relay failure
- Short in motor line
- Short between motor line and power line
- Short in motor relay
- Short in power line for motor relay
- Short to ground in motor relay

TEST CONDITION

- Initially

FAIL-SAFE ACTION

- EPS is out of operation

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Initially

50 A problem with the CPU in the EPS control unit

- Main CPU failure

TEST CONDITION

- Initially + Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Initially + Continuously

62 A problem with the CPU in the EPS control unit

- Main CPU failure

TEST CONDITION

- Initially + Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Initially + Continuously

64 Fail-safe relay contact failure

- Main CPU failure

TEST CONDITION

- Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None (When the battery voltage comes back to normal )

CONDITIONS FOR CANCELLING DTCs

- Return in the normal condition or IG OFF
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Continuously

66 A problem with the motor driven voltage

- Main CPU failure

TEST CONDITION

- Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- When the normal condition returns

CONDITIONS FOR CANCELLING DTCs

- Normal condition returns or IG OFF(0)
- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON (II)

SYSTEM CHECK CYCLES

- Continuously

67 A problem with the torque sensor I/F circuit

- Main CPU failure

TEST CONDITION

- Continuously

FAIL-SAFE ACTION

- Assist stops

CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

CONDITIONS FOR CANCELLING DTCs

- Clear DTCs with the HDS

INDICATOR STATUS

- EPS Indicator ON

SYSTEM CHECK CYCLES

- Continuously

68 A problem with the interlock circuit (torque)

- Main CPU failure

TEST CONDITION

- Continuously

#### FAIL-SAFE ACTION

- Assist stops or EPS keeps out of action

#### CONDITIONS FOR CANCELLING FAIL-SAFE ACTION

- None

#### CONDITIONS FOR CANCELLING DTCs

- IG OFF(0)
- Clear DTCs with the HDS

#### INDICATOR STATUS

- EPS Indicator ON

#### SYSTEM CHECK CYCLES

- Continuously

**\*\* Appendix D4 \*\* DTC Lists \*\*****SRS Codes.****1-1 OPEN IN DRIVER'S AIRBAG INFLATOR**

- Open in driver's airbag assembly
- Open in cable reel
- Open in harness

**1-2 INCREASED RESISTANCE IN DRIVER'S AIRBAG INFLATOR**

- Increased resistance in driver's airbag assembly
- Increased resistance in cable reel
- Increased resistance in harness

**1-3 SHORT TO ANOTHER WIRE IN DRIVER'S AIRBAG INFLATOR**

- Short to another wire in driver's airbag assembly
- Short to another wire in cable reel
- Short to another wire in harness

**1-4 SHORT TO POWER IN DRIVER'S AIRBAG INFLATOR**

- Short to power in driver's airbag assembly
- Short to power in cable reel
- Short to power in harness

**1-5 SHORT TO GROUND IN DRIVER'S AIRBAG INFLATOR**

- Short to ground in driver's airbag assembly
- Short to ground in cable reel
- Short to ground in harness

**2-1 OPEN IN PASSENGER'S AIRBAG INFLATOR**

- Open in passenger's airbag assembly
- Open in harness

**2-2 INCREASED RESISTANCE IN PASSENGER'S AIRBAG INFLATOR**

- Increased resistance in passenger's airbag assembly
- Increased resistance in harness

**2-3 SHORT TO ANOTHER WIRE IN PASSENGER'S AIRBAG INFLATOR**

- Short to another wire in passenger's airbag assembly
- Short to another wire in harness

**2-4 SHORT TO POWER IN PASSENGER'S AIRBAG****INFLATOR**

- Short to power in passenger's airbag assembly
- Short to power in harness

**2-5 SHORT TO GROUND IN PASSENGER'S AIRBAG INFLATOR**

- Short to ground in passenger's airbag assembly
- Short to ground in harness

**3-1 OPEN IN DRIVER'S SEAT BELT TENSIONER**

- Open in driver's seat belt tensioner assembly / dummy resistor
- Open in harness

**3-2 INCREASED RESISTANCE IN DRIVER'S SEAT BELT TENSIONER**

- Increased resistance in driver's seat belt tensioner assembly / dummy resistor
- Increased resistance in harness

**3-3 SHORT TO ANOTHER WIRE IN DRIVER'S SEAT BELT TENSIONER**

- Short to another wire in driver's seat belt tensioner assembly / dummy resistor
- Short to another wire in harness

**3-4 SHORT TO POWER IN DRIVER'S SEAT BELT TENSIONER**

- Short to power in driver's seat belt tensioner assembly / dummy resistor
- Short to power in harness

**3-5 SHORT TO GROUND IN DRIVER'S SEAT BELT TENSIONER**

- Short to ground in driver's seat belt tensioner assembly dummy resistor
- Short to ground in harness

**4-1 OPEN IN PASSENGER'S SEAT BELT TENSIONER**

- Open in passenger's seat belt tensioner assembly / dummy resistor
- Open in harness

**4-2 INCREASED RESISTANCE IN PASSENGER'S SEAT BELT TENSIONER**

- Increased resistance in passenger's seat belt tensioner assembly / dummy resistor
- Increased resistance in harness

#### 4-3 SHORT TO ANOTHER WIRE IN PASSENGER'S SEAT BELT TENSIONER

- Short to another wire in passenger's seat belt tensioner assembly / dummy resistor
- Short to another wire in harness

#### 4-4 SHORT TO POWER IN PASSENGER'S SEAT BELT TENSIONER

- Short to power in passenger's seat belt tensioner assembly / dummy resistor
- Short to power in harness

#### 4-5 SHORT TO GROUND IN PASSENGER'S SEAT BELT TENSIONER

- Short to ground in passenger's seat belt tensioner assembly / dummy resistor
- Short to ground in harness

#### 5-1 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 5-2 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 5-3 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 5-4 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 6-1 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 6-2 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 6-3 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 6-4 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 7-1 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 7-2 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 7-3 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 8-1 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 8-2 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 8-3 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 8-4 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 8-5 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 8-6 SRS UNIT FAILURE

- Failure of circuit in SRS unit

#### 9-1 FAULTY SRS INDICATOR LIGHT CIRCUIT

- Short in gauge assembly
- Short in harness
- Open in supply line (VA line) (ND unit)

#### 9-2 FAULTY SRS POWER SUPPLY SYSTEM

- Blown fuse (VB line)
- Open in harness (VB line)
- Short in harness (VB line)

#### 10-1 AIRBAGS AND SEATBELT TENSIONERS DEPLOYED

- SYSTEM HAS BEEN ACTIVATED IN CRASH AND NEEDS REPLACEMENT.