frame data in the lower square “2” has been stored, the freeze frame data “2” will be updated by the freeze frame data “1”.)

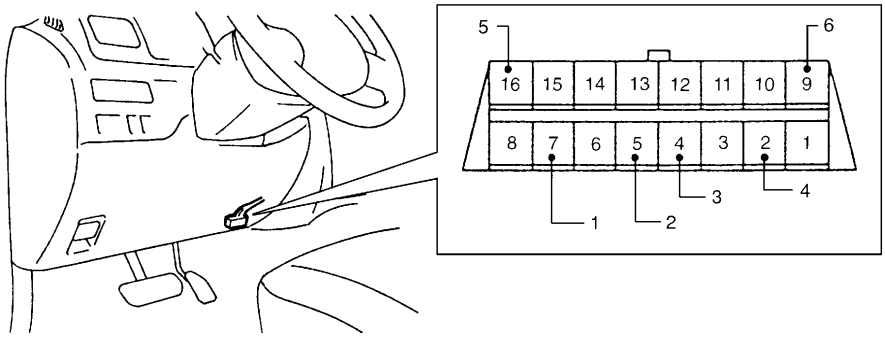
| PRIORITY | FREEZE FRAME DATA IN FRAME 1 |
|---|---|
| 1 | Freeze frame data at initial detection of malfunction among misfire detected (P0300 – P0306), fuel system too lean (P0171, P0174) and fuel system too rich (P0172, P0175) |
| 2 | Freeze frame data when a malfunction other than those in “1” above is detected. |

In the 2nd through the 4th frames, the freeze frame data of each malfunction is stored in the order as the malfunction is detected. These data are not updated.
Shown in the table below are examples of how freeze frame data are stored when two or more malfunctions are detected.

| Frame / Malfunction detection order | | FRAME 1 FREEZE FRAME DATA to be updated | FRAME 2 1st FREEZE FRAME DATA | FRAME 3 2nd FREEZE FRAME DATA | FRAME 4 3rd FREEZE FRAME DATA |
|---|---|---|---|---|---|
| | No malfunction | No freeze frame data | No freeze frame data | No freeze frame data | No freeze frame data |
| 1 | P0112 (IAT) detected | Data at P0112 detection | Data at P0112 detection | No freeze frame data | No freeze frame data |
| 2 | P0171 (Fuel system) detected | Data at P0171 detection | Data at P0112 detection | Data at P0171 detection | No freeze frame data |
| 3 | P0300 (Misfire) detected | Data at P0171 detection | Data at P0112 detection | Data at P0171 detection | Data at P0300 detection |
| 4 | P0301 (Misfire) detected | Data at P0171 detection | Data at P0112 detection | Data at P0171 detection | Data at P0300 detection |

### Freeze Frame Data Clearance
The freeze frame data is cleared at the same time as clearance of DTC.

### DLC (Data Link Connector)
DLC is in compliance with SAE J1962 in its installation position, the shape of connector and pin assignment.
OBD-II serial data line (K line of ISO 9141) is used for SUZUKI scan tool or OBD-II generic scan tool to communicate with ECM (PCM), Air bag SDM and ABS control module.

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| | |
|---|---|
| 1. OBD-II serial data line (K line of ISO 9141) | 4. Bus “+” line of SAE J1850 |
| 2. ECM (PCM) ground | 5. B+ |
| 3. Body ground | 6. SUZUKI serial data line |

## OBD System Description - Catalyst Monitor

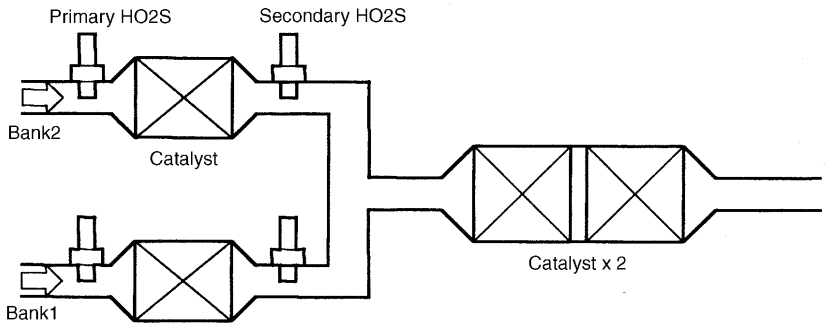
S2SQ011121008, 03(01)

### System Description / Monitoring Procedure
Exhaust oxygen concentration at the upper part and the lower part of WU-TWC is detected from HO2S-1 and HO2S-2 respectively and accordingly ECM (PCM) controls the closed loop which then controls the fuel injection volume. While the above controls is going on and if WU-TWC is in good condition, the output voltage of HO2S-2 is maintained at specified level. As WU-TWC becomes deteriorated, even when the above control is going on, the exhaust gas which has passed WU-TWC then passes HO2S-2 at the exhaust oxygen concentration similar to that of the upper part of WU-TWC without being oxygenated or converted. Thus, waveforms of HO2S-1 and HO2S-2 output voltage become alike, ECM (PCM) judges deterioration of WU-TWC by comparing waveforms of HO2S-1 and HO2S-2.

## Catalyst System Layout

The system has 4 oxygen sensors located upstream and downstream of the catalysts. The layout of catalysts and oxygen sensors is described below.

### Catalyst and HO2S Layout




I3JA01112001

## DTC Description / Detecting Condition / Confirmation Procedure

**P0420, P0430**

Refer to "DTC P0420 / P0430: Catalyst System (Bank-1 / -2) Efficiency below Threshold: H25 Engine".

## Catalyst Monitor

### Operation

| | |
|---|---|
| DTCs | P0420 (for Bank 1), P0430 (for Bank 2) |
| Monitor execution | Once per driving cycle |
| Monitoring Duration | Min 36 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine coolant temp. | 58 (136) °C(°F) | |
| Intake air temp. | –14 (7) °C(°F) | 70 (158) °C (°F) |
| Vehicle speed | 70 km/h | 130 km/h |
| Engine load | $1A | $91 |
| Engine speed | 1750 rpm | 3500 rpm |
| Sum of injection time | 0 ms | |
| MAF | 11.6 g/s | 36.7 g/s |
| Fuel enrichment | 99.22% | 106.3% |
| Time from idle switch on to off | 0.96 s | |
| Time from engine start | 160 s | |
| Time from switch on to off / off to on (ACS, EL, PSS, D/N) | 5 s | |
| Engine load change | | $0A / 50 msec |
| Misfire monitor | | 12 counts / 200 rev. |
| Lambda feedback factor | 0% | 200% |
| Estimated catalyst temp. | 500 (932) °C (°F) | 700 (1292) °C (°F) |
| Fuel system status | Closed loop mode | |
| Primary / Secondary HO2S | Normal | |
| Primary / Secondary HO2S heater | Normal | |

### Typical malfunction thresholds

| |
|---|
| Coefficient of catalyst deterioration > 0.5 |

## MODE $06 Data

| Self diagnostic test item | Test value | | Description | Scaling |
|---|---|---|---|---|
| | TID | CID | | |
| Three-way catalyst Function (P430) Bank 1 | $42 | $00 | Calculated catalyst deterioration | /256/256 |
| Three-way catalyst Function (P430) Bank 2 | $43 | $00 | | /256/256 |

## OBD System Description - Misfire Monitor

S2SQ011121009, 03(01)

### System Description / Monitoring Procedure

ECM (PCM) measures the angle speed of the crankshaft based on the pulse signal from the CKP sensor and CMP sensor for each cylinder. If it detects a large change in the angle speed of the crankshaft, it concludes occurrence of a misfire. When the number of misfire is counted by the ECM (PCM) beyond the DTC detecting condition, it determines the cylinder where the misfire occurred and outputs it as DTC.

### DTC Description / Detecting Condition / Confirmation Procedure

**P0300, P0301, P0302, P0303, P0304, P0305, P0306**

Refer to "DTC P0300 / P0301 / P0302 / P0303 / P0304 / P0305 / P0306: Misfire Detected: H25 Engine".

### Misfire Monitor

#### Operation

| | |
|---|---|
| DTCs | P0300, P0301, P0302, P0303, P0304, P0305, P0306 |
| Monitor execution | Continuous |
| Monitoring Duration | 200 rev. / 1000 rev. |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **> 5 s from engine start** | | |
| Engine coolant temp. | –10 (14) °C (°F) | |
| Engine speed | 600 rpm | 6800 rpm |
| Calculated load value | No load | |
| TP change | | 0.2 V (4.4°) / 0.05 s |
| Engine speed change | | 250 rpm / 0.05 s |
| Vehicle speed change | | 20 km/h / s |
| Engine load data change | | $15 / 0.05 s |
| Time from fuel shut off | 0.8 s | |
| Time from TP change | 0.8 s | |
| Time from engine speed change | 0.8 s | |
| Time from vehicle speed change | 1 s | |
| Time from engine load change | 1 s | |
| Time from idle switch change | 0.8 s | |
| Time from switch on to off / off to on (ACS, PPS, EL, D/N) | 1 s | |
| Fuel system status | Not shut off | |
| **0 – 5 s from engine start** | | |
| Engine coolant temp. | –10 (14) °C (°F) | |
| Intake air temp. | –14 (7) °C (°F) | |
| Engine speed | 600 rpm | 6800 rpm |
| Calculated load value | No load | |
| TP change | | 0.2 V (4.4°) / 0.05 s |
| Vehicle speed change | | 20 km/h / s |
| Barometric pressure | 71.86 kPa | |
| Fuel system status | Not shut off | |

#### Typical malfunction thresholds

| |
|---|
| Catalyst damage: 18 – 144 counts (according to engine load value and engine speed) |
| FTP emission threshold > 2% |

## OBD System Description - EVAP Control System Monitor

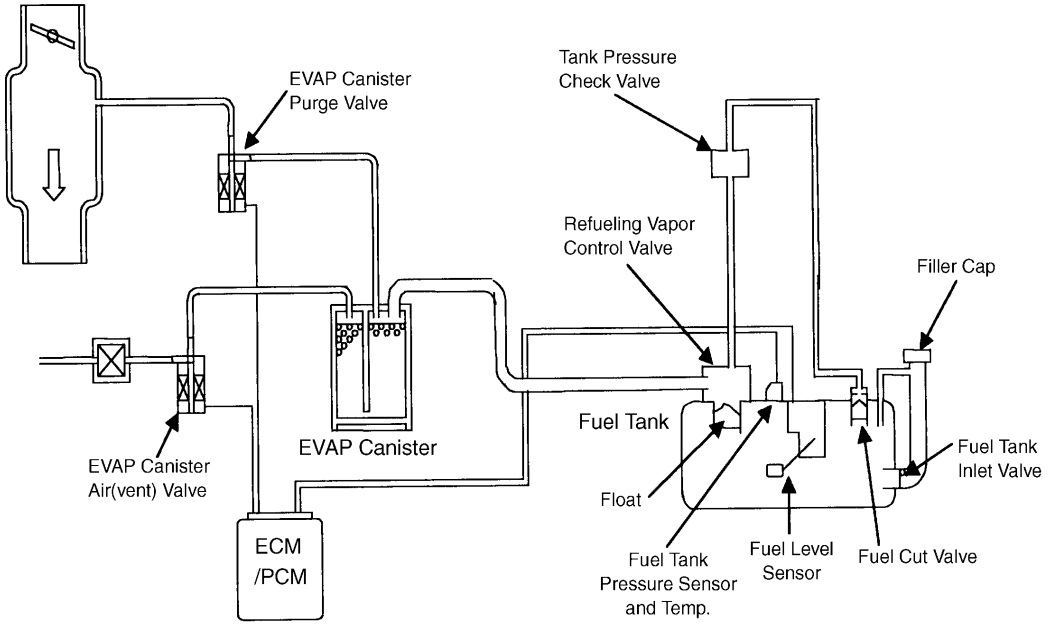
S2SQ011121010, 03(01)

### System Description / Monitoring Procedure

To monitor the EVAP control system, a fuel tank pressure sensor and an EVAP canister air (vent) valve are added to the system.

The monitoring system measures pressure change of closed EVAP system circuit under the depressurized condition. The system also measures pressure change of closed circuit to compensate evaporative pressure with the normal range pressure, if necessary.

### EVAP System Monitoring System (ORVR)

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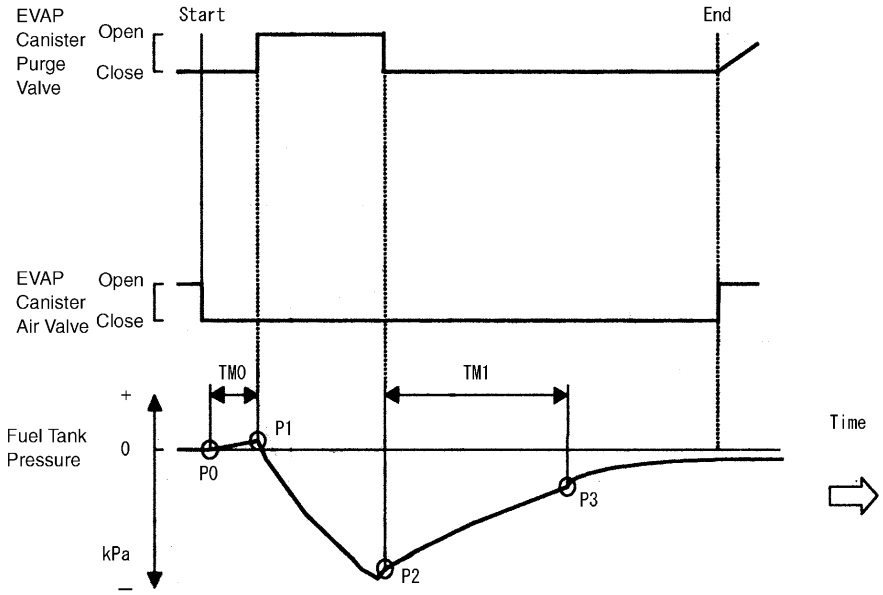
### EVAP System Monitoring Procedure




(P1 - P0) / TM0: Parameter for Compensation of Vapor Pressure
(P3 - P2) / TM1: Malfunction Parameter for 0.040 inch Leak

I2SQ01112001

## DTC Description / Detecting Condition / Confirmation Procedure

**P0442, P0455**

Refer to "DTC P0442 / P0455: Evaporative Emission Control System Leak Detected (Small Leak) / (Gross Leak): H25 Engine".

## EVAP Control System Monitor

### Operation

| | |
|---|---|
| DTCs | P0442 (small leak), P0455 (gross leak) |
| Monitor execution | Once per driving cycle |
| Sensors / components OK | CMP, ECT, VSS, MAF, TP, IAT, BARO, MAP, Fuel level sensor, Fuel tank pressure sensor, Primary HO2S |
| Monitoring Duration | Min. 30 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine coolant temp. | –10 (14) °C (°F) | 110 (230) °C (°F) |
| Engine coolant temp. at engine start | 70 (158) °C (°F) | |
| Intake air temp. | –10 (14) °C (°F) | 62 (144) °C (°F) |
| Intake air temp. change | | 3 (5.4) °C (°F) |
| TP | 0 V (0°) | 1.0 V (22°) |
| TP change | | 0.5 V (11°) / 0.05 s |
| Engine load | $00 | $96 |
| Vehicle speed | 10 km/h | 130 km/h |
| Vehicle speed change | –10 km/h | 5 km/h |
| MAP | 13.3 kPa | |
| Barometric pressure | 74.5 kPa | |
| Barometric pressure change | | 1.11 kPa |
| Battery voltage | 10.96 V | |
| Engine speed | 600 rpm | 4000 rpm |
| Fuel level | 0 L | 56.35 L |
| Time from engine start | 767 s | |
| Lambda feed back factor (P0442) | 80% | 200% |
| Lambda feed back factor (P0445) | 60% | 200% |
| Air flow accumulation | 7792 g | |
| Canister purge accumulation | 25.11 L | |
| EVAP gas estimation | | 20% |
| Fuel slosh | | 5.25 L |
| Large leak (P0442) | Normal condition detected | |
| Fuel system status | Closed loop mode | |

### Typical malfunction thresholds

| |
|---|
| **P0442** |
| Estimated leak area from tank pressure change during depressurized condition > 0.636 $mm^2$ |
| **P0455** |
| Tank pressure < 0.50 kPa |

### MODE $06 Data

| Test item (related DTC) | Test value | | Description | Scaling |
|---|---|---|---|---|
| | TID | CID | | |
| EVAP Control System (P0442) | $44 | $20 | Calculated cross section of leak | *0.000047936 $mm^2$ |
| | $44 | $30 | | *0.000047936 $mm^2$ |
| | $44 | $60 | | *0.000047936 $mm^2$ |
| Gross leak (P0455) | $45 | $00 | Tank pressure | (N-$8000) *0.001912 mmHg |
| | $45 | $81 | | (N-$8000) *0.001912 mmHg |
| | $45 | $82 | | (N-$8000) *0.001912 mmHg |

## OBD System Description - Fuel System Monitor

S2SQ011121011, 03(01)

### System Description / Monitoring Procedure

As fuel system components age or otherwise change over the life of the vehicle, the adaptive fuel strategy learns deviations from stoichiometry while running in closed loop fuel. These learned corrections are stored in keep alive memory as long term fuel trim corrections. They may be stored continue to change beyond normal limits or if a malfunction occurs, the long term fuel trim values will reach a calibratable rich or lean limit where the adaptive fuel strategy is no longer allowed to compensate for additional fuel system changes. Long term fuel trim corrections at their limits, in conjunction with a calibratable deviation in short term fuel trim, indicate a rich or lean fuel system malfunction.

### DTC Description / Detecting Condition / Confirmation Procedure

**P0171, P0172**

Refer to “DTC P0171 / P0172: Fuel System Too Lean / Rich (Bank-1): H25 Engine”.

**P0174, P0175**

Refer to “DTC P0174 / P0175: Fuel System Too Lean / Rich (Bank-2): H25 Engine”.

## Fuel System Monitor

### Operation

| | |
|---|---|
| DTCs | P0171 (for bank 1) / P0174 (for bank 2)<br>P0172 (for bank 1) / P0175 (for bank 2) |
| Monitor execution | Continuous |
| Sensors / components OK | **Phase1:** MAP, CKP, IAT, CMP sensor, Primary HO2S heater<br>**Phase2:** BARO, CMP sensor, Primary HO2S heater |
| Monitoring Duration | 20 s (phase 1) / 10 s (phase 2) |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **Phase 1 (Fuel trim value)** | | |
| Engine coolant temp. | 30 (80) °C (°F) | |
| Intake air temp. | –10 (14) °C (°F) | 60 (140) °C (°F) |
| Engine load | $10 | |
| Misfire monitor | | 14 count / 200 rev. |
| Barometric pressure | 71.86 kPa | |
| Engine speed | 600 rpm | |
| Fuel tank pressure | –8.35 kPa | 8.35 kPa |
| MAF sensor range check | Normal | |
| ECT sensor range check | Normal | |
| Back-up power | Normal | |
| BARO sensor range check | Normal | |
| Primary HO2S voltage | Normal | |
| Fuel tank pressure sensor range check | Normal | |
| TP sensor range check | Normal | |
| EGR system | Normal | |
| EVAP system (leak) | Normal | |
| EVAP system monitor (leak) | Not activated | |
| **Phase 2 (Lambda feedback status)** | | |
| Engine coolant temp. | 75 (167) °C (°F) | |
| Intake air temp. | –10 (14) °C (°F) | 80 (176) °C (°F) |
| Engine load | $28 | |
| Barometric pressure | 79.99 kPa | |
| Engine speed | 2000 rpm | |
| Time from engine start | 120 s | |
| CTP (Idle) switch | Off | |
| ECT sensor range check | Normal | |
| IAT sensor range check | Normal | |
| Primary HO2S voltage | Normal | |
| TP sensor range check | Normal | |

### Typical malfunction thresholds

| |
|---|
| **Phase 1 (Fuel trim value)** |
| **P0171, P0174** |
| Long + short term fuel trim > 33% (Canister purge control is not activated.) |
| Long + short term fuel trim > 50% (Canister purge control is not activated.) |
| **P0172, P0175** |
| Long + short term fuel trim < –28.9% (Canister purge control is not activated.) |
| Long + short term fuel trim < –69.5% (Canister purge control is activated.) |
| **Phase 2 (Lambda feedback status)** |
| **P0171, P0174** |
| Lambda feedback factor is sticking at lean limit. |
| **P0172, P0175** |
| Lambda feedback factor is sticking at rich limit. |

## OBD System Description - Oxygen Sensor Monitor

S2SQ011121012, 03(01)

## System Description / Monitoring Procedure

### Primary HO2S

For a primary HO2S, the system monitors maximum and minimum voltage, lean-to-rich and rich-to-lean response rates, and switching cycles during monitoring conditions once per driving cycle. The sensor is also monitored for activity continuously.

### Secondary HO2S

A secondary HO2S is used for catalyst monitoring only. During monitoring conditions, the system measures maximum and minimum output voltages and compares the voltage with malfunction criteria once per driving cycle.

## DTC Description / Detecting Condition / Confirmation Procedure

**P0131**

Refer to "DTC P0131: HO2S (Bank-1 Sensor-1) Circuit Low Voltage: H25 Engine".

**P0132, P1132**

Refer to "DTC P0132 / P1132: HO2S (Bank-1 Sensor-1) Circuit High Voltage / Shorted to HO2S Heater Power Supply: H25 Engine".

**P0133**

Refer to "DTC P0133: HO2S (Bank-1 Sensor-1) Circuit Slow Response: H25 Engine".

**P0134**

Refer to "DTC P0134: HO2S (Bank-1 Sensor-1) No Activity Detected: H25 Engine".

**P0137, P0138**

Refer to "DTC P0137 / P0138: HO2S (Bank-1 Sensor-2) Circuit Low / High Voltage: H25 Engine".

**P0151**

Refer to "DTC P0151: HO2S (Bank-2 Sensor-1) Circuit Low Voltage: H25 Engine".

**P0152, P1152**

Refer to "DTC P0152 / P1152: HO2S (Bank-2 Sensor-1) Circuit High Voltage / Shorted to HO2S Heater Power Supply: H25 Engine".

**P0153**

Refer to "DTC P0153: HO2S (Bank-2 Sensor-1) Circuit Slow Response: H25 Engine".

**P0154**

Refer to "DTC P0154: HO2S (Bank-2 Sensor-1) No Activity Detected: H25 Engine".

**P0157, P0158**

Refer to "DTC P0157 / P0158: HO2S (Bank-2 Sensor-2) Circuit Low / High Voltage: H25 Engine".

## Primary HO2S Monitor

### Operation

| | |
|---|---|
| DTCs | P0133 (for bank 1), P0153 (for bank 2) |
| Monitor execution | Once per driving cycle |
| Monitoring Duration | 20 s |

| | |
|---|---|
| DTCs | P0134 (for bank 1), P0154 (for bank 2) |
| Monitor execution | Continuous |
| Monitoring Duration | 20 s (Activity check) / 0.96 – 15 s (according to ECT at engine starts) (Bias voltage check) |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0133, P0153** | | |
| Engine coolant temp. | 40 (104) °C (°F) | |
| Intake air temp. | –14 (7) °C (°F) | 70 (158) °C (°F) |
| Engine speed | 1300 rpm | 4000 rpm |
| Engine load | $1B | $78 |
| Engine load change | | $07 / 0.05 s |
| Vehicle speed | 30 km/ h | 120 km/ h |
| TP change | | 0.32 V (7.04°) / 0.05 s |
| Time after closed loop | 3 s | |
| Time from switch on to off/ off to on (ACS, EL, PSS, D/N) | 5 s | |
| HO2S input voltage high peak | 0.5 V | |
| HO2S input voltage low peak | | 0.335 V |
| HO2S rich cycle | 0.06 s | 3 s |

| Parameter | Minimum | Maximum |
|---|---|---|
| HO2S lean cycle | 0.06 s | 3 s |
| Misfire monitor | | 12 counts / 200 rev. |
| Lambda feed back factor | 39.8% | 119.5% |
| Fuel enrichment | 99.22% | 106.3% |
| Estimated catalyst Temp. | 200 (392) °C (°F) | 640 (1184) °C (°F) |
| Fuel system status | Closed loop mode | |
| Idle switch | Off | |
| Primary HO2S heater | Normal condition or not monitored | |
| **P0134, P0154** | | |
| **Phase 1 (HO2S activity check)** | | |
| Engine Coolant Temp. | 70 (158) °C (°F) | |
| Engine load | $32 | |
| Vehicle speed | 40 km/h | |
| Time after engine start | 120 s | |
| Primary HO2S input voltage | 250 mV | 600 mV |
| Idle switch | Off | |
| Primary HO2S Heater | Normal | |
| MAF sensor range check | Normal | |
| ECT sensor range check | Normal | |
| **Phase 2 (Bias voltage check)** | | |
| Engine Coolant Temp. at engine start | | 40 (104) °C (°F) |
| Engine speed | 600 rpm | |
| Last ECT of previous Driving | 75 (167) °C (°F) | |
| Time after engine start | | 2 – 20 s (according to ECT at engine starts) |
| Time of OFF idle after engine start | | 0.24 s |

### Typical malfunction thresholds

| |
|---|
| **P0133, P0153** |
| Switch cycle average > 5.04 s<br>Response rate > 1.703 |
| **P0134, P0154** |
| **Phase 1:** HO2S input voltage < 0.5 V |
| **Phase 2:** HO2S input voltage < 0.2 V or > 0.45 V |

## Primary HO2S Circuit Monitor

### Operation

| | |
|---|---|
| DTCs | P0131 (for bank 1), P0151 (for bank 2), |
| Monitor execution | Once per driving cycle |
| Monitoring Duration | 50 s |

| | |
|---|---|
| DTCs | P0132 (for bank 1), P0152 (for bank 2), |
| Monitor execution | Once per driving cycle |
| Monitoring Duration | 50 s |

| | |
|---|---|
| DTCs | P1132 (for bank 1), P1152 (for bank 2) |
| Monitor execution | Continuous |
| Monitoring Duration | 20 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0131, P0151** | | |
| Engine coolant temp. | 70 (158) °C (°F) | |
| Engine speed | 1000 rpm | 4000 rpm |
| Engine speed change | | 250 rpm / 0.05 s |
| Engine load | $1B | $78 |
| Engine load change | | $0A / 0.05 s |
| Vehicle speed | | 130 km/h |

| Parameter | Minimum | Maximum |
|---|---|---|
| TP change | | 0.2 V (4.4°) / 0.05 s |
| Time after closed loop | 10 s | |
| Lambda feed back factor | 87.5% | 112.5% |
| Fuel enrichment | 94.53% | 106.25% |
| Fuel system status | Closed loop mode | |
| Primary HO2S heater | Normal | |
| Primary HO2S slow response | Normal | |
| **P0132, P0152** | | |
| Engine coolant temp. | 70 (158) °C (°F) | |
| Engine speed | 1000 rpm | 4000 rpm |
| Engine speed change | | 250 rpm / 0.05 s |
| Engine load | $1B | $78 |
| Engine load change | | $0A / 0.05 s |
| Vehicle speed | | 130 km/h |
| TP change | | 0.2 V (4.4°) / 0.05 s |
| Time after closed loop | 10 s | |
| Lambda feed back factor | 87.5% | 112.5% |
| Fuel enrichment | 94.53% | 106.25% |
| Fuel system status | Closed loop mode | |
| Primary HO2S heater | Normal | |
| Primary HO2S slow response | Normal | |
| **P1132, P1152** | | |
| Time from engine start | 248 s | |
| Engine speed | 600 rpm | |

### Typical malfunction thresholds

| |
|---|
| **P0131, P0151** |
| Min. voltage > 0.4 V |
| **P0134, P0154** |
| Max. voltage > 1.2 V or < 0.6 V |
| **P1132, P1152** |
| HO2S input voltage > 2.0 V |

## Secondary HO2S Circuit Monitor

### Operation

| | |
|---|---|
| DTCs | P0137 (for bank 1), P0157 (for bank 2) |
| Monitor execution | Once per driving cycle |
| Monitoring Duration | 4 s |

| | |
|---|---|
| DTCs | P0138 (for bank 1), P0158 (for bank 2) |
| Monitor execution | Once per driving cycle (Maximum voltage),<br>Continuous (Shorted to HO2S power supply) |
| Monitoring Duration | 20 s (Shorted to HO2S power supply) |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0137, P0157** | | |
| Engine Coolant Temp. | 70 (158) °C (°F) | |
| Engine speed | | 4000 rpm |
| Time from fuel shut off | 160 ms | |
| Post HO2S Heater operation time | 78 s | |
| Estimated catalyst temp. | 352 (665) °C (°F) | |
| Fuel system status | Fuel shut off | |
| Primary HO2S slow response | Normal | |
| Primary HO2S heater | Normal | |
| Secondary HO2S heater | Normal | |
| **P0138, P0158** | | |
| **Phase 1 (Maximum voltage)** | | |

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine speed | 600 rpm | |
| Catalyst system check | Normal | |
| **Phase 2 (Shorted to HO2S heater power supply)** | | |
| Engine speed | 600 rpm | |
| Time from engine start | 248 s | |

### Typical malfunction thresholds

| |
|---|
| **P0137, P0157** |
| HO2S input voltage > 0.50 V |
| **P0138, P0158** |
| **Phase 1:** HO2S input voltage < 0.35 V |
| **Phase 2:** HO2S input voltage > 2.0 V |

### MODE $06 Data

| Self diagnostic test item | Test value | | Description | Scaling |
|---|---|---|---|---|
| | TID | CID | | |
| O2S 1 circuit low volt (P0131) | $47 | $00 | Min voltage of O2 | *10/256 mV |
| O2S 1 circuit high volt (P0132 / P1132) | $48 | $80 | Max voltage of O2 | *10/256 mV |
| | $48 | $01 | Max voltage of O2 | *10/256 mV |
| | $48 | $02 | Sensor voltage | *10/256 mV |
| Slow response (P0133) | $49 | $00 | Sensor deterioration | /16384 |
| | $49 | $01 | Period of feed back | *40/256*2 msec |
| No activity detect (P0134) | $4A | $00 | Sensor voltage | *10/256 mV |
| | $4A | $81 | Sensor voltage | *10/256 mV |
| O2S 2 circuit volt (P0137 / P0138) | $4C | $80 | Sensor voltage | *10/256 mV |
| | $4C | $01 | Sensor voltage | *10/256 mV |
| | $4C | $02 | Minimum voltage | *10/256 mV |
| O2S 1 circuit low volt (P0151) | $53 | $00 | Minimum volt | *10/256 mV |
| O2S 1 circuit high volt (P0152) | $54 | $80 | Maximum volt | *10/256 mV |
| | $54 | $01 | Maximum volt | *10/256 mV |
| | $54 | $02 | Sensor volt | *10/256 mV |
| Slow response (P0153) | $55 | $00 | Sensor Deterioration | /16384 |
| | $55 | $01 | Period of feed back | *40/256/2 msec |
| No activity detect (P0154) | $56 | $00 | Sensor Volt | *10/256 mV |
| | $56 | $81 | Sensor Volt | *10/256 mV |
| O2S 2 circuit volt (P0156 / P0158) | $58 | $80 | Sensor Volt | *10/256 mV |
| | $58 | $01 | Sensor Volt | *10/256 mV |
| | $58 | $02 | Minimum Volt | *10/256 mV |
| High voltage (P0157) | $59 | $00 | Voltage | *10/256 mV |

## OBD System Description - HO2S Heater Monitor

S2SQ011121013, 03(01)

### System Description / Monitoring Procedure

For both primary and secondary HO2S heaters, the system monitors proper current and loaded voltage. The HO2S heaters are monitored once per driving cycle during monitoring conditions.

### DTC Description / Detecting Condition / Confirmation Procedure

**P0135**

Refer to “DTC P0135: HO2S (Bank-1 Sensor-1) Heater Circuit Malfunction: H25 Engine”.

**P0141**

Refer to “DTC P0141: HO2S (Bank-1 Sensor-2) Heater Circuit Malfunction: H25 Engine”.

**P0155**

Refer to “DTC P0155: HO2S (Bank-2 Sensor-1) Heater Circuit Malfunction: H25 Engine”.

**P0161**

Refer to “DTC P0161: HO2S (Bank-2 Sensor-2) Heater Circuit Malfunction: H25 Engine”.

## Primary HO2S Heater Monitor

### Operation

| | |
|---|---|
| DTCs | P0135 (for bank 1), P0155 (for bank 2) |
| Monitor execution | Continuous |
| Monitoring Duration | 0.2 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **Phase 1** | | |
| Battery voltage | 9 V | 16 V |
| Engine speed | 600 rpm | |
| Heater control | On | |
| **Phase 2** | | |
| Engine speed | 600 rpm | |
| Heater control | On | |

### Typical malfunction thresholds

| |
|---|
| **Phase 1:** Heater current < 0.16 – 0.28 A (according to battery voltage (V)) for 0.2 sec |
| **Phase 2:** Heater current > 10 A |

## Secondary HO2S Heater Monitor

### Operation

| | |
|---|---|
| DTCs | P0141 (for bank 1), P0161 (for bank 2) |
| Monitor execution | Continuous |
| Monitoring Duration | 2 s / 0.08 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **Phase 1** | | |
| Battery voltage | 9 V | 16 V |
| Engine speed | 600 rpm | |
| Heater control | On | |
| **Phase 2** | | |
| Engine speed | 600 rpm | |
| Heater control | On | |

### Typical malfunction thresholds

| |
|---|
| **Phase 1:** Heater current < 0.16 – 0.28 A (according to battery voltage (V)) for 0.2 sec |
| **Phase 2:** Heater current > 10 A for 0.2 sec |

## MODE $06 Data

| Self diagnostic test item (related DTC) | Test value | | Description | Scaling |
|---|---|---|---|---|
| | TID | CID | | |
| O2S B1S1 heater malfunction (P0135) | $4E | $00 | Current of heater | *40/256 |
| | $4E | $81 | Current of heater | *40/256 |
| O2S B2S1 heater malfunction (P0155) | $5A | $00 | Current of heater | *40/256 |
| | $5A | $81 | Current of heater | *40/256 |
| O2S B1S2 heater circuit malfunction (P0141) | $4F | $00 | Current of heater | *40/256 |
| | $4F | $81 | Current of heater | *40/256 |
| O2S B2S2 heater circuit malfunction (P0161) | $5B | $00 | Current of heater | *40/256 |
| | $5B | $81 | Current of heater | *40/256 |

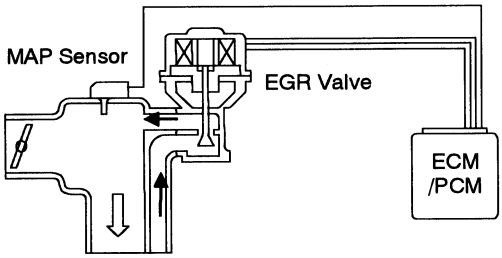
# OBD System Description - EGR System Monitor

S2SQ011121014, 03(01)

## System Description / Monitoring Procedure

To monitor electric controlled EGR system, the system measures pressure change caused by switching of the EGR valve during deceleration condition and also measures the voltage of EGR valve stepping motor electrical circuit continuously.

## EGR System Monitoring System




I3JA01112004

### DTC Description / Detecting Condition / Confirmation Procedure

**P0401, P0402**

Refer to "DTC P0401 / P0402: Exhaust Gas Recirculation (EGR) Flow Insufficient Detected / Excessive Detected: H25 Engine".

**P0403**

Refer to "DTC P0403: Exhaust Gas Recirculation (EGR) Control Circuit: H25 Engine".

### EGR System Monitor

#### Operation

| | |
|---|---|
| DTCs | P0401 (insufficient flow), P0402 (excessive flow) |
| Monitor execution | Once per driving cycle |
| Sensors components OK | CMP, MAP, VSS, IAT |
| Monitoring Duration | 5 s |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine coolant temp. | 70 (158) °C (°F) | |
| Intake air temp. | –10 (14) °C (°F) | 70 (158) °C (°F) |
| Engine load | $22 | $78 |
| Engine load change | | $07 / 0.05 s |
| MAP | 0 kPa | 104 kPa |
| Barometric pressure | 71.86 kPa | |
| Battery voltage | 10 V | |
| Engine speed | 1600 rpm | 3500 rpm |
| Engine speed change | | 200 rpm |
| IAC valve step change | | 12 step |
| Canister purge valve duty change | | 30% |
| Vehicle speed | 50 km/h | 130 km/h |
| MAF | 440 g/min | |
| Time from switch on to off / off to on (ACS, EL, PSS, D/N) | 5 s | |
| TP change | | 0.04 V (0.88 o) |
| MAF sensor range check | Normal | |
| TP sensor range check | Normal | |
| ECT sensor range check | Normal | |
| BARO sensor range check | Normal | |
| EGR valve circuit check | Normal | |

#### Typical malfunction thresholds

| |
|---|
| **P0401:** MAP difference between EGR on & off < 0.667 kPa |
| **P0402:** MAP difference between EGR on & off > 14.7 kPa |

### EGR System Circuit Monitor

#### Operation

| | |
|---|---|
| DTCs | P0403 |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| EGR valve control | Operated | |

### Typical malfunction thresholds

| |
|---|
| Monitor signal > 127 count |

### MODE $06 Data

| Self diagnostic test item (related DTC) | Test value | | Description | Scaling |
|---|---|---|---|---|
| | TID | CID | | |
| EGR (P0402 / P0401) | $51 | $80 | Differential Pressure | *5/32/256 mmHg |
| | $51 | $01 | Differential Pressure | *5/32/256 mmHg |

## OBD System Description - Thermostat Monitor

S2SQ011121015, 03(01)

### System Description / Monitoring Procedure

The engine block temperature is estimated to modelize accumulated combustion heat value since engine start (based on mass intake air flow) and radiation heat value (radiation from engine, radiation when fuel shut-off, etc.). The heat exchange value between engine and engine coolant is estimated, and the engine coolant temperature is estimated. When estimated temperature reaches the specified temperature and the measured temperature is lower than criteria, the malfunction is detected.

### DTC Description / Detecting Condition / Confirmation Procedure

**P0128**

Refer to "DTC P0128: Coolant Thermostat (Coolant Temp. below Thermostat Regulating Temp.): H25 Engine".

### Thermostat Monitor

### Operation

| | |
|---|---|
| DTCs | P0128 |
| Monitor execution | Once per driving cycle |
| Sensors / components OK | CMP, ECT |
| Monitoring Duration | 900 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine coolant temp. at engine start | –10 (14) °C (°F) | 45 (113) °C (°F) |
| Time for engine start | 500 – 875 s (according to ECT) | |
| Sum of injection time | 14.0 – 55.0 s (according to ECT) | 134.2 s |
| MAF sensor range check | Normal | |
| IAT sensor range check | Normal | |

### Typical malfunction thresholds

| |
|---|
| Engine coolant temp. < 75 (167) °C (°F) |

## OBD System Description - Comprehensive Component (Engine Input) Monitor

S2SQ011121016, 03(01)

### Monitoring Procedure

Input signals of MAF (P0102 / P0103), MAP (P0107 / P0108), IAT (P0112 / P0113), ECT (P0117 / P0118), TP (P0122 / P0123), Fuel tank pressure sensor (P0452 / P0453), Fuel level sensor (P0463) and Barometric pressure sensor (P1450) are checked for open, short of circuit by monitoring input voltage.

### DTC Description / Detecting Condition / Confirmation Procedure

**P0101**

Refer to "DTC P0101: Mass Air Flow (MAF) Sensor Performance Problem: H25 Engine".

**P0102**

Refer to "DTC P0102: Mass Air Flow (MAF) Sensor Circuit Low Voltage: H25 Engine".

**P0103**

Refer to "DTC P0103: Mass Air Flow (MAF) Sensor Circuit High Voltage: H25 Engine".

**P0107, P0108**

Refer to “DTC P0107 / P0108: Manifold Absolute Pressure Sensor Circuit Low / High Input: H25 Engine”.
**P0111**
Refer to “DTC P0111: Intake Air Temperature (IAT) Sensor Circuit Range / Performance Problem: H25 Engine”.
**P0112**
Refer to “DTC P0112: Intake Air Temperature (IAT) Sensor Circuit Low Input: H25 Engine”.
**P0113**
Refer to “DTC P0113: Intake Air Temperature (IAT) Sensor Circuit High Input: H25 Engine”.
**P0116**
Refer to “DTC P0116: Engine Coolant Temperature (ECT) Sensor Performance: H25 Engine”.
**P0117**
Refer to “DTC P0117: Engine Coolant Temperature (ECT) Sensor Circuit Low Input: H25 Engine”.
**P0118**
Refer to “DTC P0118: Engine Coolant Temperature (ECT) Sensor Circuit High Input: H25 Engine”.
**P0121**
Refer to “DTC P0121: Throttle Position (TP) Sensor Circuit Performance Problem: H25 Engine”.
**P0122**
Refer to “DTC P0122: Throttle Position (TP) Sensor Circuit Low Input: H25 Engine”.
**P0123**
Refer to “DTC P0123: Throttle Position (TP) Sensor Circuit High Input: H25 Engine”.
**P0125**
Refer to “DTC P0125: Insufficient Coolant Temperature for Closed Loop Fuel Control: H25 Engine”.
**P0335**
Refer to “DTC P0335: Crankshaft Position (CKP) Sensor Circuit Malfunction: H25 Engine”.
**P0340**
Refer to “DTC P0340: Camshaft Position (CMP) Sensor Circuit Malfunction: H25 Engine”.
**P0451**
Refer to “DTC P0451: Evaporative Emission Control System Pressure Sensor Performance: H25 Engine”.
**P0452, P0453**
Refer to “DTC P0452 / P0453: Evaporative Emission Control System Pressure Sensor Low / High Input: H25 Engine”.
**P0461**
Refer to “DTC P0461: Fuel Level Sensor Circuit Performance: H25 Engine”.
**P0463**
Refer to “DTC P0463: Fuel Level Sensor Circuit High Input: H25 Engine”.
**P0500**
Refer to “DTC P0500: Vehicle Speed Sensor (VSS) Malfunction: H25 Engine”.
**P1450, P1451**
Refer to “DTC P1450 / P1451: Barometric Pressure Sensor Circuit Malfunction / Performance Problem: H25 Engine”.
**P1500**
Refer to “DTC P1500: Engine Start Signal Circuit Malfunction: H25 Engine”.
**P1510**
Refer to “DTC P1510: ECM (PCM) Back-Up Power Supply Malfunction: H25 Engine”.

## Sensor Circuit Monitor

### Operation

| | |
|---|---|
| DTCs | P0102 / P0103, P0107 / P0108, P0112 / P0113, P0117 / P0118, P0122 / P0123, P0452 / P0453, P0463, P1450 |
| Monitor execution | Continuous |
| Monitoring Duration | 0.96 s (P0102 / P0103, P0122 / P0123)<br>4.96 s (P0107 / P0108, P0112 / P0113, P1408)<br>5 s (P0452 / P0453)<br>5.12 s (P0117 / P0118)<br>10.2 s (P0463)<br>19 s (P1450) |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0112 / P0113 (IAT sensor), P0117 / P0118 (ECT sensor), P0122 / P0123 (TP sensor), P1450 (BARO sensor)** | | |
| None | | |
| **P0102 / P0103 (MAF sensor)** | | |

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine speed | 600 rpm | 2000 rpm |
| **P0107/ P0108 (MAP sensor)** | | |
| Sum of injection time | 5.2 s | |
| Engine coolant temp. | 45 (113) °C (°F) | |
| Intake air temp. | –10 (14) °C (°F) | |
| Engine load (P0107) | $50 | |
| Engine load (P0108) | | $32 |
| Canister purge valve control (P0108) | | 5.1% |
| MAF sensor range check | Normal | |
| ECT sensor range check | Normal | |
| **P0452 / P0453 (Fuel tank pressure sensor)** | | |
| Battery voltage | 10.96 V | |
| **P0463 (Fuel level sensor)** | | |
| Engine speed | 600 rpm | |

### Typical malfunction thresholds

| |
|---|
| **P0102:** Sensor voltage < 0.3 V |
| **P0103:** Sensor voltage > 5.0 V |
| **P0107:** Sensor voltage < 1.0 V |
| **P0108:** Sensor voltage > 2.7 V |
| **P0112:** Sensor voltage < 0.16 V |
| **P0113:** Sensor voltage > 5.0 V |
| **P0117:** Sensor voltage < 0.16 V |
| **P0118:** Sensor voltage > 5.0 V |
| **P0122:** Sensor voltage < 0.1 V |
| **P0123:** Sensor voltage > 4.8 V |
| **P0452:** Voltage < 0.1 V |
| **P0453:** Voltage > 5.0 V |
| **P0463:** Sensor voltage > 9.8 V |
| **P1450:** Voltage < 0.1 V (low voltage) or Voltage > 5.1 V (high voltage) |

## MAF Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0101 |
| Monitor execution | Continuous |
| Sensors / components OK | MAP, CKP |
| Monitoring Duration | 3.04 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Intake air temp. | –14 (7) °C (°F) | 70 (158) °C (°F) |
| Barometric pressure | 71.86 kPa | |
| Engine speed | 2800 rpm | 4500 rpm |
| Manifold absolute pressure | 67.99 kPa | 98.66 kPa |
| MAF sensor range check | Normal | |
| BARO sensor range check | Normal | |

### Typical malfunction thresholds

| |
|---|
| Measured MAF / Calculated MAF < 0.13 |
| Measured MAF / Calculated MAF > 1.83 |

## IAT Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0111 |
| Monitor execution | Once per driving cycle |
| Sensors / components OK | ECT |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| ECT at engine start | –10 (14) °C (°F) | 30 (86) °C (°F) |
| Engine coolant temp. | 70 (158) °C (°F) | |
| Engine speed | 600 rpm | |
| Sum of injection time | 76.8 s | |
| Time from engine start | 742 s | |
| Vehicle speed | 0 km/h | |
| MAF sensor range check | Normal condition | |
| IAT sensor range check | Normal condition | |
| Idle switch (CTP switch) | On | |

### Typical malfunction thresholds

| |
|---|
| IAT < –10 (14) °C (°F) or IAT > 70 (158) °C (°F)<br>IAT change < 1 (1.8) °C (°F) |

## ECT Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0116 / P0125 |
| Monitor execution | Once per driving cycle |
| Monitoring Duration | 1040 sec (P0116 Phase 1), 900 s (P0116 Phase 2) |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0116 (Phase 1)** | | |
| IAT change | 1 (1.8) °C (°F) | |
| Time from engine start | 1040 – 3000 s (according to ECT at engine starts) | |
| Sum of injection time | 100 – 134 s (according to ECT at engine starts) | |
| ECT | 30 (86) °C (°F) | |
| ECT sensor range check | Normal | |
| MAF sensor range check | Normal | |
| IAT sensor range check | Normal | |
| CMP sensor | Normal | |
| **P0116 (Phase 2)** | | |
| IAT change | 1 (1.8) °C (°F) | |
| Time from engine start | 900 – 3000 s (according to ECT at engine starts) | |
| Sum of injection time | 90 – 134 s (according to ECT at engine starts) | |
| ECT | 70 (158) °C (°F) | |
| ECT sensor range check | Normal | |
| MAF sensor range check | Normal | |
| IAT sensor range check | Normal | |
| CMP sensor | Normal | |
| **P0125** | | |
| Time from engine start | 29.8 – 450 s (according to ECT at engine starts) | |
| Sum of injection time | 0.717 – 27.6 s (according to ECT at engine starts) | |
| ECT sensor range check | Normal | |
| MAF sensor range check | Normal | |
| CMP sensor | Normal | |

### Typical malfunction thresholds

| |
|---|
| **P0116** |
| **Phase 1:** ECT < 50 – 70 (122 – 158) °C (°F) (according to ECT at engine starts) |
| **Phase 2:** ECT change < 1(1.8) °C (°F) |
| **P0125** |
| ECT sensor voltage > 2.4 V (< 31 (87.8) °C (°F)) |

## TP Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0121 |
| Monitor execution | Continuous |
| Sensors / components OK | CMP |
| Monitoring Duration | 3.04 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **Phase 1** | | |
| Engine coolant temp. | 75 (167) °C (°F) | |
| Engine speed change | 2000 rpm | |
| Engine load | $48 | |
| ECT sensor range check | Normal | |
| MAF sensor range check | Normal | |
| BARO sensor range check | Normal | |
| TP sensor range check | Normal | |
| **Phase2** | | |
| Engine coolant temp. | 75 (167) °C (°F) | |
| Engine speed change | | 3200 rpm |
| Engine load | | $28 |
| ECT sensor range check | Normal | |
| MAF sensor range check | Normal | |
| BARO sensor range check | Normal | |
| TP sensor range check | Normal | |

### Typical malfunction thresholds

| |
|---|
| **Phase 1:** TP voltage = 0.1 – 0.6 V |
| **Phase 2:** TP voltage = 3.0 – 4.8 V |

## Fuel Tank Pressure Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0451 |
| Monitor execution | Continuous |
| Monitoring Duration | 5 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Battery voltage | 10.96 v | |
| Canister purge valve duty | 10.16% | |
| Fuel tank pressure sensor range check | Normal | |

### Typical malfunction thresholds

| |
|---|
| Fuel tank pressure < –3.5 kPa or > 6.6 kPa |

## Fuel Level Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0461 |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Fuel level sensor | 0 V | 10.2 V |
| Time from engine start | 1.92 s | |
| Battery voltage | 10.96 V | 16.0 V |
| Sum of injection | 2308 s | |

### Typical malfunction thresholds

| |
|---|
| Fuel level change < 7.0 L |

## VSS Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0500 |
| Monitor execution | Continuous |
| Monitoring Duration | 4 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine speed | | 4000 rpm |
| Fuel system status | Fuel shut off mode | |

### Typical malfunction thresholds

| |
|---|
| Sensor signal < 2 km/h |

## Barometric Pressure Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P1451 |
| Monitor execution | Continuous |
| Sensors / components OK | CMP, IAC system |
| Monitoring Duration | 19 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Canister purge valve control | | 5.1% |
| Engine speed | 650 rpm | 800 rpm |
| Engine coolant temp. | 75 (167) °C (°F) | |
| Vehicle speed | 0 km/h (0 mph) | |
| Intake air temp. | –14 (7) °C (°F) | 70 (158) °C (°F) |
| MAP | 20 kPa | 40 kPa |
| ACS, EL, PSS switch | Off | |
| CTP (idle) switch | On | |
| MAF sensor range check | Normal | |
| MAP sensor range check | Normal | |
| TP sensor range check | Normal | |

### Typical malfunction thresholds

| |
|---|
| Pressure difference from calculated barometric pressure > 0 kPa or 170 kPa |

## CKP Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0335 |
| Monitor execution | Continuous |
| Sensors / components OK | CMP |
| Monitoring Duration | 2.96 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine speed | 600 rpm | |

### Typical malfunction thresholds

| |
|---|
| Sensor signal: No signal |

### CMP Sensor Rationality Monitor

#### Operation

| | |
|---|---|
| DTCs | P0340 |
| Monitor execution | Continuous (phase 1) |
| Monitoring Duration | 5.04 s (phase 1) / 8 rev. (phase 2) |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **Phase 1: Cylinder sensor signal (REF)** | | |
| Battery voltage | 8 V | |
| Cranking (starter) switch | On | |
| **Phase 2: Cam angle signal (POS)** | | |
| Engine speed | 75 rpm | |
| Cylinder signal | 1 pulse | |

#### Typical malfunction thresholds

| |
|---|
| **Phase 1:** Cylinder signal: No signal |
| **Phase 2:** Cam angle signal: < 10 or > 250 during 2 cylinder signals |

### Starter Signal Circuit Rationality Monitor

#### Operation

| | |
|---|---|
| DTCs | P1500 |
| Monitor execution | Continuous |
| Monitoring duration | 20 s (phase 1) / 180 s (phase 2) |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **Phase 1** | | |
| Vehicle speed | 0 km/h | |
| Engine speed | 600 r/min. | |
| VSP sensor | Normal | |
| CMP sensor signal | Cylinder signal is detected | |
| **Phase 2** | | |
| Engine speed | 600 r/min. | |

#### Typical malfunction thresholds

| |
|---|
| **Phase 1:** Start signal: Cnotinuous OFF from ignition switch ON |
| **Phase 2:** Start signal: Continuous ON |

### Back-up Power Supply Circuit Monitor

#### Operation

| | |
|---|---|
| DTCs | P1510 |
| Monitor execution | Continuous |
| Monitoring duration | 4 s |

#### Enable condition

| Parameter | Minimum | Maximum |
|---|---|---|
| Battery voltage | 7.9 V | 17 V |
| Engine speed | 600 r/min. | |

#### Typical malfunction thresholds

| |
|---|
| ECU power voltage < 3.48 V or > 7 V |

## OBD System Description - Comprehensive Component Monitor (Engine Output)

S2SQ011121017, 03(01)

### DTC Description / Detecting Condition / Confirmation Procedure

**P0444, P0496**

Refer to “DTC P0444 / P0496: Evaporative Emission Control System Purge Control Valve Circuit Open / EVAP System Flow during Non-Purge: H25 Engine”.

**P0445**

Refer to “DTC P0445: Evaporative Emission Control System Purge Control Valve Circuit Shorted: H25 Engine”.

**P0447**

Refer to “DTC P0447: Evaporative Emission Control System Vent Control Circuit Open: H25 Engine”.

**P0448**

Refer to “DTC P0448: Evaporative Emission Control System Vent Control Circuit Shorted: H25 Engine”.

**P0452**

Refer to “DTC P0452 / P0453: Evaporative Emission Control System Pressure Sensor Low / High Input: H25 Engine”.

**P0505, P0506, P0507**

Refer to “DTC P0505 / P0506 / P0507: Idle Control System / RPM Lower than Expected / RPM Higher than Expected: H25 Engine”.

### Canister Purge Valve Circuit Monitor

#### Operation

| | |
|---|---|
| DTCs | P0444 / P0445 |
| Monitoring Duration | 240 counts |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine speed | 600 rpm | 4000 rpm |
| Battery voltage | 10.96 V | |
| Canister purge valve duty (P0444) | | 48% |
| Canister purge valve duty (P0445) | 50% | |

#### Typical malfunction thresholds

| |
|---|
| **P0444** |
| Monitor signal: open |
| **P0445** |
| Monitor signal: short |

### Canister Purge Valve Monitor

#### Operation

| | |
|---|---|
| DTCs | P0496 |
| Monitoring Duration | 30 s |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| EVAP control system monitor | Activated | |

#### Typical malfunction thresholds

| |
|---|
| Fuel tank pressure change < 0 kPa |

### Canister Vent Valve Circuit Monitor

#### Operation

| | |
|---|---|
| DTCs | P0447 / P0448 |
| Monitor execution | Continuous |
| Monitoring Duration | 0.96 s |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine speed | 600 rpm | |
| Battery voltage | 10.96 V | |

#### Typical malfunction thresholds

| |
|---|
| **P0447** |

| |
|---|
| Monitor signal: open |
| **P0448** |
| Monitor signal: short |

## IAC System Monitor

### Monitoring procedure

The Idle Air Control (IAC) solenoid functionally checked by monitoring the closed loop idle speed correction required to maintain the desired idle rpm. If the proper idle rpm cannot be maintained and the system has a high rpm (+200) or low rpm error (–100) greater than the malfunction threshold, an IAC malfunction is indicated.

### Operation

| | |
|---|---|
| DTCs | P0505 |
| Monitor execution | Continuous |
| Sensors OK | Phase 1: MAF, VSS, IAT |
| Monitoring Duration | 2.55 s (Phase 1), 20.4 s (Phase 2) |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **Phase 1** | | |
| Engine coolant temp. | 75 (167) °C (°F) | |
| Engine speed | 2000 rpm | 4000 rpm |
| Battery voltage | 10.96 V | |
| Intake air temp. | –14 (7) °C (°F) | 70 (158) °C (°F) |
| Barometric pressure | 71.86 kPa | |
| Canister purge valve duty | | 10% |
| CTP (idle) switch | On | |
| EVAP control system | Normal | |
| ECT sensor range check | Normal | |
| IAC circuit | Normal | |
| IAC monitor from target engine speed | Normal | |
| Fuel system | Normal | |
| TP sensor range check | Normal | |
| **Phase 2** | | |
| Engine speed | | 4000 rpm |
| Battery voltage | 6.0 V | |

### Typical malfunction thresholds

| | |
|---|---|
| **Phase 1:** | Measured MAF > (F1 + F2)<br>F1 (Measured MAF (g/min)): 903 – 2968 (according to IAC target position (step))<br>F2 (Measured MAF (g/min)): 38.8 – 491 (according to IAC target position (step)) |
| **Phase 2:** | Monitor signal: Open or short |

## IAC Actuator Circuit Monitor

### Operation

| | |
|---|---|
| DTCs | P0506 / P0507 |
| Monitor execution | Continuous |
| Sensors OK | IAT, VSS, MAF |
| Monitoring Duration | 10 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine coolant temp. | 75 (167) °C (°F) | |
| Engine speed | 600 rpm | |
| Battery voltage | 10.96 V | |
| Vehicle speed | | 2 km/h |
| Intake air temp. | –14 (7) °C (°F) | 70 (158) °C (°F) |
| Barometric pressure | 71.86 kPa | |
| Canister purge valve duty | | 0% |
| Misfire monitor | | 12 counts / 200 rev. |

| Parameter | Minimum | Maximum |
|---|---|---|
| Target engine speed | 600 rpm | 1000 rpm |
| TP change | | 0.04 V (0.88°) |
| CTP (idle) switch | On | |
| ACS, EL, PSS, STA switch | Off | |
| IAC system status | Idle with closed loop | |
| EVAP control system | Normal | |
| ECT sensor range check | Normal | |
| IAC circuit | Normal | |
| IAC flow | Normal | |
| BARO sensor range check | Normal | |
| Fuel system | Normal | |
| TP sensor range check | Normal | |

### Typical malfunction thresholds

| | |
|---|---|
| **P0506:** | Difference from target engine speed < –100 rpm at IAC step > 115 |
| **P0507:** | Difference from target engine speed > +200 rpm at IAC step < 5 |

### MODE $06 Data

| Self diagnostic test item (related DTC) | Test value | | Description | Scaling |
|---|---|---|---|---|
| | TID | CID | | |
| EVAP purge valve (P0496) | $5C | $80 | Tank Pressure | 0.001912 mmHg |

## OBD System Description - Comprehensive Component Monitor (AT Input)

S2SQ011121018, 03(01)

### DTC Description / Detecting Condition / Confirmation Procedure

**P0705, P0707**

Refer to “DTC P0705 / P0707: Transmission Range Sensor Circuit Malfunction (PRNDL Input) / Transmission Range Sensor Circuit Low Input (for Vehicle with ORVR System): ”.

Refer to “DTC P0705: Transmission Range Sensor (Switch) Circuit Malfunction (for Vehicle without ORVR System): ”.

**P0717**

Refer to “DTC P0717: Input / Turbine Speed Sensor Circuit No Signal (for Vehicle with ORVR System): ”.

**P0722**

Refer to “DTC P0722: Output Speed Sensor Circuit No Signal (for Vehicle with ORVR System): ”.

**P1740**

Refer to “DTC P1740: Cruise Control Signal Circuit (for Vehicle with ORVR System): ”.

**P1875**

Refer to “DTC P1875: “4WD LOW” Switch Circuit Malfunction (If Equipped): ”.

### Transmission Range Switch (Sensor) Circuit Monitor

#### Monitoring procedure

Input signals of Transmission range switch (Shift position switch) (P0707) is checked for open, short of circuit by monitoring input voltage.

### Operation

| | |
|---|---|
| DTCs | P0707 |
| Monitor execution | Continuous |
| Monitoring Duration | 25 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Vehicle speed | 60 km/h | |

### Typical malfunction thresholds

| |
|---|
| Input signal: No signal |

### Transmission Range Switch (Sensor) Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0705 |

| | |
|---|---|
| Monitor execution | Continuous |
| Monitoring Duration | 10 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| None | | |

### Typical malfunction thresholds

| |
|---|
| Input signal: Multiple signals are inputted |

## Input Shaft Speed Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0717 |
| Monitor execution | Continuous |
| Monitoring Duration | 1 s (1st), 2 s (2nd, 3rd) |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Vehicle speed (output shaft speed sensor) | 10 km/h (1st) — 30 km/h (3rd) | |

### Typical malfunction thresholds

| |
|---|
| Input signal: 63 rpm |

## Output Shaft Speed Sensor Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P0722 |
| Monitor execution | Continuous |
| Monitoring Duration | 5 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Engine speed | 3000 rpm | |

### Typical malfunction thresholds

| |
|---|
| Input signal: No signal |

## Cruise Control Signal Circuit Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P1740 |
| Monitor execution | Continuous |
| Monitoring duration | 5 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Vehicle speed | | 10 km/h |

### Typical malfunction thresholds

| |
|---|
| Input signal: Low |

## 4WD Low Switch Rationality Monitor

### Operation

| | |
|---|---|
| DTCs | P1875 |
| Monitor execution | Continuous |
| Monitoring duration | 20 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Vehicle speed | 5 km/h | |
| TP | 5% | |

### Typical malfunction thresholds

| |
|---|
| Vehicle speed difference > 10 km/h |

## OBD System Description - Comprehensive Component Monitor (AT Output)

S2SQ011121019, 03(01)

### DTC Description / Detecting Condition / Confirmation Procedure

**P0743**

Refer to “DTC P0743: TCC (Lock-Up) Solenoid Electrical: ”.

**P0753, P0758**

Refer to “DTC P0753 / P0758: Shift Solenoid-A (#1) / -B (#2) Electrical: ”.

**P0741, P0742**

Refer to “DTC P0741 / P0742: TCC (Lock-Up) Solenoid Valve Performance or Stuck OFF / Stuck ON (for Vehicle with ORVR System): ”.

Refer to “DTC P0741: TCC (Lock-Up) Solenoid Valve Performance or Stuck OFF (for Vehicle without ORVR System): ”.

**P0751, P0752, P0756, P0757**

Refer to “DTC P0751 / P0752 / P0756 / P0757: Shift Solenoid Valve-A (#1) / -B (#2) Performance, Stuck OFF or Stuck ON (for Vehicle with ORVR System): ”.

Refer to “DTC P0751 / P0756: Shift Solenoid Valve-A (#1) / -B (#2) Performance or Stuck OFF (for Vehicle without ORVR System): ”.

### TCC Solenoid Circuit Monitor

#### Operation

| | |
|---|---|
| DTCs | P0743 |
| Monitor execution | Continuous |
| Monitoring Duration | 0.2 s |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| TCC (short) | On | |
| TCC (open) | Off | |

#### Typical malfunction thresholds

| |
|---|
| Monitor signal: On (open) |
| Monitor signal: Off (short) |

### Shift Solenoid #1 Circuit Monitor

#### Operation

| | |
|---|---|
| DTCs | P0753 |
| Monitor execution | Continuous |
| Monitoring Duration | 0.2 s |

#### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Solenoid (short) | On | |
| Solenoid (open) | Off | |

#### Typical malfunction thresholds

| |
|---|
| Monitor signal: On (open) |
| Monitor signal: Off (short) |

## Shift Solenoid #2 Circuit Monitor

### Operation

| | |
|---|---|
| DTCs | P0758 |
| Monitor execution | Continuous |
| Monitoring Duration | 0.2 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| Solenoid (short) | On | |
| Solenoid (open) | Off | |

### Typical malfunction thresholds

| |
|---|
| Monitor signal: On (open) |
| Monitor signal: Off (short) |

## TCC Solenoid Rationality Monitor

### Monitoring procedure

TCM (PCM) monitors operation (engagement condition) of TCC in response to ON/OFF command to the TCC solenoid using input and output speed sensor signals.

### Operation

| | |
|---|---|
| DTCs | P0741 / P0742 |
| Monitor execution | Continuous |
| Monitoring Duration | 5 s / 3 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0741** | | |
| TCC control | On | |
| Gear position | 3rd or 4th | |
| **P0742** | | |
| TCC control | Off | |
| Gear position | 2nd, 3rd, or 4th | |

### Typical malfunction thresholds

| |
|---|
| **P0741** |
| Input / Output speed ratio: 0.734 – 0.828, 1.031 – 1.344 |
| **P0742** |
| Input / Output speed ratio: 1.469 – 1.500, 0.984 – 1.031, 0.671 – 0.718 |

## Shift Solenoid #1 Rationality Monitor

### Monitoring procedure

TCM (PCM) calculates the actual transmission gear ratio from input and output speed sensor signals and monitor it. TCM (PCM) detects a trouble when the actual transmission gear ratio is not equal to the ratio of each gear as commanded by TCM (PCM).

### Operation

| | |
|---|---|
| DTCs | P0751 / P0752 |
| Monitor execution | Continuous |
| Monitoring Duration | 1.5 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0751** | | |
| Gear position | 2nd | |
| **P0752** | | |
| Gear position | 4th | |

### Typical malfunction thresholds

| |
|---|
| **P0751** |
| Input / Output speed ratio: 0.891 – 1.094 |
| **P0752** |
| Input / Output speed ratio: 1.563 – 3.094 |

## Shift Solenoid #2 Rationality Monitor

### Monitoring procedure

TCM (PCM) calculates the actual transmission gear ratio from input and output speed sensor signals and monitor it. TCM (PCM) detects a trouble when the actual transmission gear ratio is not equal to the ratio of each gear as commanded by TCM (PCM).

### Operation

| | |
|---|---|
| DTCs | P0756 / P0757 |
| Monitor execution | Continuous |
| Monitoring Duration | 3 s / 2 s |

### Enable conditions

| Parameter | Minimum | Maximum |
|---|---|---|
| **P0756** | | |
| Gear position | 2nd | |
| **P0757** | | |
| Gear position | 4th | |

### Typical malfunction thresholds

| |
|---|
| **P0756** |
| Input / Output speed ratio: 2.531 – 3.094 |
| **P0757** |
| Input / Output speed ratio: 0.891 – 1.094 |

## Engine and Emission Control System Introduction

S2SQ011121004, 03(01)

The engine and emission control system has 4 major sub-systems: air intake system, fuel delivery system, electronic control system and emission control system.
Air intake system includes air cleaner, MAF sensor, throttle body, IAC valve and intake manifold.
Fuel delivery system includes fuel pump, delivery pipe, fuel pressure regulator, fuel injectors, etc.
Electronic control system includes ECM (PCM), various sensors and controlled devices.
Emission control system includes EGR, EVAP and PCV systems.

## Air Intake System Description

S2SQ011121005, 03(01)

The main components of the air intake system are air cleaner, MAF sensor, air cleaner intake air pipe, throttle body, intake collector, IAC valve and intake manifold. The air (by the amount corresponding to the throttle valve opening and engine speed) is filtered by the air cleaner, passes through the throttle body, is distributed by the intake manifold and finally drawn into each combustion chamber.
When the IAC valve is opened according to the signal from ECM (PCM), the air bypasses the throttle valve through bypass passage and is finally drawn into the intake manifold.