## J1979-DA, Digital Annex of E/E Diagnostic Test Modes

### RATIONALE

This document has been issued to make available the initial version of J1979-DA. This Digital Annex contains exactly the same data as Appendices A through G of the J1979 document which was published September 2010. The intent is to eventually provide this document as an excel document with more frequent updates than the base J1979 document. J1979-DA is referenced by both SAE and ISO standards.

### 1. SCOPE

On-Board Diagnostic (OBD) regulations require passenger cars, and light and medium duty trucks, to support communication of a minimum set of diagnostic information to off-board "generic" test equipment. This document specifies the diagnostic data which may be required to be supported by motor vehicles and external test equipment for diagnostic purposes which pertain to motor vehicle emission-related data.

SAE J1979 was originally developed to meet U.S. OBD requirements for 1996 and later model year vehicles. ISO 15031-5 was based on SAE J1979 and was intended to combine the U.S. requirements with European OBD requirements for 2000 and later model year vehicles.

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APPENDIX A - (NORMATIVE)
PID (PARAMETER ID)/OBDMID (ON-BOARD DIAGNOSTIC MONITOR ID)/
TID (TEST ID)/INFOTYPE SUPPORTED DEFINITION

This Appendix specifies standardized hex values to be used in the request message for Services $01, $02, $05, $06, $08, and $09 to retrieve supported PIDs, OBDMIDs, TIDs, and INFOTYPEs.

TABLE A1 - SUPPORTED PID/OBDMID/TID/INFOTYPE DEFINITION

| Supported PID/OBDMID/ TID/INFOTYPE (Hex) | Scaling/Bit Number of Data Bytes = 4 Data A - D or B - E: Bit Evaluation PID/OBDMID/TID/INFOTYPE Supported (Hex) | | | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 00 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 0 | 01<br>02<br>:<br>20 | 0 = not supported<br>1 = supported | SAE J1978 specifies the behavior of the external test equipment for how to interpret the data received to identify supported PIDs/OBDMIDs/TIDs/ INFOTYPEs for each ECU. |
| 20 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 0 | 21<br>22<br>:<br>40 | 0 = not supported<br>1 = supported | For all protocols except ISO 14230-4, the ECU shall not respond to unsupported PID/OBDMID/TID/InfoType ranges unless subsequent ranges have a supported PID/OBDMID/TID/InfoType.  For ISO 14230-4, the ECU can either not respond or send a negative response (see Table 6). |
| 40 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 0 | 41<br>42<br>:<br>60 | 0 = not supported<br>1 = supported | |
| 60 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 0 | 61<br>62<br>:<br>80 | 0 = not supported<br>1 = supported | |
| 80 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 0 | 81<br>82<br>:<br>A0 | 0 = not supported<br>1 = supported | |
| A0 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 0 | A1<br>A2<br>:<br>C0 | 0 = not supported<br>1 = supported | |
| C0 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 0 | C1<br>C2<br>:<br>E0 | 0 = not supported<br>1 = supported | |
| E0 | Data A bit 7<br>Data A bit 6<br>:<br>Data D bit 1<br>Data D bit 0 | E1<br>E2<br>:<br>FF<br>ISO/SAE reserved (set to 0) | 0 = not supported<br>1 = supported | |

APPENDIX B - (NORMATIVE)
PIDS (PARAMETER ID) FOR SERVICES $01 AND $02 SCALING AND DEFINITION

B.1      NOMENCLATURE

This Appendix uses the following nomenclature for numbering and units for the U.S., European notation, and External Test Equipment display. Table B1 includes an example.

TABLE B1 - NUMBERING AND UNITS FOR THE U.S. NOTATION, EUROPEAN NOTATION
AND EXTERNAL TEST EQUIPMENT DISPLAY

| Appendix Example | U.S. Notation | European Notation | External Test Equipment Display |
|---|---|---|---|
| 4750.75 min$^{-1}$ | 4750.75 min$^{-1}$ | 4750.75 min$^{-1}$ | 4750.75 min$^{-1}$ |

B.2      SIGNALS RECEIVED VIA DISTRIBUTED NETWORKS

In distributed network architectures, certain OBD devices may be hardwired to other ECUs or be independent OBD mechatronic devices, e.g. smart sensor/actuator, connected through a network from another ECU (both referred to as remote OBD devices). When remote OBD devices are not hardwired to the OBD ECU and the data is *not* received over the data bus from the specific remote OBD device, this may occur for two reasons:

– The remote ECU is not functioning and sending any data.

– The OBD device that is hardwired to the remote ECU has failed and the remote ECU is sending a message with invalid data for the OBD remote device.

In either one of these cases the following applies:

– The primary OBD ECU shall report Service $01 and Service $02 data parameters as the minimum or maximum value to indicate that the signal has not been received. A PID which includes this invalid data (no signal) shall either be reported with a minimum value ($00 or $0000) or maximum value ($FF or $FFFF), e.g. PID $0D "Vehicle Speed Sensor" = $FF = 255 km/h, PID $2F "Fuel Level Input" = $00 = 0.0 %. The reported value shall be determined by the manufacturer based on system design and network architecture to represent the least likely value to be expected under normal conditions.

– The OBD ECU may store a network communication DTC after appropriate filtering, if the ECU detects that any remote OBD signal is completely missing. It shall set a DTC for "Lost Communication with 'X' Control Module".

– The OBD ECU may store a network communication DTC after appropriate filtering, if the ECU detects that any remote OBD signal is unavailable or invalid. This means that the remote ECU is still sending a message, but the OBD device hardwired to it is faulted and the data is indicated to be invalid or contains default data. It shall set a DTC for "Invalid Data Received from 'X' Control Module".

Figure B1 is an example of Fuel Level Sending Unit input via network message illustrates a possible configuration of providing Fuel Level and Vehicle Speed information to the external test equipment.

The network communication DTCs shall be obtained from SAE J2012 and/or SAE J2012 DA.

B.3      INFERRED SIGNALS

In some cases, PID data can be inferred from one or more available signals in the OBD ECU. For example, BARO can be inferred using mass air flow, engine RPM and throttle position rather than being directly read from a BARO pressure sensor. If one or more of the inputs used to infer the data are faulted and the PID data is unavailable, the PID shall indicate default value currently being used by the OBD ECU.
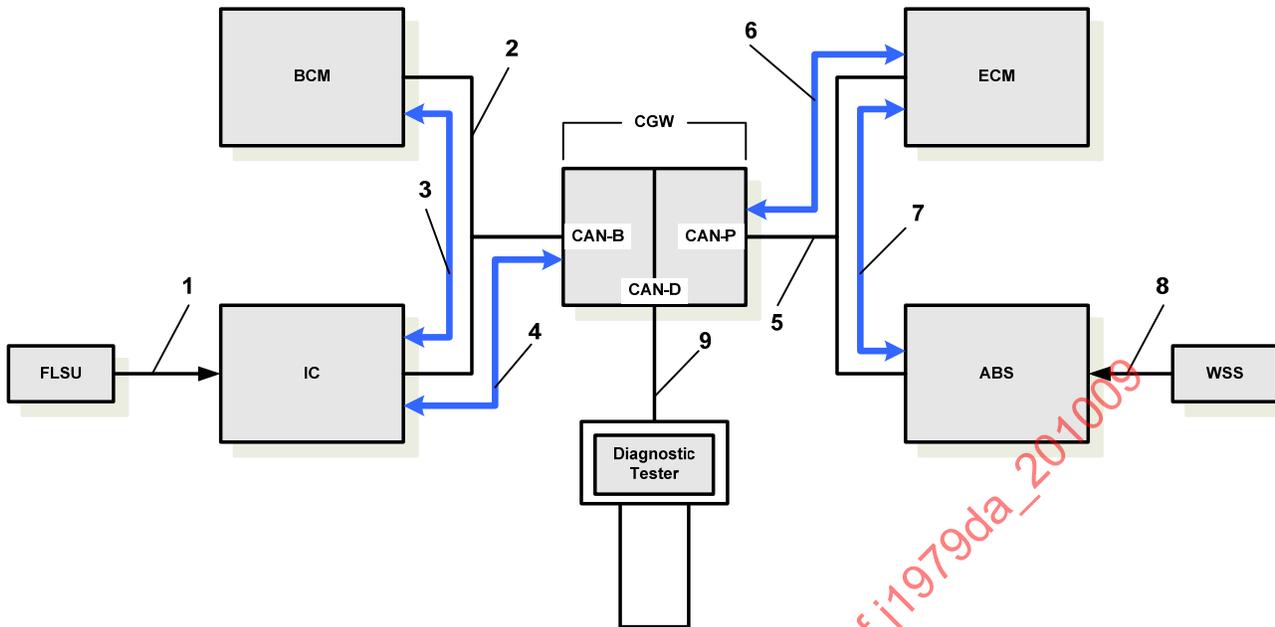
**Key**

1   Fuel Level Sending Unit connected to Instrument Cluster via A/D hardwire link
2   Body CAN bus
3   IC sends fuel level data to BCM
4   IC sends fuel level data to CGW
5   Powertrain CAN bus
6   ECM sends wheel speed data to CGW
7   ABS sends wheel speed data to ECM via Powertrain CAN bus
8   Wheel Speed Sensor connected to ABS (networked Wheel Speed read for ECM)
9   Diagnostic CAN bus
ABS   Anti-lock Brake Control Module
BCM   Body Control Module
CAN-B   Body CAN
CAN-P   Powertrain CAN
CAN-D   Diagnostic CAN
CGW   Central Gateway
ECM   Engine Control Module
FLSU   Fuel Level Sending Unit
IC   Instrument Cluster
WSS   Wheel Speed Sensor

FIGURE B1 - EXAMPLE OF FUEL LEVEL SENDING UNIT INPUT VIA NETWORK MESSAGE

B.4   PID STRUCTURE

Many PIDs starting with PID $65 incorporate a new bit-mapped structure that creates duplicate PIDs e.g. $05 - Engine Coolant Temperature and $67 - Engine Coolant Temperature. In general, it is recommended that manufacturers support only one PID; however, there may be cases where some older tools and applications, e.g. a telematic unit, may not have been updated to read the new bit-mapped PIDs. As a result, there may be manufacturers that want to support both the old and new bit-mapped PIDs for backward compatibility. Using these duplicate PIDs to display the same ECU data is allowed unless otherwise specified in the PID description.

J1979 PIDs have a defined length. When using PIDs that support multiple data items, all specified bytes must be used even if not all the data is supported. For example, PID $66 supports two MAF sensors, however, if only MAF A sensor is supported, the PID must still contain three bytes of data including data byte C for the unsupported MAF B sensor. The data for the unsupported sensor is not specified in this document; however, it is recommended that unsupported data bytes be filled with $00 or $0000.

Figure B2 - Sensor and actuator definitions and locations provides the reference to the sensor and actuator data definitions in the Appendices of this document.

Diagram labels:

- Chrg Air Cool Byp. Cont. A
- Chrg Air Cool Temp 1
- IAT 12
- IAT 11
- MAF A
- Air Filter
- TCA
- TC Compressor
- TCB
- MAF B
- IAT 21
- IAT 22
- CACT2
- CAC Bypass Control B
- TC Boost Pres Sensor B
- Intake Air Flow Cont B / Intake Throttle Sensor B
- EGR Throttle Cont A / EGR Sensor B or / Intake Air Flow Cont A / Intake Air Flow Pos A
- EGR Temp ?
- Charge Air Cooler
- Fuel Rail Pres Sensor A
- MAP
- EGR Control A / EGR Sensor A
- EGR Temp A
- EGR Cooler
- EGR Cooler
- EGR Temp B
- EGR Control B / EGR Sensor C
- Turbo Charger Boost Cont. B / Turbo Charger Boost Cont. Pos Sensor B
- Fuel Temp Sensor A
- TC Turbine
- TCA
- TCB
- Fuel Pump Cont A (Hi Pres)
- Fuel Pump Cont B (Lo Pres)
- TC Boost Cont. A / TC Boost Cont. Pos Sensor A
- EGT12
- DPF1
- DOC 1
- EGT13
- EGT11
- Fuel Pres Reg Cont 1
- Fuel Tank
- Fuel Volume Reg Cont
- DOC 2
- DPF2
- DPF Pres Sensor B

**Key**

| | | | |
|---|---|---|---|
| CACBCx | Charge Air Cooler Bypass Control A and B | FTx | Fuel Temperature Sensor A and B |
| CACTx | Charge Air Cooler Temperature Sensor 1 and 2 | FVRC | Fuel Volume Regulator Control |
| DOCx | Diesel Oxidation Catalyst Bank 1 and 2 | IATxy | Intake Air Temperature Sensor, Bank x, Location y (location determined by airflow through the engine) |
| DIAC | Diesel Intake Air Control | IAF_x_REL | Diesel Intake Air Flow Position Sensor A and B |
| DIACP | Diesel intake Air Control Position | MAFx | Mass Air Flow Sensor A and B |
| DPFx | Diesel Particulate Filter Bank 1 and 2 | MAP | Manifold Absolute Pressure |
| DPFPx | Diesel Particulate Filter Pressure Sensor, Bank 1 and 2 | TCx | Turbocharger A and B |
| EGRTC x | EGR Throttle Control A and B | TCBCx | Turbocharger Boost Control A and B |
| EGRx | EGR Sensor A, B and C | TCBCPx | Turbocharger Boost Control Position Sensor A and B |
| EGRTx | EGR Temperature Sensor A and B | BARO | Atmospheric Pressure |
| EGTxy | Exhaust Gas Temperature Sensor, Bank x, Location y (location determined by airflow through the engine) | MAP | Manifold pressure, closest to the intake valves |
| FPRCx | Fuel Pressure Regulator Control 1 and 2 | Boost Pressure | Pressure after the pressurizing device, but before the throttle body, if present |
| FPCx | Fuel Pump Control A (High Pressure) and B (Low Pressure) | Inlet Pressure | Pressure after the throttle body, but before the pressurizing device |
| FRPx | Fuel Rail Pressure Sensor A and B | | |

FIGURE B2 - SENSOR AND ACTUATOR DEFINITIONS AND LOCATIONS

B.5    PID DEFINITIONS

TABLE B2 - PID $01 DEFINITION

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 01 | Monitor status since DTCs cleared | | | |
| | The bits in this PID shall report two pieces of information for each monitor: <br> – monitor status since DTCs were last cleared, saved in NVRAM or Keep Alive RAM; and <br> – monitors supported on this vehicle. | | | |
| | **Number of emission-related DTCs and MIL status** | **A (bit)** | **byte 1 of 4** | **DTC and MIL status:** |
| | # of DTCs stored in this ECU | 0-6 | hex to decimal | DTC_CNT: xxd |
| | Number of confirmed emission-related DTCs stored in the ECU, available for display using Service $03. | | | |
| | Malfunction Indicator Lamp (MIL) Status | 7 | 0 = MIL OFF; 1 = MIL ON | MIL: OFF or ON |
| | The MIL status shall indicate "OFF" during the key-on, engine-off functional bulb check or while indicating I/M readiness unless the MIL has also been commanded "ON" for a detected malfunction. The "ON" status shall reflect whether there are any confirmed DTCs stored that are currently illuminating the MIL and, at the option of the manufacturer, any pending DTCs that are currently blinking or illuminating the MIL (e.g. catalyst damaging misfire). | | | |
| | **Supported tests which are continuous** | **B (bit)** | **byte 2 of 4 (Low Nibble)** | **Support status of continuous monitors:** |
| | Misfire monitoring supported | 0 | 0 = monitor not supported (NO) <br> 1 = monitor supported (YES) | MIS_SUP: NO or YES |
| | Shall be supported on vehicles that utilize a misfire monitor | | | |
| | Fuel system monitoring supported | 1 | 0 = monitor not supported (NO) <br> 1 = monitor supported (YES) | FUEL_SUP: NO or YES |
| | Shall be supported on vehicles that utilize closed loop control of air/fuel ratio or closed loop control of the fuel injection delivery system | | | |
| | Comprehensive component monitoring supported | 2 | 0 = monitor not supported (NO) <br> 1 = monitor supported (YES) | CCM_SUP: NO or YES |
| | Shall be supported on vehicles that utilize comprehensive component monitoring | | | |
| | Compression ignition monitoring supported | 3 | 0 = Spark ignition monitors supported <br> 1 = Compression ignition monitors supported | Not displayed by external test equipment |
| | Indicates support of spark ignition or compression ignition monitors and data labels within Data Bytes C and D of PID $01. | | | |
| | **Status of continuous monitoring tests since DTC cleared:** | **B (bit)** | **byte 2 of 4 (High Nibble)** | **Completion status of continuous monitors since DTC cleared:** |
| | Misfire monitoring ready | 4 | 0 = monitor complete, or not applicable (YES) <br> 1 = monitor not complete (NO) | MIS_RDY: YES or NO |
| | Misfire monitoring shall always indicate complete for spark-ignition vehicles. Misfire monitoring shall indicate complete for compression-ignition vehicles after the misfire evaluation is complete. | | | |
| | Fuel system monitoring ready | 5 | 0 = monitor complete, or not applicable (YES) <br> 1 = monitor not complete (NO) | FUEL_RDY: YES or NO |
| | Fuel system monitoring shall always indicate complete for spark-ignition and compression ignition vehicles that only have fuel system monitors required by regulation to be continuous. For spark-ignition and compression ignition vehicles that have one or more non-continuous fuel system monitors (e.g.. cylinder air-fuel imbalance or injection quantity/timing), fuel system monitoring shall indicate complete only after all non-continuous fuel system evaluation(s) are complete. | | | |

TABLE B2 - PID $01 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 01 | Comprehensive component monitoring ready | 6 | 0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO) | CCM_RDY: YES or NO |
| | Comprehensive component monitoring shall always indicate complete on all vehicles. | | | |
| | NOTE: While there are many individual monitors within comprehensive components that do not run continuously or may take a while to complete, it is generally assumed that most of these monitors will have run by the time other readiness monitors (e.g., catalyst, exhaust gas sensor, etc) indicate complete.  Additionally, given the large number of individual monitors within comprehensive components, it would be very difficult to determine which of the individual diagnostics have not yet run or are otherwise preventing this bit from indicating complete. Accordingly, this bit should be set to always indicate "complete". | | | |
| | ISO/SAE reserved (bit shall be reported as "0") | 7 | | — |
| | The following descriptions for Bytes C and D are to be used for spark ignition vehicles only. | | | |
| | **Supported tests run at least once per trip** | **C (bit)** | **byte 3 of 4** | **Support status of non-continuous monitors:** |
| | Catalyst monitoring supported | 0 | | CAT_SUP: NO or YES |
| | Heated catalyst monitoring supported | 1 | | HCAT_SUP: NO or YES |
| | Evaporative system monitoring supported | 2 | | EVAP_SUP: NO or YES |
| | Secondary air system monitoring supported | 3 | 0 = monitor not supported (NO) 1 = monitor supported (YES) | AIR_SUP: NO or YES |
| | ISO/SAE reserved (bit shall be reported as "0") | 4 | | — |
| | Oxygen sensor monitoring supported | 5 | | O2S_SUP: NO or YES |
| | Oxygen sensor heater monitoring supported | 6 | | HTR_SUP: NO or YES |
| | EGR and/or VVT system monitoring supported | 7 | | EGR_SUP: NO or YES |
| | **Status of tests run at least once per trip** | **D (bit)** | **byte 4 of 4** | **Completion status of non-continuous monitors since DTCs cleared:** |
| | Catalyst monitoring ready | 0 | 0 = monitor complete (YES) | CAT_RDY: YES, NO or N/A |
| | Heated catalyst monitoring ready | 1 | | HCAT_RDY: YES, NO or N/A |
| | Evaporative system monitoring ready | 2 | 0 = monitor not applicable (N/A) | EVAP_RDY: YES, NO or N/A |
| | Secondary air system monitoring ready | 3 | | AIR_RDY: YES or NO |
| | ISO/SAE reserved (bit shall be reported as "0") | 4 | 1 = monitor not complete (NO) | — |
| | Oxygen sensor monitoring ready | 5 | NOTE: any monitor reported as 'not supported' in Data Byte C shall be reported as not applicable (N/A) in Data Byte D | O2S_RDY: YES, NO or N/A |
| | Oxygen sensor heater monitoring ready | 6 | | HTR_RDY: YES, NO or N/A |
| | EGR and/or VVT system monitoring ready | 7 | | EGR_RDY: YES, NO or N/A |

TABLE B2 - PID $01 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 01 | The following descriptions for Bytes C and D are to be used for compression ignition vehicles only. | | | |
| | **Supported tests run at least once per trip** | **C (bit)** | byte 3 of 4 | **Support status of non-continuous monitors:** |
| | NMHC catalyst monitoring supported | 0 | | HCCATSUP: NO or YES |
| | NOx/SCR aftertreatment monitoring supported | 1 | | NCAT_SUP: NO or YES |
| | ISO/SAE reserved (bit shall be reported as "0") | 2 | | |
| | Boost pressure system monitoring supported | 3 | 0 = monitor not supported (NO) | BP_SUP: NO or YES |
| | ISO/SAE reserved (bit shall be reported as "0") | 4 | 1 = monitor supported (YES) | — |
| | Exhaust gas sensor monitoring supported | 5 | | EGS_SUP: NO or YES |
| | PM filter monitoring supported | 6 | | PM_SUP: NO or YES |
| | EGR and/or VVT system monitoring supported | 7 | | EGR_SUP: NO or YES |
| | **Status of tests run at least once per trip** | **D (bit)** | byte 4 of 4 | **Completion status of non-continuous monitors since DTCs cleared:** |
| | NMHC catalyst monitoring ready | 0 | | HCCATRDY: YES, NO or N/A |
| | NOx/SCR aftertreatment monitoring ready | 1 | 0 = monitor complete (YES) | NCAT_RDY: YES, NO or N/A |
| | ISO/SAE reserved (bit shall be reported as "0") | 2 | 0 = monitor not applicable (N/A) | — |
| | Boost pressure system monitoring ready | 3 | 1 = monitor not complete (NO) | BP_RDY: YES, NO or N/A |
| | ISO/SAE reserved (bit shall be reported as "0") | 4 | NOTE: any monitor reported as 'not supported' in Data Byte C shall be reported as not applicable (N/A) in Data Byte D | — |
| | Exhaust gas sensor monitoring ready | 5 | | EGS_RDY: YES, NO or N/A |
| | PM filter monitoring ready | 6 | | PM_RDY: YES, NO or N/A |
| | EGR and/or VVT system monitoring ready | 7 | | EGR_RDY: YES, NO or N/A |

TABLE B3 - PID $02 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 02 | DTC that caused required freeze frame data storage | A, B | 00 00 | FF FF | Hexadecimal e.g. P01AB | DTCFRZF: Pxxxx, Cxxxx, Bxxxx, Uxxxx |
| | $0000 indicates no stored freeze frame data. DTC format and DTCs are defined in SAE J2012 and/or SAE J2012 DA. | | | | | |

TABLE B4 - PID $03 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value |
|---|---|---|---|---|
| 03 | Fuel system 1 status: | A (bit) | byte 1 of 2 | FUELSYS1: |
| | (Unused bits shall be reported as '0'; no more than one bit at a time can be set to a '1' of that bank.) | 0 | 1 = Open loop - has not yet satisfied conditions to go closed loop | OL |
| | | 1 | 1 = Closed loop - using oxygen sensor(s) as feedback for fuel control | CL |
| | | 2 | 1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment) | OL-Drive |
| | | 3 | 1 = Open loop - due to detected system fault | OL-Fault |
| | | 4 | 1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control | CL-Fault |
| | | 5-7 | ISO/SAE reserved (bits shall be reported as '0') | — |
| | Fuel system status shall be supported by spark ignition vehicles that use closed loop feedback control of air/fuel ratio. NOTE: Fuel systems 1 and 2 do not normally refer to injector banks. Fuel systems 1 and 2 are intended to represent completely different fuel systems that can independently enter and exit closed-loop fuel. Banks of injectors on a V-engine are generally not independent and share the same closed-loop enablement criteria. If the engine is off and the ignition is on, all bits in Data Byte A and Data Byte B shall be reported as '0'. For vehicles that employ engine shutoff strategies (e.g. engine shutoff at idle) all bits in Data Byte A and Data Byte B shall be reported as '0', when the engine is turned off by the vehicle control system | | | |
| | Fuel system 2 status: | B (bit) | byte 2 of 2 | FUELSYS2: |
| | (Unused bits shall be reported as '0'; no more than one bit at a time can be set to a '1' of that bank.) | 0 | 1 = Open loop - has not yet satisfied conditions to go closed loop | OL |
| | | 1 | 1 = Closed loop - using oxygen sensor(s) as feedback for fuel control | CL |
| | | 2 | 1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment) | OL-Drive |
| | | 3 | 1 = Open loop - due to detected system fault | OL-Fault |
| | | 4 | 1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control | CL-Fault |
| | | 5-7 | ISO/SAE reserved (bits shall be reported as '0') | — |
| | Fuel system status shall be supported by spark ignition vehicles that use closed loop feedback control of air/fuel ratio. NOTE: Fuel systems 1 and 2 do not normally refer to injector banks. Fuel systems 1 and 2 are intended to represent completely different fuel systems that can independently enter and exit closed-loop fuel. Banks of injectors on a V-engine are generally not independent and share the same closed-loop enablement criteria. If the engine is off and the ignition is on, all bits in Data Byte A and Data Byte B shall be reported as '0'. For vehicles that employ engine shutoff strategies (e.g. engine shutoff at idle) all bits in Data Byte A and Data Byte B shall be reported as '0', when the engine is turned off by the vehicle control system | | | |

TABLE B5 - PID $04 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 04 | Calculated LOAD Value | A | 0 % | 100 % | 100/255 % | LOAD_PCT: xxx.x % |
| | LOAD_PCT = [current airflow] / [(peak airflow at WOT@STP as a function of rpm) * (BARO/29.92) * SQRT(298/(AAT+273))]<br><br>Alternatively, spark ignition and compression ignition vehicles may use the following definition for calculated engine load value:<br><br>LOAD_PCT = [current engine torque] / [(peak engine torque @STP as a function of rpm) * (BARO/29.92) * SQRT(298/(AAT+273))]<br><br>Where:<br>– STP = Standard Temperature and Pressure = 25 °C, 29.92 in Hg BARO,<br>– SQRT = square root;<br>– WOT = wide open throttle;<br>– AAT = Ambient Air Temperature and is in °C<br><br>NOTE: At engine off and ignition on the LOAD_PCT = 0 %. If engine torque is negative, LOAD_PCT shall be reported as 0%.<br><br>Characteristics of LOAD_PCT:<br>– Reaches 100 % at WOT/Wide Open Pedal at any altitude, temperature or rpm for both naturally aspirated and boosted engines.<br>– Indicates percent of peak available torque during normal, fault-free conditions.<br>– For spark ignition engines, linearly correlated with engine vacuum at MBT spark and stoichiometry. Note that hybrid engine controls can independently control torque.<br>– Compression-ignition engines (diesels) shall support this PID using torque.<br><br>Both spark-ignition and compression-ignition vehicles shall support PID $04. See PID $43 for an additional definition of engine LOAD. | | | | | |

TABLE B6 - PID $05 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 05 | Engine Coolant Temperature | A | – 40 °C | +215 °C | 1 °C with – 40 °C offset | ECT: xxx °C (xxx °F) |
| | ECT shall display engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor. | | | | | |

Figure B3 indicates the method to determine how many data bytes will be reported for Service $01, PIDs $06 to $09 and PIDs $55 to $58.  The number of data bytes to be reported will depend on the data content of the "Location of Oxygen Sensor" PIDs $13 and $1D. Bank support is defined for the vehicle, not for each ECU.

## Determination of usage of Byte B in addition to Byte A
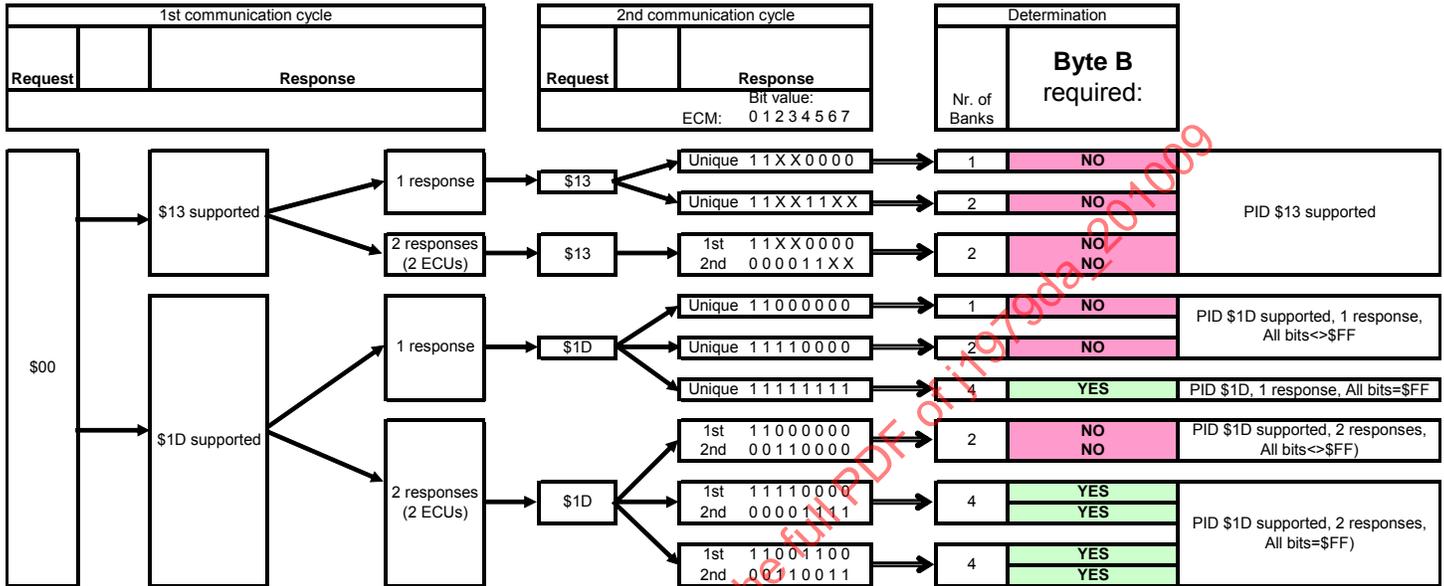## for Service $01 PIDs $06 to $09 and PIDs $55 to $58



FIGURE B3 - DETERMINATION OF NUMBER OF DATA BYTES FOR PIDS $06 TO $09 AND $55 TO $58

TABLE B7 - PID $06 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 06 | Short Term Fuel Trim - Bank 1 (use if only 1 fuel trim value) | A | −100 % (lean) | +99.22 % (rich) | 100/128 % (0 % at 128) | SHRTFT1: xxx.x % |
| | Short Term Fuel Trim - Bank 3 | B | | | | SHRTFT3: xxx.x % |
| | Short Term Fuel Trim shall be supported by spark ignition vehicles that use closed loop feedback control of air/fuel ratio. Short Term Fuel Trim Bank 1/3 shall indicate the correction currently being utilized by the closed-loop fuel algorithm. If the fuel system is in open loop, SHRTFT1/3 shall report 0 % correction. Data B shall only be included in the response to a PID $06 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 3 for the vehicle. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D. In no case shall an ECU send an unsupported data byte A if data byte B is supported. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. | | | | | | |

TABLE B8 - PID $07 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 07 | Long Term Fuel Trim – Bank 1 (use if only 1 fuel trim value) | A | −100 % (lean) | +99.22 % (rich) | 100/128 % (0 % at 128) | LONGFT1: xxx.x % |
|  | Long Term Fuel Trim – Bank 3 | B |  |  |  | LONGFT3: xxx.x % |
| | Long Term Fuel Trim shall be supported by spark ignition vehicles that use closed loop feedback control of air/fuel ratio. Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction currently being utilized by the fuel control algorithm at the time the data is requested, in both open-loop and closed-loop fuel control. If no correction is utilized in open-loop fuel, LONGFT shall report 0 % correction. If long-term fuel trim is not utilized at all by the fuel control algorithm, the PID shall not be supported. Data B shall only be included in the response to a PID $07 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 3 for the vehicle. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D. In no case shall an ECU send an unsupported data byte A if data byte B is supported. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. ||||||| |

TABLE B9 - PID $08 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 08 | Short Term Fuel Trim - Bank 2 (use if only 1 fuel trim value) | A | −100 % (lean) | +99.22 % (rich) | 100/128 % (0 % at 128) | SHRTFT2: xxx.x % |
|  | Short Term Fuel Trim - Bank 4 | B |  |  |  | SHRTFT4: xxx.x % |
| | Short Term Fuel Trim shall be supported by spark ignition vehicles that use closed loop feedback control of air/fuel ratio. Short Term Fuel Trim Bank 2/4 shall indicate the correction currently being utilized by the closed-loop fuel algorithm. If the fuel system is in open-loop, SHRTFT24 shall report 0 % correction. Data B shall only be included in the response to a PID $08 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 4 for the vehicle. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D. In no case shall an ECU send an unsupported data byte A if data byte B is supported. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. ||||||| |

TABLE B10 - PID $09 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 09 | Long Term Fuel Trim – Bank 2 (use if only 1 fuel trim value) | A | −100 % (lean) | +99.22 % (rich) | 100/128 % (0 % at 128) | LONGFT2: xxx.x % |
|  | Long Term Fuel Trim - Bank 4 | B |  |  |  | LONGFT4: xxx.x % |
| | Long Term Fuel Trim shall be supported by spark ignition vehicles that use closed loop feedback control of air/fuel ratio. Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction currently being utilized by the fuel control algorithm at the time the data is requested, in both open-loop and closed-loop fuel control. If no correction is utilized in open-loop fuel, LONGFT shall report 0 % correction. If long-term fuel trim is not utilized at all by the fuel control algorithm, the PID shall not be supported. Data B shall only be included in the response to a PID $09 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 4 for the vehicle. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D if data byte B is supported. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. ||||||| |

TABLE B11 - PID $0A DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 0A | Fuel Pressure (gauge) | A | 0 kPa (gauge) | 765 kPa (gauge) | 3 kPa per bit (gauge) | FP: xxx kPa (xx.x psi) |
| | FP shall display fuel pressure when the reading is referenced to atmosphere (gauge pressure). | | | | | |

TABLE B12 - PID $0B DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 0B | Intake Manifold Absolute Pressure | A | 0 kPa (absolute) | 255 kPa (absolute) | 1 kPa per bit (absolute) | MAP: xxx.x kPa (xxx.x inHg) |
| | MAP shall display manifold pressure derived from a Manifold Absolute Pressure sensor, if a sensor is utilized. If a vehicle uses both a MAP and MAF sensor, both the MAP and MAF PIDs shall be supported. | | | | | |
| | If PID $4F is not supported for this ECU, or if PID $4F is supported and includes $00 for Intake Manifold Absolute Pressure, the external test equipment shall use the scaling values included in this table for those values. If PID $4F is supported for this ECU and Data D of $4F contains a value greater than $00, the external test equipment shall calculate scaling and range for this PID as explained in the PID $4F Data D definition. | | | | | |

TABLE B13 - PID $0C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 0C | Engine RPM | A, B | 0 min$^{-1}$ | 16383.75 min$^{-1}$ | 1/4 rpm per bit | RPM: xxxxx min$^{-1}$ |
| | Engine RPM shall display revolutions per minute of the engine crankshaft. | | | | | |

TABLE B14 - PID $0D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 0D | Vehicle Speed Sensor | A | 0 km/h | 255 km/h | 1 km/h per bit | VSS: xxx km/h (xxx mph) |
| | VSS shall display vehicle road speed. Vehicle speed may be derived from a vehicle speed sensor, calculated by the ECU using other speed sensors, or obtained from the vehicle serial data communication bus. | | | | | |

TABLE B15 - PID $0E DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 0E | Ignition Timing Advance for #1 Cylinder | A | – 64 | 63.5 | 1/2 with 0 at 128 | SPARKADV: xx.x |
| | Ignition timing advance shall be supported by spark ignition vehicles. | | | | | |
| | Ignition timing spark advance in degrees before top dead center ( BTDC) for #1 cylinder (not including mechanical advance). | | | | | |

TABLE B16 - PID $0F DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 0F | Intake Air Temperature | A | − 40 °C | +215 °C | 1 °C with − 40 °C offset | IAT: xxx °C (xxx °F) |
| | IAT shall display intake manifold air temperature. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B17 - PID $10 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 10 | Air Flow Rate from Mass Air Flow Sensor | A, B | 0 g/s | 655.35 g/s | 0.01 g/s (1/100) | MAF: xxxx.xx g/s (xxxx.x lb/min) |
| | MAF shall display the airflow rate as measured by a vehicle that utilizes a MAF sensor or an equivalent source. If the engine is off and the ignition is on, the actual sensor value reading shall be reported. If the actual sensor reading can not be reported, the MAF value shall be reported as 0.00 g/s. | | | | | |
| | If PID $50 is not supported for this ECU, or if PID $50 is supported and includes $00 for Air Flow Rate from Mass Air Flow Sensor, the external test equipment shall use the scaling values included in this table for those values. If PID $50 is supported for this ECU and Data A of PID $50 contains a value greater than $00, the external test equipment shall calculate scaling and range for this PID as explained in the PID $50 Data A definition. | | | | | |

TABLE B18 - PID $11 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 11 | Absolute Throttle Position | A | 0 % | 100 % | 100/255 % | TP: xxx.x % |
| | Absolute throttle position (not "relative" or "learned" throttle position) shall be displayed as a normalized value, scaled from 0 to 100 %. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, TP shall display (1.0 / 5.0) = 20 % at closed throttle and 50 % at 2.5 volts. Throttle position at idle will usually indicate greater than 0 %, and throttle position at wide open throttle will usually indicate less than 100 %. | | | | | |
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. | | | | | |
| | A single throttle plate could have up to three throttle position sensors, A, B and C. A dual throttle plate system could have up to four throttle position sensors, A, B, C and G. | | | | | |
| | NOTE: See PID $45 for a definition of Relative Throttle Position. | | | | | |

TABLE B19 - PID $12 DEFINITION

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 12 | Commanded Secondary Air Status | A (bit) | byte 1 of 1 | AIR_STAT: |
|  | (If supported, one, and only one bit at a time can be set to a 1.) | 0 | 1 = upstream of first catalytic converter | AIR_STAT: UPS |
|  |  | 1 | 1 = downstream of first catalytic converter inlet | AIR_STAT: DNS |
|  |  | 2 | 1 = atmosphere / off | AIR_STAT: OFF |
|  |  | 3 | 1 = pump commanded on for diagnostics | AIR_STAT: DIAG |
|  |  | 4 - 7 | ISO/SAE reserved (Bits shall be reported as '0'.) | — |

TABLE B20 - PID $13 DEFINITION (1 OR 2 BANKS)

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 13 | Location of Oxygen Sensors | A (bit) | byte 1 of 1 | O2SLOC: |
|  |  | 0 | 1 = Bank 1 - Sensor 1 present at that location | O2S11 |
|  |  | 1 | 1 = Bank 1 - Sensor 2 present at that location | O2S12 |
|  |  | 2 | 1 = Bank 1 - Sensor 3 present at that location | O2S13 |
|  |  | 3 | 1 = Bank 1 - Sensor 4 present at that location | O2S14 |
|  |  | 4 | 1 = Bank 2 - Sensor 1 present at that location | O2S21 |
|  |  | 5 | 1 = Bank 2 - Sensor 2 present at that location | O2S22 |
|  |  | 6 | 1 = Bank 2 - Sensor 3 present at that location | O2S23 |
|  |  | 7 | 1 = Bank 2 - Sensor 4 present at that location | O2S24 |

Location of Oxygen Sensors, where sensor 1 is closest to the engine. Each bit indicates the presence or absence of an oxygen sensor at the following location.

NOTE: PID $13 shall only be supported by a given vehicle if PID $1D is not supported. In no case shall a vehicle support both PIDs. PID $13 is recommended for 1 or 2 bank O2 sensor engine configurations, and never for 3 or 4 bank O2 sensor engine configurations. See Figure B3 for an explanation of how this PID will be used to determine how many data bytes will be reported when short term or long term fuel trim values are reported with PIDs $06 to $09 and PIDs $55 to $58.

TABLE B21 - PID $14 - $1B DEFINITION (1 OR 2 BANKS)

| PID (hex) | Description Use if PID $13 is Supported! | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 14 | Bank 1 – Sensor 1 | | | | | |
| 15 | Bank 1 – Sensor 2 | | PIDs $14 - $1B shall be used for a conventional, 0 to 1 volt oxygen sensor. Any sensor with a different full scale value shall be normalized to provide nominal full scale at $C8 (200 decimal). Wide-range/linear oxygen sensors shall use PIDs $24 to $2B or PIDs $34 to $3B. | | | |
| 16 | Bank 1 – Sensor 3 | | | | | |
| 17 | Bank 1 – Sensor 4 | | | | | |
| 18 | Bank 2 – Sensor 1 | | | | | |
| 19 | Bank 2 – Sensor 2 | | | | | |
| 1A | Bank 2 – Sensor 3 | | | | | |
| 1B | Bank 2 – Sensor 4 | | | | | |
|  | Oxygen Sensor Output Voltage (Bx-Sy) | A | 0 V | 1.275 V | 0.005 V | O2Sxy: x.xxx V |
|  | Short Term Fuel Trim (Bx-Sy) associated with this sensor. (reported as $FF if this sensor is not used in the calculation or if SHRTFT is not applicable.) | B | – 100.00 % (lean) | 99.22 % (rich) | 100/128 % (0 % at 128) | SHRTFTxy: xxx.x % |
|  | NOTE: The PIDs listed in this table only apply if PID $13 is used to define the oxygen sensor location. | | | | | |

TABLE B22 - PID $14 - $1B DEFINITION (3 OR 4 BANKS)

| PID (hex) | Description Use if PID $1D is Supported! | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 14 | Bank 1 – Sensor 1 | | PIDs $14 - $1B shall be used for a conventional, 0 to 1 volt oxygen sensor. Any sensor with a different full scale value shall be normalized to provide nominal full scale at $C8 (200 decimal). Wide-range/linear oxygen sensors shall use PIDs $24 to $2B or PIDs $34 to $3B. | | | |
| 15 | Bank 1 – Sensor 2 | | | | | |
| 16 | Bank 2 – Sensor 1 | | | | | |
| 17 | Bank 2 – Sensor 2 | | | | | |
| 18 | Bank 3 – Sensor 1 | | | | | |
| 19 | Bank 3 – Sensor 2 | | | | | |
| 1A | Bank 4 – Sensor 1 | | | | | |
| 1B | Bank 4 – Sensor 2 | | | | | |
| | Oxygen Sensor Output Voltage (Bx-Sy) | A | 0 V | 1.275 V | 0.005 V | O2Sxy: x.xxx V |
| | Short Term Fuel Trim (Bx-Sy) associated with this sensor (reported as $FF if this sensor is not used in the calculation or if SHRTFT is not applicable.) | B | – 100.00 % (lean) | 99.22 % (rich) | 100/128 % (0 % at 128) | SHRTFTxy: xxx.x % |
| NOTE: The PIDs listed in this table only apply if PID $1D is used to define the oxygen sensor location. | | | | | | |

TABLE B23 - PID $1C DEFINITION

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 1C | OBD requirements to which vehicle or engine is certified. | A (hex) | byte 1 of 1 (State Encoded Variable) | OBDSUP: |
| | Data may be reported for the vehicle by a single ECU or may be reported by any OBD ECU that activates the MIL. | | | |
| | OBD II (California ARB) - California-only (including other "green" states) OBD II certified systems. "Certified to California OBDII" should only be included if the actual test group is intended for certification by CARB. | 01 | | OBD II |
| | OBD (US Federal EPA) - US Federal only OBD-certified (including vehicles using US Federal allowance to certify to California OBD II but then turn off/disable 0.020" evap leak detection) | 02 | | OBD |
| | OBD and OBD II - US 50-state certified or non-California vehicles certified to California OBD II requirements (including 0.020" evap leak detection) in lieu of US Federal OBD. | 03 | | OBD and OBD II |
| | OBD I - Certified to California OBD I requirements (pre-1996 model year California certified vehicles) | 04 | | OBD I |
| | Not OBD compliant - Not certified to any OBD requirements (e.g., US Federal pre-1996 model year, Canadian pre-1997 model year, non-street legal applications, US Federal 8500-14000 vehicles not in phase-ins of 2004-2008 US Federal OBD) | 05 | | NO OBD |

TABLE B23 - PID $1C DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 1C | EOBD (Euro OBD) | 06 | | EOBD |
| | EOBD and OBD II | 07 | | EOBD and OBD II |
| | EOBD and OBD | 08 | | EOBD and OBD |
| | EOBD, OBD and OBD II | 09 | | EOBD, OBD and OBD II |
| | JOBD (Japan OBD) | 0A | | JOBD |
| | JOBD and OBD II | 0B | | JOBD and OBD II |
| | JOBD and EOBD | 0C | | JOBD and EOBD |
| | JOBD, EOBD, and OBD II | 0D | | JOBD, EOBD, and OBD II |
| | ISO/SAE reserved | 0E | | |
| | ISO/SAE reserved | 0F | | |
| | ISO/SAE reserved | 10 | | |
| | Engine Manufacturer Diagnostics (EMD) - Heavy-duty vehicles (>14,000) certified to EMD under title 13, CCR section 1971 (e.g., 2007-2009 model year diesel and gasoline engines) | 11 | | EMD |
| | Engine Manufacturer Diagnostics Enhanced (EMD+) - Heavy-duty engines (>14,000) certified to EMD+ under title 13, CCR section 1971.1 (e.g., 2010-2012 model year diesel and gasoline engines not certified to HD OBD, 2013-2019 model year alternate fuel engines) | 12 | | EMD+ |
| | Heavy Duty On-Board Diagnostics (Child/Partial) - Heavy-duty engines (>14,000) certified to HDOBD as an extrapolated/child rating under title 13, CCR section 1971.1(d)(7.1.2) or (7.2.3) (e.g., 2010-2015 model year diesel and gasoline engines that are subject to HDOBD but are not the full OBD/parent rating) | 13 | | HD OBD-C |
| | Heavy Duty On-Board Diagnostics - Heavy-duty engines (>14,000) certified to HDOBD as a full OBD/parent rating under title 13, CCR section 1971.1(d)(7.1.1) or (7.2.2) (e.g., 2010 and beyond model year diesel and gasoline engines that are subject to full HDOBD) | 14 | | HD OBD |
| | World Wide Harmonized OBD | 15 | | WWH OBD |
| | SAE/ISO reserved | 16 | | SAE/ISO reserved |
| | Heavy Duty Euro OBD Stage I without NOx control | 17 | | HD EOBD-I |
| | Heavy Duty Euro OBD Stage I with NOx control | 18 | | HD EOBD-I N |
| | Heavy Duty Euro OBD Stage II without NOx control | 19 | | HD EOBD-II |
| | Heavy Duty Euro OBD Stage II with NOx control | 1A | | HD EOBD-II N |
| | ISO/SAE reserved | 1B | | |
| | Brazil OBD Phase 1 | 1C | | OBDBr-1 |
| | Brazil OBD Phase 2 | 1D | | OBDBr-2 |
| | Korean OBD | 1E | | KOBD |
| | India OBD I | 1F | | IOBD I |
| | India OBD II | 20 | | IOBD II |
| | Heavy Duty Euro OBD Stage VI | 21 | | HD EOBD-VI |
| | ISO/SAE reserved | 22 - FA | | — |
| | ISO/SAE - Not available for assignment | FB - FF | | SAE J1939 special meaning |

TABLE B24 - PID $1D DEFINITION (3 OR 4 BANKS)

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 1D | Location of oxygen sensors | A (bit) | byte 1 of 1 | O2SLOC: |
| | | 0 | 1 = Bank 1 - Sensor 1 present at that location | O2S11 |
| | | 1 | 1 = Bank 1 - Sensor 2 present at that location | O2S12 |
| | | 2 | 1 = Bank 2 - Sensor 1 present at that location | O2S21 |
| | | 3 | 1 = Bank 2 - Sensor 2 present at that location | O2S22 |
| | | 4 | 1 = Bank 3 - Sensor 1 present at that location | O2S31 |
| | | 5 | 1 = Bank 3 - Sensor 2 present at that location | O2S32 |
| | | 6 | 1 = Bank 4 - Sensor 1 present at that location | O2S41 |
| | | 7 | 1 = Bank 4 - Sensor 2 present at that location | O2S42 |
| | Location of oxygen sensors, where sensor 1 is closest to the engine. Each bit indicates the presence or absence of an oxygen sensor at the following location. | | | |
| | NOTE:  PID $1D shall only be supported by a given vehicle if PID $13 is not supported. In no case shall a vehicle support both PIDs. PID $1D is recommended for 3 or 4 bank O2 sensor engine configurations, and never for 1 or 2 bank O2 sensor engine configurations. See Figure B3 for an explanation of how this PID will be used to determine how many data bytes will be reported when short term or long term fuel trim values are reported with PIDs $06 to $09 and PIDs $55 to $58. | | | |

TABLE B25 - PID $1E DEFINITION

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 1E | Auxiliary Input Status | A (bit) | byte 1 of 1 | Auxiliary Input Status |
| | Power Take Off (PTO) Status | 0 | 0 = PTO not active (OFF); 1 = PTO active (ON). | PTO_STAT: OFF or ON |
| | | 1-7 | ISO/SAE reserved (Bits shall be reported as '0'.) | — |

TABLE B26 - PID $1F DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/ Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 1F | Time Since Engine Start | A, B | 0 sec. | 65535 sec. | 1 second per count | RUNTM: xxxxx sec. |
| | For non-hybrid vehicles, RUNTM shall increment while the engine is running. It shall freeze if the engine stalls. RUNTM shall be reset to zero during every control module power-up and when entering the key-on, engine off position. RUNTM is limited to 65535 seconds and shall not wrap around to zero.  For hybrid vehicles or for vehicles that employ engine shutoff strategies (e.g. engine shutoff at idle), RUNTM shall increment after the ignition switch is turned to the on position and the engine is running, or, if the vehicle can be started in electric-only mode, RUNTM shall increment after the ignition switch is turned to the on position and the vehicle starts to move. It shall continue to increment even if the engine is turned off by the vehicle control system. RUNTM shall be reset to zero during every control module power-up and when entering the key-on, engine off position. RUNTM is limited to 65535 seconds and shall not wrap around to zero. | | | | | | |

TABLE B27 - PID $21 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 21 | Distance Traveled While MIL is Activated | A, B | 0 km | 65535 km | 1 km per count | MIL_DIST: xxxxx km (xxxxx miles) |
| | Data may be reported for the vehicle by a single ECU or may be reported by each OBD ECU that activates the MIL.<br><br>Conditions for "Distance traveled" counter:<br>• reset to $0000 when MIL state changes from deactivated to activated;<br>• accumulate counts in km if MIL is activated (ON);<br>• do not change value while MIL is not activated (OFF);<br>• reset to $0000 if diagnostic information is cleared either by service $04 or at least 40 warm-up cycles without MIL activated;<br>• do not wrap to $0000 if value is $FFFF. | | | | | | |

TABLE B28 - PID $22 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 22 | Fuel Pressure relative to manifold vacuum | A, B | 0 kPa | 5177.27 kPa | 0.079 kPa (5178/65535) per bit unsigned, 1 kPa = 0.1450377 PSI | FP: xxxx.x kPa (xxx.x PSI) |
| | FP shall display fuel pressure when the reading is referenced to manifold vacuum (relative pressure). | | | | | | |

TABLE B29 - PID $23 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 23 | Fuel Rail Pressure | A, B | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | FRP: xxxxxx kPa (xxxxx.x PSI) |
| | FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure). This PID is intended for diesel fuel pressure and gasoline direct injection systems that have a higher pressure range than PIDs $0A and $22. | | | | | | |

TABLE B30 - PID $24 - $2B DEFINITION (1 OR 2 BANKS)

| PID (hex) | Description<br>Use if PID $13 is Supported! | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment<br>SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 24 | Bank 1 – Sensor 1 (wide range O2S) | | | | | |
| 25 | Bank 1 – Sensor 2 (wide range O2S) | | | | | |
| 26 | Bank 1 – Sensor 3 (wide range O2S) | | | | | |
| 27 | Bank 1 – Sensor 4 (wide range O2S) | | | | | |
| 28 | Bank 2 – Sensor 1 (wide range O2S) | | | | | |
| 29 | Bank 2 – Sensor 2 (wide range O2S) | | | | | |
| 2A | Bank 2 – Sensor 3 (wide range O2S) | | | | | |
| 2B | Bank 2 – Sensor 4 (wide range O2S) | | | | | |
| | Equivalence Ratio (lambda) (Bx-Sy) | A, B | 0 | 1.999 | 0.0000305 (2/65535) | LAMBDAxy: xxx.xxx |
| | Oxygen Sensor Voltage (Bx-Sy) | C, D | 0 V | 7.999 V | 0.000122 V (8/65535) | O2Sxy: xxx.xxx V |
| | PIDs $24 to $2B shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed.<br><br>If PID $4F is not supported for this ECU, or if PID $4F is supported and includes $00 for either Equivalence Ratio or Maximum Oxygen Sensor Voltage, the external test equipment shall use the scaling values included in this table for those values. If PID $4F is supported for this ECU and Data A or Data B of PID $4F contains a value greater than $00, the external test equipment shall calculate scaling and range for these PIDs as explained in the PID $4F definition.<br><br>NOTE:  LAMBDA is preferred for External Test Equipment Display instead of EQ_RAT in previous versions of this document.<br><br>NOTE:  The PIDs listed in this table only apply if PID $13 is used to define the oxygen sensor location. | | | | | |

TABLE B31 - PID $24 - $2B DEFINITION (3 OR 4 BANKS)

| PID (hex) | Description<br>Use if PID $1D is Supported! | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment<br>SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 24 | Bank 1 - Sensor 1 (wide range O2S) | | | | | |
| 25 | Bank 1 - Sensor 2 (wide range O2S) | | | | | |
| 26 | Bank 2 - Sensor 1 (wide range O2S) | | | | | |
| 27 | Bank 2 - Sensor 2 (wide range O2S) | | | | | |
| 28 | Bank 3 - Sensor 1 (wide range O2S) | | | | | |
| 29 | Bank 3 - Sensor 2 (wide range O2S) | | | | | |
| 2A | Bank 4 - Sensor 1 (wide range O2S) | | | | | |
| 2B | Bank 4 - Sensor 2 (wide range O2S) | | | | | |
| | Equivalence Ratio (lambda) (Bx-Sy) | A, B | 0 | 1.999 | 0.0000305 (2/65535) | LAMBDAxy: xxx.xxx |
| | Oxygen Sensor Voltage (Bx-Sy) | C, D | 0 V | 7.999 V | 0.000122 V (8/65535) | O2Sxy: xxx.xxx V |
| | PIDs $24 to $2B shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed.<br><br>See the explanation of scaling values for PIDs $24 to $2B for 1 or 2 bank systems in the previous table.<br><br>NOTE:  The PIDs listed in this table only apply if PID $1D is used to define the oxygen sensor location. | | | | | |

TABLE B32 - PID $2C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 2C | Commanded EGR | A | 0 % (no flow) | 100 % (max. flow) | 100/255 % | EGR_PCT: xxx.x % |
| | Commanded EGR displayed as a percent. EGR_PCT shall be normalized to the maximum EGR commanded output control parameter. EGR systems use a variety of methods to control the amount of EGR delivered to the engine. | | | | | |
| | 1) If an on/off solenoid is used, EGR_PCT shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on. | | | | | |
| | 2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed. | | | | | |
| | 3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%; the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 128 counts shall display 0% at zero counts, 100% at 128 counts and 50% at 64 counts. | | | | | |
| | 4) Any other actuation method shall be normalized to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position. | | | | | |

TABLE B33 - PID $2D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 2D | EGR Error | A | – 100 % (less than commanded) | +99.22 % (more than commanded) | 100/128 % (0 % at 128) | EGR_ERR: xxx.x % |
| | EGR error is a percent of commanded EGR. Often, EGR valve control outputs are not in the same engineering units as the EGR feedback input sensors. For example, an EGR valve can be controlled using a duty-cycled vacuum solenoid; however, the feedback input sensor is a position sensor. This makes it impossible to display "actual" versus "commanded" in the same engineering units. EGR error solved this problem by displaying a normalized (non-dimensional) EGR system feedback parameter. EGR error is defined to be | | | | | |
| | ((EGR actual - EGR commanded) / EGR commanded) * 100% | | | | | |
| | For example, if 10% EGR is commanded and 5 % is delivered to the engine, the EGR_ERR is ((5% – 10%) / 10%) * 100% = –50% error. | | | | | |
| | EGR_ERR may be computed using various control parameters such as position, steps, counts, etc. All EGR systems must react to quickly changing conditions in the engine; therefore, EGR_ERR will generally show errors during transient conditions. Under steady condition, the error will be minimized (not necessarily zero, however) if the EGR system is under control. | | | | | |
| | If the control system does not use closed loop control, EGR_ERR shall not be supported. | | | | | |
| | When commanded EGR is 0%, EGR error is technically undefined. In this case EGR error should be set to 0% when actual EGR = 0% or EGR error should be set to 99.2% when actual EGR > 0%. | | | | | |

TABLE B34 - PID $2E DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 2E | Commanded Evaporative Purge | A | 0 % no flow | 100 % max. flow | 100/255 % | EVAP_PCT: xxx.x % |
| | Commanded evaporative purge control valve displayed as a percent. EVAP_PCT shall be normalized to the maximum EVAP purge commanded output control parameter. | | | | | |
| | 1) If an on/off solenoid is used, EVAP_PCT shall display 0% when purge is commanded off, 100% when purge is commanded on. | | | | | |
| | 2) If a vacuum solenoid is duty-cycled, the EVAP purge valve duty cycle from 0 to 100% shall be displayed. | | | | | |
| | 3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, and the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EVAP purge valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts. | | | | | |
| | 4) Any other actuation method shall be normalized to display 0% when no purge is commanded and 100% at the maximum commanded purge position/flow. | | | | | |

TABLE B35 - PID $2F DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 2F | Fuel Level Input | A | 0 % no fuel | 100 % max. fuel capacity | 100/255 % | FLI: xxx.x % |
| | FLI shall indicate nominal fuel tank liquid fill capacity as a percent of maximum. FLI may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs. Vehicles that use gaseous fuels shall display the percent of useable fuel capacity. If there are two tanks in a bi-fuel car, one for each fuel type, the Fuel Level Input reported shall be from the tank, which contains the fuel type the engine is running on. | | | | | |

TABLE B36 - PID $30 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 30 | Number of warm-ups since DTCs cleared | A | 0 | 255 | 1 warm-up per count | WARM_UPS: xxx |
| | Number of OBD warm-up cycles since all DTCs were cleared (via external test equipment or possibly, a battery disconnect). A warm-up is defined in the OBD regulations to be sufficient vehicle operation such that coolant temperature rises by at least 22 °C (40 °F) from engine starting and reaches a minimum temperature of 70 °C (160 °F) (60 °C (140 °F) for diesels). This PID is not associated with any particular DTC. It is simply an indication for I/M, of the last time external test equipment was used to clear DTCs. If greater than 255 warm-ups have occurred, WARM_UPS shall remain at 255 and not wrap to zero. Data may be reported for the vehicle by a single ECU or may be reported by each OBD ECU that activates the MIL. | | | | | |

TABLE B37 - PID $31 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 31 | Distance traveled since DTCs cleared | A, B | 0 km | 65535 km | 1 km per count | CLR_DIST: xxxxx km (xxxxx miles) |
| | This is distance accumulated since DTCs were cleared (via external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/Maintenance) of the last time external test equipment was used to clear DTCs. If greater than 65535 km has occurred, CLR_DIST shall remain at 65535 km and not wrap to zero. Data may be reported for the vehicle by a single ECU or may be reported by each OBD ECU that activates the MIL. | | | | | | |

TABLE B38 - PID $32 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 32 | Evap System Vapor Pressure | A, B | ($8000) −8192 Pa (−32.8878 inH2O) | ($7FFF) 8191.75 Pa, (32.8868 in H2O) | 0.25 Pa (1/4) per bit signed | EVAP_VP: xxxx.x Pa (xx.xxx in $H_2O$) |
| | This is evaporative system vapor pressure. The pressure signal is normally obtained from a sensor located in the fuel tank (FTP – Fuel Tank Pressure) or a sensor in an evaporative system vapor line. If a wider pressure range is required, PID $54 scaling allows for a wider pressure range than PID $32.

For systems supporting Evap System Vapor Pressure, one of the following two PIDs is required: $32 or $54. Support for more than one of these PIDs is not allowed. | | | | | | |

TABLE B39 - PID $33 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 33 | Barometric Pressure | A | 0 kPa (absolute) | 255 kPa (absolute) | 1 kPa per bit (absolute) | BARO: xxx kPa (xx.x inHg) |
| | Barometric pressure. BARO is normally obtained from a dedicated BARO sensor, from a MAP sensor at key-on and during certain modes of driving, or inferred from a MAF sensor and other inputs during certain modes of driving. The control module shall report BARO from whatever source it is derived from.

NOTE 1:  Some weather services report local BARO values adjusted to sea level. In these cases, the reported value may not match the displayed value on the external test equipment.
NOTE 2:  If BARO is inferred while driving and stored in non-volatile RAM or Keep-alive RAM, BARO may not be accurate after a battery disconnect or total memory clear. | | | | | | |

TABLE B40 - PID $34 - $3B DEFINITION (1 OR 2 BANKS)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 34 | Bank 1 – Sensor 1 (wide range O2S) | | | | | |
| 35 | Bank 1 – Sensor 2 (wide range O2S) | | | | | |
| 36 | Bank 1 – Sensor 3 (wide range O2S) | | | | | |
| 37 | Bank 1 – Sensor 4 (wide range O2S) | | | | | |
| 38 | Bank 2 – Sensor 1 (wide range O2S) | | | | | |
| 39 | Bank 2 – Sensor 2 (wide range O2S) | | | | | |
| 3A | Bank 2 – Sensor 3 (wide range O2S) | | | | | |
| 3B | Bank 2 – Sensor 4 (wide range O2S) | | | | | |
| | Equivalence Ratio (lambda) (Bx-Sy) | A, B | 0 | 1.999 | 0.0000305 (2/65535) | LAMBDAxy: xxx.xxx |
| | Oxygen Sensor Current (Bx-Sy) | C, D | − 128 mA | 127.996 mA | 0.00390625 mA (128/32768) ($8000 = 0 mA) | O2Sxy: xxx.xx mA |
| | PIDs $34 to $3B shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed. If PID $4F is not supported for this ECU, or if PID $4F is supported and includes $00 for either Equivalence Ratio or Maximum Oxygen Sensor Current, the external test equipment shall use the scaling values included in this table for those values. If PID $4F is supported for this ECU and Data A or Data C of PID $4F contains a value greater than $00, the external test equipment shall calculate scaling and range for these PIDs as explained in the PID $4F definition. NOTE:  LAMBDA is preferred for External Test Equipment Display instead of EQ_RAT in previous versions of this document. NOTE:  The PIDs listed in this table only apply if PID $13 is used to define the oxygen sensor location. | | | | | | |

TABLE B41 - PID $34 - $3B DEFINITION (3 OR 4 BANKS)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 34 | Bank 1 – Sensor 1 (wide range O2S) | | | | | |
| 35 | Bank 1 – Sensor 2 (wide range O2S) | | | | | |
| 36 | Bank 2 – Sensor 1 (wide range O2S) | | | | | |
| 37 | Bank 2 – Sensor 2 (wide range O2S) | | | | | |
| 38 | Bank 3 – Sensor 1 (wide range O2S) | | | | | |
| 39 | Bank 3 – Sensor 2 (wide range O2S) | | | | | |
| 3A | Bank 4 – Sensor 1 (wide range O2S) | | | | | |
| 3B | Bank 4 – Sensor 2 (wide range O2S) | | | | | |
| | Equivalence Ratio (lambda) (Bx-Sy) | A, B | 0 | 1.999 | 0.0000305 (2/65535) | LAMBDAxy: xxx.xxx |
| | Oxygen Sensor Current (Bx-Sy) | C, D | − 128 mA | 127.996 mA | 0.00390625 mA (128/32768) ($8000 = 0 mA) | O2Sxy: xxx.xx mA |
| | PIDs $34 to $3B shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed. See the explanation of scaling values for PIDs $34 to $3B for 1 or 2 bank systems in the previous table. NOTE:  The PIDs listed in this table only apply if PID $1D is used to define the oxygen sensor location. | | | | | | |

TABLE B42 - PID $3C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 3C | Catalyst Temperature Bank 1, Sensor 1 | A, B | – 40 °C | + 6513.5 °C | 0.1 °C / bit with – 40 °C offset | CATEMP11: xxxx °C (xxxx °F) |
| | CATEMP11 shall display catalyst temperature for a bank 1 catalyst or the Bank 1, Sensor 1 catalyst temperature sensor. CATEMP11 may be obtained directly from a sensor or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B43 - PID $3D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 3D | Catalyst Temperature Bank 2, Sensor 1 | A, B | – 40 °C | + 6513.5 °C | 0.1 °C / bit with – 40 °C offset | CATEMP21: xxxx °C (xxxx °F) |
| | CATEMP21 shall display catalyst temperature for a bank 2 catalyst or the Bank 2, Sensor 1 catalyst temperature sensor. CATEMP21 may be obtained directly from a sensor or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B44 - PID $3E DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 3E | Catalyst Temperature Bank 1, Sensor 2 | A, B | – 40 °C | + 6513.5 °C | 0.1 °C / bit with – 40 °C offset | CATEMP12: xxxx °C (xxxx °F) |
| | CATEMP12 shall display catalyst temperature for an additional bank 1 catalyst or the Bank 1, Sensor 2 catalyst temperature sensor. CATEMP12 may be obtained directly from a sensor or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B45 - PID $3F DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 3F | Catalyst Temperature Bank 2, Sensor 2 | A, B | – 40 °C | + 6513.5 °C | 0.1 °C / bit with – 40 °C offset | CATEMP22: xxxx °C (xxxx °F) |
| | CATEMP22 shall display catalyst temperature for an additional bank 2 catalyst or the Bank 2, Sensor 2 catalyst temperature sensor. CATEMP22 may be obtained directly from a sensor or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B46 - PID $41 DEFINITION

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 41 | Monitor status this driving cycle | | | |

The bit in this PID shall report two pieces of information for each monitor:

1) Monitor enable status for the current driving cycle. This bit shall indicate when a monitor is disabled in a manner such that there is no easy way for the driver to operate the vehicle to allow the monitor to run. Typical examples are:
– engine-off soak not long enough (e.g., cold start temperature conditions not satisfied);
– monitor maximum time limit or number of attempts/aborts exceeded;
– ambient air temperature too low or too high;
– BARO too low (high altitude).
– monitor disabled due to sensor failure.

The monitor shall not indicate "disabled" for operator-controlled conditions such as rpm, load, and throttle position. The monitor shall not indicate "disabled" from key-on because minimum time limit has not been exceeded or engine warm-up conditions have not been met, since these conditions will eventually be met as the vehicle continues to be driven.

NOTE:  If the operator drives the vehicle to a different altitude or ambient air temperature conditions, monitor status may change from enabled to disabled. The monitor status for this PID shall not change from disable to enable even if the conditions change back and the monitor is actually enabled. This could result in a monitor status showing "disabled" but eventually showing "complete".

2) Monitor completion status for the current driving/monitoring cycle. Status shall be reset to "not complete" upon starting a new monitoring cycle. Note that some monitoring cycles can include various engine-operating conditions; other monitoring cycles begin after the ignition key is turned off. Some status bits on a given vehicle can utilize engine-running monitoring cycles while others can utilize engine-off monitoring cycles. Resetting the bits to "not complete" upon starting the engine will accommodate most engine-running and engine-off monitoring cycles; however, manufacturers are free to define their own monitoring cycles.

PID $41 bits shall be utilized for all non-continuous monitors which are supported, and change completion status in PID $01. If a non-continuous monitor is not supported or always shows "complete", the corresponding PID $41 bits shall indicate disabled and complete. PID $41 bits may be utilized at the vehicle manufacturer's discretion for all continuous monitors which are supported, with the exception of data byte B bit 2 which shall always show CCM (Comprehensive Component Monitoring) as enabled for spark-ignition and compression-ignition vehicles.

TABLE B46 - PID $41 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 41 | | A (bit) | byte 1 of 4 | |
| | Reserved – shall be reported as $00 | 0-7 | | — |
| | **Enable status of continuous monitors this monitoring cycle:** | **B (bit)** | **byte 2 of 4 (Low Nibble)** | |
| | Misfire monitoring enabled<br>Fuel system monitoring enabled<br>Comprehensive component monitoring enabled | 0<br>1<br><br>2 | See PID $01 to determine which monitors are supported.<br>0 = monitor disabled for rest of this monitoring cycle (NO)<br>0 = monitor not supported (N/A)<br>1 = monitor enabled for this monitoring cycle (YES) | MIS_ENA: NO, YES or N/A<br>FUEL_ENA: NO, YES or N/A<br><br>CCM_ENA: NO, YES or N/A |
| | Enable status of continuous monitors this monitoring cycle: NO means disabled for rest of this monitoring cycle, N/A means not supported in PID $01; YES means enabled for this monitoring cycle. | | | |
| | Compression ignition monitoring supported | 3 | 0 = Spark ignition monitors supported<br>1 = Compression ignition monitors supported | Not displayed by external test equipment |
| | Indicates support of spark ignition or compression ignition monitors and data labels within Data Bytes C and D of PID $41. | | | |
| | **Completion status of continuous monitors this monitoring cycle:** | **B (bit)** | **byte 2 of 4 (High Nibble)** | |
| | Misfire monitoring completed<br>Fuel system monitoring completed<br>Comprehensive component monitoring completed | 4<br>5<br>6 | See PID $01 to determine which monitors are supported.<br><br>0 = monitor complete this monitoring cycle (YES)<br>0 = monitor not supported (N/A)<br>1 = monitor not complete this monitoring cycle (NO) | MIS_CMPL: YES, NO or N/A<br>FUELCMPL: YES, NO, or N/A<br>CCM_CMPL: YES, NO or N/A |
| | ISO/SAE reserved (Bit shall be reported as '0') | 7 | | — |
| | **The following descriptions for Bytes C and D are to be used for spark ignition vehicles only.** | | | |
| | **Enable status of non-continuous monitors this monitoring cycle:** | **C (bit)** | **byte 3 of 4** | **Enable status of non-continuous monitors this monitoring cycle:** |
| | Catalyst monitoring<br>Heated catalyst monitoring<br>Evaporative system monitoring<br>Secondary air system monitoring<br>ISO/SAE reserved (bit shall be reported as "0")<br>Oxygen sensor monitoring<br>Oxygen sensor heater monitoring<br>EGR and/or VVT system monitoring | 0<br>1<br>2<br>3<br>4<br><br>5<br>6<br>7 | See PID $01 to determine which monitors are supported.<br>0 = monitor disabled for rest of this monitoring cycle (NO)<br>0 = monitor not supported (N/A)<br>1 = monitor enabled for this monitoring cycle (YES) | CAT_ENA: NO, YES or N/A<br>HCAT_ENA: NO, YES or N/A<br>EVAP_ENA: NO, YES or N/A<br>AIR_ENA: NO, YES, or N/A<br>—<br><br>O2S_ENA: NO, YES or N/A<br>HTR_ENA: NO, YES or N/A<br>EGR_ENA: NO, YES or N/A |

TABLE B46 - PID $41 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 41 | **Completion status of non-continuous monitors this monitoring cycle:** | **D (bit)** | **byte 4 of 4** | **Completion status of non-continuous monitors this monitoring cycle:** |
| | Catalyst monitoring completed | 0 | See PID $01 to determine which monitors are supported. | CAT_CMPL: YES, NO or N/A |
| | Heated catalyst monitoring completed | 1 | | HCATCMPL: YES, NO or N/A |
| | Evaporative system monitoring completed | 2 | | EVAPCMPL: YES, NO or N/A |
| | Secondary air system monitoring completed | 3 | 0 = monitor complete this monitoring cycle (YES) | AIR_CMPL: YES, NO or N/A |
| | ISO/SAE reserved (bit shall be reported as "0") | 4 | 0 = monitor not supported (N/A) | — — — |
| | Oxygen sensor monitoring completed | 5 | 1 = monitor not complete this monitoring cycle (NO) | O2S_CMPL: YES, NO or N/A |
| | Oxygen sensor heater monitoring completed | 6 | | HTR_CMPL: YES, NO or N/A |
| | EGR and/or VVT system monitoring completed | 7 | | EGR_CMPL: YES, NO or N/A |
| | **The following descriptions for Bytes C and D are to be used for compression ignition vehicles only.** | | | |
| | **Enable status of non-continuous monitors this monitoring cycle:** | **C (bit)** | **byte 3 of 4** | **Enable status of non-continuous monitors this monitoring cycle:** |
| | NMHC catalyst monitoring | 0 | See PID $01 to determine which monitors are supported. | HCCATENA: NO, YES or N/A |
| | NOx/SCR aftertreatment monitoring | 1 | | NCAT_ENA: NO, YES or N/A |
| | ISO/SAE reserved (bit shall be reported as "0") | 2 | 0 = monitor disabled for rest of this monitoring cycle (NO) | — — — |
| | Boost pressure system monitoring | 3 | | BP_ENA: NO, YES or N/A |
| | ISO/SAE reserved (bit shall be reported as "0") | 4 | 0 = monitor not supported (N/A) | — — — |
| | Exhaust gas sensor monitoring | 5 | 1 = monitor enabled for this monitoring cycle (YES) | EGS_ENA: NO, YES or N/A |
| | PM filter monitoring | 6 | | PM_ENA: NO, YES or N/A |
| | EGR and/or VVT system monitoring | 7 | | EGR_ENA: NO, YES or N/A |
| | **Completion status of non-continuous monitors this monitoring cycle:** | **D (bit)** | **byte 4 of 4** | **Completion status of non-continuous monitors this monitoring cycle:** |
| | NMHC catalyst monitoring completed | 0 | See PID $01 to determine which monitors are supported. | HCCATCMP: YES, NO or N/A |
| | NOx/SCR aftertreatment monitoring completed | 1 | | NCATCMPL: YES, NO or N/A |
| | ISO/SAE reserved (Bit shall be reported as '0'.) | 2 | 0 = monitor complete this monitoring cycle (YES) | — — — |
| | Boost pressure system monitoring completed | 3 | 0 = monitor not supported (N/A) | BP_CMPL: YES, NO or N/A |
| | ISO/SAE reserved (bit shall be reported as "0") | 4 | 1 = monitor not complete this monitoring cycle (NO) | — — — |
| | Exhaust gas sensor monitoring completed | 5 | | EGS_CMPL: YES, NO or n/A |
| | PM filter monitoring completed | 6 | | PM_CMPL: YES, NO or N/A |
| | EGR and/or VVT system monitoring completed | 7 | | EGR_CMPL: YES, NO or N/A |

TABLE B47 - PID $42 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 42 | Control module voltage | A, B | 0 V | 65.535 V | 0.001 V (1/1000) per bit | VPWR: xx.xx V |
| | VPWR – power input to the control module. VPWR is normally battery voltage, less any voltage drop in the circuit between the battery and the control module. | | | | | |
| | NOTE: 42-volts vehicles may utilize multiple voltages for different systems on the vehicle. VPWR represents the voltage at the control module; it may be significantly different than battery voltage. | | | | | |

TABLE B48 - PID $43 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 43 | Absolute Load Value | A, B | 0 % | 25700 % | 100/255 % | LOAD_ABS: xxxxx.x % |

The absolute load value has some different characteristics than the LOAD_PCT defined in PID $04. This definition, although restrictive, will standardize the calculation. LOAD_ABS is the normalized value of air mass per intake stroke displayed as a percent:

LOAD_ABS = [air mass (g / intake stroke)] / [1.184 (g / liter) * cylinder displacement (liters / intake stroke)]

NOTE: At engine off and ignition on the LOAD_ABS = 0 %.

Derivation:
– air mass (g / intake stroke) = [total engine air mass (g/sec)] / [rpm (revs/min)* (1 min / 60 sec) * (1/2 # of cylinders (intake strokes / rev)];
– LOAD_ABS = [air mass (g)/intake stroke] / [maximum air mass (g)/intake stroke at WOT@STP at 100 % volumetric efficiency] * 100 %.

Where:
– STP = Standard Temperature and Pressure = 25 °C, 29.92 in Hg (101.3 kPa) BARO,
– WOT = wide open throttle.
– The quantity (maximum air mass (g)/intake stroke at WOT@STP at 100 % volumetric efficiency) is a constant for a given cylinder swept volume. The constant is 1.184 (g/liter) * cylinder displacement (liters/intake stroke) based on air density at STP.

Characteristics of LOAD_ABS:
– ranges from 0 % to approximately 95 % for naturally aspirated engines, 0 % to 400 % for boosted engines;
– linearly correlated with engine indicated and brake torque;
– often used to schedule spark and EGR rates;
– peak value of LOAD_ABS correlates with volumetric efficiency at WOT;
– indicates the pumping efficiency of the engine for diagnostic purposes.

Spark-ignition vehicles are required to support PID $43. Compression-ignition (diesel) vehicles are not required to support this PID.

See PID $04 for an additional definition of engine LOAD.

TABLE B49 - PID $44 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 44 | Fuel/Air Commanded Equivalence Ratio | A, B | 0 | 1.999 | 0.0000305 (2/65535) | LAMBDA: xxx.xxx |
| | Spark ignition fuel control systems that utilize conventional (not wide-range/linear) oxygen sensor shall display the commanded open loop F/A equivalence ratio (also known as lambda) while the fuel control system is in open loop. LAMBDA shall indicate 1.000 while in closed-loop fuel. Fuel systems that utilize wide-range/linear oxygen sensors shall display the commanded F/A equivalence ratio (lambda) in both open-loop and closed-loop operation. | | | | | |
| | NOTE:  A/F Equivalence Ratio (AFR)  = (Stoichiometric A/F Ratio) / (Actual A/F Ratio); > 1 is rich, < 1 is lean  Lambda (λ) = (Actual A/F Ratio) / (Stoichiometric A/F Ratio); > 1 is lean, < 1 is rich  Lambda is the inverse of A/F equivalence ratio  F/A Equivalence Ratio (FAR)  = (Stoichiometric F/A Ratio) / (Actual F/A Ratio); > 1 is lean, < 1 is rich  Lambda is same as F/A equivalence ratio | | | | | |
| | To obtain the actual A/F ratio being commanded, multiply the stoichiometric A/F ratio by the inverse of the equivalence ratio (lambda). For example, for gasoline, stoichiometric is a ratio of 14.64:1. If the fuel control system was commanding a 0.95 LAMBDA, the commanded A/F ratio to the engine would be 14.64 * 0.95 = 13.9 A/F. | | | | | |
| | If PID $4F is not supported for this ECU, or if PID $4F is supported and includes $00 for Equivalence Ratio, the external test equipment shall use the scaling value included in this table. If PID $4F is supported for this ECU and Data A of PID $4F contains a value greater than $00, the external test equipment shall calculate scaling for this PID as explained in the PID $4F definition. | | | | | |

TABLE B50 - PID $45 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 45 | Relative Throttle Position | A | 0 % | 100 % | 100/255 % | TP_R: xxx.x % |
| | Relative or "learned" throttle position shall be displayed as a normalized value, scaled from 0 to 100 %. TP_R should display a value of 0 % at the "learned" closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-throttle position is at 1.0 volts, TP shall display (1.0 − 1.0 / 5.0) = 0 % at closed throttle and 30 % at 2.5 volts. Because of the closed-throttle offset, wide-open throttle will usually indicate substantially less than 100 %. | | | | | |
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. See PID $11 for a definition of Absolute Throttle Position. | | | | | |

TABLE B51 - PID $46 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 46 | Ambient air temperature (same scaling as IAT - $0F) | A | − 40 °C | + 215 °C | 1 °C with − 40 °C offset | AAT: xxx °C / xxx °F |
| | AAT shall display ambient air temperature. AAT may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus or may be inferred by the control strategy using other sensor inputs, e.g. IAT. | | | | | |

TABLE B52 - PID $47 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 47 | Absolute Throttle Position B | A | 0 % | 100 % | 100/255 % | TP_B: xxx.x % |
| | Absolute throttle position B, (not "relative" or "learned" throttle position) shall be displayed as a normalized value, scaled from 0 to 100 %. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-throttle position is at 1.0 volts, TP_B shall display (1.0 / 5.0) = 20 % at closed throttle and 50 % at 2.5 volts. Throttle position at idle will usually indicate greater than 0 %, and throttle position at wide-open throttle will usually indicate less than 100 %. ||||||
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. ||||||
| | A single throttle plate could have up to three throttle position sensors, A, B and C. A dual throttle plate system could have up to four throttle position sensors, A, B, C and G. ||||||

TABLE B53 - PID $48 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 48 | Absolute Throttle Position C | A | 0 % | 100 % | 100/255 % | TP_C: xxx.x % |
| | Absolute throttle position C, (not "relative" or "learned" throttle position) shall be displayed as a normalized value, scaled from 0 to 100 %. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-throttle position is at 1.0 volts, TP_C shall display (1.0 / 5.0) = 20 % at closed throttle and 50 % at 2.5 volts. Throttle position at idle will usually indicate greater than 0 %, and throttle position at wide-open throttle will usually indicate less than 100 %. ||||||
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. ||||||
| | A single throttle plate could have up to three throttle position sensors, A, B and C. A dual throttle plate system could have up to four throttle position sensors, A, B, C and G. ||||||

TABLE B54 - PID $49 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 49 | Accelerator Pedal Position D | A | 0 % | 100 % | 100/255 % | APP_D: xxx.x % |
| | Accelerator Pedal Position D, (not "relative" or "learned" pedal position) shall be displayed as a normalized value, scaled from 0 to 100 %. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-pedal position is 1.0 volt, APP_D shall display (1.0 / 5.0) = 20 % at closed pedal and 50 % at 2.5 volts. Pedal position at idle will usually indicate greater than 0 %, and pedal position at wide-open pedal will usually indicate less than 100 %. ||||||
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. ||||||
| | The designation "D" shall match the diagnostic trouble code defined in SAE J2012 and/or SAE J2012 DA. If additional DTCs are defined, those should match this PID designation. Pedal sensor designations are D, E and F. ||||||

TABLE B55 - PID $4A DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4A | Accelerator Pedal Position E | A | 0 % | 100 % | 100/255 % | APP_E: xxx.x % |
| | Accelerator Pedal Position E, (not "relative" or "learned" pedal position) shall be displayed as a normalized value, scaled from 0 to 100 %. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-pedal position is 1.0 volt, APP_E shall display (1.0 / 5.0) = 20 % at closed pedal and 50 % at 2.5 volts. Pedal position at idle will usually indicate greater than 0 %, and pedal position at wide-open pedal will usually indicate less than 100 %. | | | | | |
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. | | | | | |
| | The designation "E" shall match the diagnostic trouble code defined in SAE J2012 and/or SAE J2012 DA. If additional DTCs are defined, those should match this PID designation. Pedal sensor designations are D, E and F. | | | | | |

TABLE B56 - PID $4B DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4B | Accelerator Pedal Position F | A | 0 % | 100 % | 100/255 % | APP_F: xxx.x % |
| | Accelerator Pedal Position F, (not "relative" or "learned" pedal position) shall be displayed as a normalized value, scaled from 0 to 100 %. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-pedal position is 1.0 volt, APP_F shall display (1.0 / 5.0) = 20 % at closed pedal and 50 % at 2.5 volts. Pedal position at idle will usually indicate greater than 0 %, and pedal position at wide-open pedal will usually indicate less than 100 %. | | | | | |
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. | | | | | |
| | The designation "F" shall match the diagnostic trouble code defined in SAE J2012 and/or SAE J2012 DA. If additional DTCs are defined, those should match this PID designation. Pedal sensor designations are D, E and F. | | | | | |

TABLE B57 - PID $4C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4C | Commanded Throttle Actuator Control | A | 0 % (closed throttle) | 100 % (wide-open throttle) | 100/255 % | TAC_PCT: xxx.x % |
| | Commanded TAC displayed as a percent. TAC_PCT shall be normalized to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening: | | | | | |
| | 1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0 %, and the fully open throttle position shall be displayed as 100 %. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 128 counts shall display 0 % at 0 counts, 100 % at 128 counts and 50 % at 64 counts. | | | | | |
| | 2) Any other actuation method shall be normalized to display 0 % when the throttle is commanded closed and 100 % when the throttle is commanded open. | | | | | |

TABLE B58 - PID $4D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4D | Engine run time while MIL is activated | A, B | 0 min | 65 535 min | 1 min per count | MIL_TIME: xxxx hrs, xx min |
| | Conditions for "Engine run time while MIL is activated" counter: <br> – reset to $0000 when MIL state changes from deactivated to activated by this ECU; <br> – accumulate counts in minutes if MIL is activated (ON); <br> – do not change value while MIL is not activated (OFF); <br> – reset to $0000 if diagnostic information is cleared either by service $04 or at least 40 warm-up cycles without MIL activated; <br> – do not wrap to $0000 if value is $FFFF. | | | | | |

TABLE B59 - PID $4E DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4E | Engine run time since DTCs cleared | A, B | 0 min | 65 535 min | 1 min per count | CLR_TIME: xxxx hrs, xx min |
| | Engine run time accumulated since DTCs were cleared (via external test equipment or possibly a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/Maintenance) of the last time external test equipment was used to clear DTCs. If greater than 65535 min has occurred, CLR_TIME shall remain at 65535 min and not wrap to zero. | | | | | |

TABLE B60 - PID $4F DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4F | External Test Equipment Configuration Information #1 | | | | | |
| | These values shall be used by the external test equipment to calculate scaling factors for PIDs that are different from the values in the PID definition tables included in this document. | | | | | |
| | Maximum value for Equivalence Ratio | A | 0 | 255 | 1 | These values are not intended for display to the service technician. |
| | Data A shall be used by the external test equipment to calculate the scaling per bit of PIDs $24 to $2B, PIDs $34 to $3B, and PID $44. If Data A is reported as $00, the external test equipment shall use the "Maximum value for Equivalence Ratio" included in the original PID definition (1.999 / 65535 = 0.0000305 per bit). If the value reported in Data A of PID $4F is greater than $00, that value shall be divided by 65535 to calculate the scaling per bit to use to display Equivalence Ratio. (Data A contains the new maximum value for PIDs $24 to $2B, PIDs $34 to $3B and PID $44.) | | | | | |
| | The following is an example to calculate PID $24 with PID $4F supported and including a non-zero value. In this example, a manufacturer needs a range of equivalence ratio larger than 0 to 1.999. The manufacturer needs a range of 0 to 4 and sets Data A = 4. | | | | | |
| | EXAMPLE: $LAMBDA11_{(PID24)} = DATA\_A\_B_{(PID24)} * (DATA\_A_{(PID4F)} / 65535)$ <br> New scaling per bit for PID $24 = $DATA\_A_{(PID4F)} / 65535 = 4_{(10)} / 65535_{(10)} = 0.0000610$ per bit <br> $DATA\_A\_B_{(PID24)} = \$7D00 = 32000_{10}$ = value reported by vehicle ECU <br> $LAMBDA11_{PID24} = 32000 * (4 / 65535) = 1.953$ | | | | | |

TABLE B60 - PID $4F DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4F | Maximum value for Oxygen Sensor Voltage | B | 0 V | 255 V | 1 V | These values are not intended for display to the service technician. |
| | Data B shall be used by the external test equipment to calculate the scaling per bit of PIDs $24 to $2B.<br><br>If PIDs $24 to $2B are supported by this ECU and Data B is reported as $00, the external test equipment shall use the "Maximum value for Oxygen Sensor Voltage" included in the original PID definition (7.999 V / 65535 bits = 0.000122 V per bit). If the value reported in Data B of PID $4F is greater than $00, that value shall be divided by 65535 to calculate the scaling per bit to use to display Oxygen Sensor Voltage.<br><br>If PIDs $34 to $3B are supported by this ECU, this value shall be reported as $00.<br><br>The following is an example to calculate PID $24 with PID $4F supported and including a non-zero value. In this example, a manufacturer needs a range of voltage larger than 0 to 7.999 V. The manufacturer needs a range of 0 to 16 V and sets Data A = 16.<br><br>EXAMPLE: $O2S11_{(PID24)} = DATA\_C\_D_{(PID24)} * (DATA\_B_{(PID4F)} * 1 V / 65535)$<br>New scaling per bit for PID $24 = $DATA\_B_{(PID4F)} * 1 V / 65535 = 16_{(10)} * 1 V / 65535_{(10)} = 0.000244$ V per bit<br>$DATA\_C\_D_{(PID24)} = \$9C40 = 40000_{10}$ = value reported by vehicle ECU<br>$O2S11_{(PID24)} = 40000 * (16 V / 65535) = 9.766$ V | | | | | |
| | Maximum value for Oxygen Sensor Current | C | 0 mA | 255 mA | 1 mA | These values are not intended for display to the service technician. |
| | Data C shall be used by the external test equipment to calculate the scaling per bit of PIDs $34 to $3B.<br><br>If PIDs $34 to $3B are supported by this ECU and Data C is reported as $00, the external test equipment shall use the "Maximum value for Oxygen Sensor Current" included in the original PID definition (128 mA / 32768 bits = 0.00390625 mA per bit). If the value reported in Data C of PID $4F is greater than $00, that value shall be divided by 32768 (oxygen sensor current range is ½ of 65536 because both negative and positive currents can be represented) to calculate the scaling per bit to use to display Oxygen Sensor Current.<br><br>If PIDs $24 to $2B are supported by this ECU, this value shall be reported as $00.<br><br>The following is an example to calculate PID $34 with PID $4F supported and including a non-zero value. In this example, a manufacturer doesn't need a range of –128 to 127.996 milliamps and wishes to increase the resolution. The manufacturer only needs a range of - 64 to +64 mA and sets Data C = 64 mA.<br><br>EXAMPLE: $O2S11_{(PID34)} = DATA\_C\_D_{(PID34)} * (DATA\_C_{(PID4F)} * 1 mA / 32768)$<br>New scaling per bit for PID $34 = $DATA\_C_{(PID4F)} * 1 mA / 32768 = 64_{(10)}$ mA $/ 32768_{(10)} = 0.001953$ mA per bit<br><br>Positive value reported by vehicle ECU:<br>$DATA\_C\_D_{(PID34)} = \$9C40$ (applying the appropriate offset $9C40 - $8000) $= 7232_{(10)}$<br>$O2S11_{(PID34)} = 7232 * (64 mA / 32768) = +14.125$ mA<br><br>Negative value reported by vehicle ECU:<br>$DATA\_C\_D_{(PID34)} = \$5C40$ (applying the appropriate offset $5C40 - $8000) $= -9152_{(10)}$<br>$O2S11_{(PID34)} = -9152 * (64 mA / 32768) = -17.875$ mA | | | | | |

TABLE B60 - PID $4F DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 4F | Maximum value for Intake Manifold Absolute Pressure | D | 0 kPa | 2550 kPa | 10 kPa | These values are not intended for display to the service technician. |
| | Data D shall be used by the external test equipment to calculate the scaling per bit of PID $0B. | | | | | |
| | If Data D is reported as $00, the external test equipment shall use the "Intake Manifold Absolute Pressure" included in the original PID definition (255 kPa / 255 bits = 1 kPa per bit). If the value reported in Data D of PID $4F is greater than $00, that value shall be multiplied by 10 kPa per bit and then divided by 255 to calculate the scaling per bit to use to display Intake Manifold Absolute Pressure. | | | | | |
| | The following is an example to calculate PID $0B with PID $4F supported and including a non-zero value. In this example, a manufacturer needs a range of pressure larger than 0 to 255 kPa. The manufacturer needs a range of 0 to 765 kPa and sets Data A = 77, the closest value possible to 76.5. | | | | | |
| | EXAMPLE: $MAP_{(PID0B)} = DATA\_A_{(PID0B)} * (DATA\_D_{(PID4F)} * 10$ kPa per bit / 255) New scaling per bit for PID $0B = $DATA\_D_{(PID4F)} * 10$ kPa / 255 = $77_{(10)} * 10$ kPa / 255 = 3.0196 kPa per bit. $DATA\_A_{(PID0B)} = \$7F = 127_{(10)}$ = value reported by vehicle ECU $MAP_{(PID0B)} = 127 * (770$ kPa / 255) = 383.5 kPa | | | | | |

TABLE B61 - PID $50 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 50 | External Test Equipment Configuration Information #2 | | | | | |
| | These values shall be used by the external test equipment to calculate scaling factors for PIDs that are different from the values in the PID definition tables included in this document. | | | | | |
| | Maximum value for Air Flow Rate from Mass Air Flow Sensor | A | 0 g/s | 2550 g/s | 10 g/s | These values are not intended for display to the service technician. |
| | Data A shall be used by the external test equipment to calculate the scaling per bit of PID $10. If Data A is reported as $00, the external test equipment shall use the "Air Flow Rate from Mass Air Flow Sensor" included in the original PID definition (655.35 g/s / 65535 bits = 0.01 g/s per bit). If the value reported in Data A of PID $50 is greater than $00, that value shall be multiplied by 10 g/s and then divided by 65 535 to calculate the scaling per bit to use to display Air Flow Rate from Mass Air Flow Sensor. | | | | | |
| | The following is an example to calculate PID $10 with PID $50 supported and including a non-zero value. In this example, a manufacturer needs a range of air flow rate larger than 0 to 655.35 g/s. The manufacturer needs a range of 0 to 1000 g/s and sets Data A = 100, | | | | | |
| | EXAMPLE: $MAF_{(PID10)} = DATA\_A\_B_{(PID10)} * (DATA\_A_{(PID50)} * 10$ g/s / 65535) New scaling per bit for PID $10 = $DATA\_A_{(PID50)} * 10$ g/s / 65535 = $100_{(10)} * 10$ g/s / 65535 = 0.01526 g/s per bit $DATA\_A\_B_{(PID10)} = \$E290 = 58000_{(10)}$ = value reported by vehicle ECU */ $MAF_{(PID10)} = 58000 * (1000$ g/s / 65535) = 885.02 g/s | | | | | |
| | Reserved for future expansion – report as $00 | B | | | | |
| | Reserved for future expansion – report as $00 | C | | | | |
| | Reserved for future expansion – report as $00 | D | | | | |

TABLE B62 - PID $51 DEFINITION

| PID (hex) | Description | Data Byte | Scaling | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 51 | Type of fuel currently being utilized by the vehicle | A (hex) | byte 1 of 1 (State Encoded Variable) | FUEL_TYP |
| | | 00 | Not available | NONE |
| | | 01 | Gasoline/petrol | GAS |
| | | 02 | Methanol | METH |
| | | 03 | Ethanol | ETH |
| | | 04 | Diesel | DSL |
| | | 05 | Liquefied Petroleum Gas (LPG) | LPG |
| | | 06 | Compressed Natural Gas (CNG) | CNG |
| | | 07 | Propane | PROP |
| | | 08 | Battery/electric | ELEC |
| | | 09 | Bi-fuel vehicle using gasoline | BI_GAS |
| | | 0A | Bi-fuel vehicle using methanol | BI_METH |
| | | 0B | Bi-fuel vehicle using ethanol | BI_ETH |
| | | 0C | Bi-fuel vehicle using LPG | BI_LPG |
| | | 0D | Bi-fuel vehicle using CNG | BI_CNG |
| | | 0E | Bi-fuel vehicle using propane | BI_PROP |
| | | 0F | Bi-fuel vehicle using battery | BI_ELEC |
| | | 10 | Bi-fuel vehicle using battery and combustion engine | BI_MIX |
| | | 11 | Hybrid vehicle using gasoline engine | HYB_GAS |
| | | 12 | Hybrid vehicle using gasoline engine on ethanol | HYB_ETH |
| | | 13 | Hybrid vehicle using diesel engine | HYB_DSL |
| | | 14 | Hybrid vehicle using battery | HYB_ELEC |
| | | 15 | Hybrid vehicle using battery and combustion engine | HYB_MIX |
| | | 16 | Hybrid vehicle in regeneration mode | HYB_REG |
| | | 17 – FF | ISO/SAE reserved | — |

EXAMPLE:  If a Bi-fuel vehicle has less than 10 % ethanol in the gasoline/petrol, then the external test equipment shall display state $09. In such a case, the system would be using gasoline/petrol (fuel) tables and OBD thresholds. PID $52 should either artificially display 0 % or some number 10 % or less if the system has such resolution. If the ethanol in the gasoline/petrol is above 10 %, then the external test equipment shall display state $0B. PID $52 shall report the calculated ethanol/alcohol percentage.

Note: "Not available" (Data $00) shall be used for the following conditions where no fuel is being utilized:
- Ignition Key On/Engine Off, for example, for bi-fuel vehicles when the vehicle cannot identify which fuel is being used before engine start
- Engine stopped for vehicle using Start/Stop strategy or for hybrid vehicle with engine stopped

If FUEL_TYP is utilized on a single fuel vehicle, it can continue to indicate the previously utilized fuel type while the engine is in Decel Fuel Cut Off mode. It is not required to indicate $00 while in DFCO.

TABLE B63 - PID $52 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 52 | Alcohol Fuel Percentage | A | 0 % no alcohol | 100 % max. alcohol | 100/255 % | ALCH_PCT: xxx.x % |
| | ALCH_PCT shall indicate the percentage of alcohol contained in ethanol or methanol fuels, if the vehicle is certified to support alcohol fuels of > 10%. For example, ethanol fuel (E85) normally contains 85 % ethanol, in which case ALCH_PCT shall display 85.0 %. Alcohol percentage can be determined using a sensor or can be inferred by the fuel control software. ||||||

TABLE B64 - PID $53 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 53 | Absolute Evap System Vapor Pressure | A, B | 0 kPa (0.00 inH$_2$O) | 327.675 kPa (1315.49 inH$_2$O) | 0.005 kPa (1/200), unsigned | EVAP_VPA: xxx.xxx kPa (xxxx.xx inH$_2$O) |
| | Absolute evaporative system vapor pressure. The pressure signal is normally obtained from a sensor located in the fuel tank (FTP – Fuel Tank Pressure) or a sensor in an evaporative system vapor line. ||||||

TABLE B65 - PID $54 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 54 | Evap System Vapor Pressure | A, B | ($8000) – 32768 Pa | ($7FFF) 32767 Pa (131.55 inH$_2$O) | 1 Pa, signed | EVAP_VP: xxxxx Pa (xxx.xx inH$_2$O) |
| | Evaporative system vapor pressure. The pressure signal is normally obtained from a sensor located in the fuel tank (FTP – Fuel Tank Pressure) or a sensor in an evaporative system vapor line. PID $54 scaling allows for a wider pressure range than PID $32. ||||||
| | For systems supporting Evap System Vapor Pressure, one of the following 2 PIDs is required: $32, or $54. Support for more than one of these PIDs is not allowed. ||||||

TABLE B66 - PID $55 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 55 | Short Term Secondary O2 Sensor Fuel Trim – Bank 1 (use if only 1 fuel trim value) | A | – 100 % (lean) | + 99.22 % (rich) | 100/128 % (0 % at 128) | STSO2FT1: xxx.x % |
| | Short Term Secondary O2 Sensor Fuel Trim – Bank 3 | B | | | | STSO2FT3: xxx.x % |
| | Short Term Secondary Fuel Trim shall be supported by spark ignition vehicles that use secondary closed loop feedback control of air/fuel ratio. ||||||
| | Short Term Secondary O2 Sensor Fuel Trim Bank 1/3 shall indicate the correction currently being utilized by the closed-loop fuel algorithm. If the fuel system is in open loop, STSO2FT shall report 0 % correction. ||||||
| | Data B shall only be included in the response to a PID $55 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 3. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. ||||||

TABLE B67 - PID $56 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 56 | Long Term Secondary O2 Sensor Fuel Trim – Bank 1 (use if only 1 fuel trim value) | A | − 100 % (lean) | + 99.22 % (rich) | 100/128 % (0 % at 128) | LGSO2FT1: xxx.x % |
| | Long Term Secondary O2 Sensor Fuel Trim – Bank 3 | B | | | | LGSO2FT3: xxx.x % |
| | Long Term Secondary Fuel Trim shall be supported by spark ignition vehicles that use secondary closed loop feedback control of air/fuel ratio. Secondary O2 Sensor Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LGSO2FT shall indicate the correction currently being utilized by the fuel control algorithm at the time the data is requested, in both open-loop and closed-loop fuel control. If no correction is utilized in open-loop fuel, LGSO2FT shall report 0 % correction. If secondary O2 sensor long-term fuel trim is not utilized at all by the fuel control algorithm, the PID shall not be supported. Data B shall only be included in the response to a PID $56 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 3. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. | | | | | | |

TABLE B68 - PID $57 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 57 | Short Term Secondary O2 Sensor Fuel Trim - Bank 2 (use if only 1 fuel trim value) | A | − 100 % (lean) | + 99.22 % (rich) | 100/128 % (0 % at 128) | STSO2FT2: xxx.x % |
| | Short Term Secondary O2 Sensor Fuel Trim - Bank 4 | B | | | | STSO2FT4: xxx.x % |
| | Short Term Secondary Fuel Trim shall be supported by spark ignition vehicles that use secondary closed loop feedback control of air/fuel ratio. Short Term Secondary O2 Sensor Fuel Trim Bank 2/4 shall indicate the correction currently being utilized by the closed-loop fuel algorithm. If the fuel system is in open loop, STSO2FT shall report 0 % correction. Data B shall only be included in the response to a PID $57 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 4. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. | | | | | | |

TABLE B69 - PID $58 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 58 | Long Term Secondary O2 Sensor Fuel Trim – Bank 2 (use if only 1 fuel trim value) | A | – 100 % (lean) | + 99.22 % (rich) | 100/128 % (0 % at 128) | LGSO2FT2: xxx.x % |
| | Long Term Secondary O2 Sensor Fuel Trim - Bank 4 | B | | | | LGSO2FT4: xxx.x % |
| | Long Term Secondary Fuel Trim shall be supported by spark ignition vehicles that use secondary closed loop feedback control of air/fuel ratio. | | | | | |
| | Secondary Sensor Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LGSO2FT shall indicate the correction currently being utilized by the fuel control algorithm at the time the data is requested, in both open-loop and closed-loop fuel control. If no correction is utilized in open-loop fuel, LGSO2FT shall report 0 % correction. If post O2 sensor long-term fuel trim is not utilized at all by the fuel control algorithm, the PID shall not be supported. | | | | | |
| | Data B shall only be included in the response to a PID $58 request if PID $1D (Location of Oxygen Sensors) indicates an oxygen sensor is present in Bank 4. The external test equipment can determine length of the response message based on the data content of PID $13 or $1D. See Figure B3 for an explanation of the method to determine how many data bytes will be reported. | | | | | |

TABLE B70 - PID $59 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 59 | Fuel Rail Pressure (absolute) | A, B | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | FRP: xxxxxx kPa (xxxxx.x PSI) |
| | FRP shall display fuel rail pressure at the engine when the reading is absolute. This PID is intended for diesel fuel-pressure and gasoline direct-injection systems that have a higher pressure range than PIDs $0A and $22. | | | | | |

TABLE B71 - PID $5A DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 5A | Relative Accelerator Pedal Position | A | 0 % | 100 % | 100/255 % | APP_R: xxx.x % |
| | Relative or "learned" pedal position shall be displayed as a normalized value, scaled from 0 to 100 %. APP_R should display a value of 0 % at the "learned" closed-pedal position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-pedal position is at 1.0 volts, APP_R shall display (1.0 – 1.0 / 5.0) = 0.0 % at closed pedal and 30.0 % at 2.5 volts. Because of the closed-pedal offset, wide-open pedal will usually indicate substantially less than 100.0 %. In many cases, APP_R will be the average of multiple pedal sensor values. | | | | | |
| | For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100.0 % minus the percent of maximum input reference voltage. See PID $49 for a definition of Absolute Pedal Position. | | | | | |

TABLE B72 - PID $5B DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 5B | Hybrid/EV Battery Pack Remaining Charge | A | 0 % | 100 % | 100/255 % | BAT_PWR: xxx.x% |
| | BAT_PWR shall display the percent remaining level of charge for the hybrid battery pack, expressed as a percentage of full charge, commonly referred to as State Of Charge (SOC). | | | | | |

TABLE B73 - PID $5C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 5C | Engine Oil Temperature | A | -40 °C | 215 °C | 1 °C with -40 °C offset | EOT: xxx °C (xxx °F) |
| | EOT shall display engine oil temperature. EOT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B74 - PID $5D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 5D | Fuel Injection Timing | A,B | -210.00 | 301.992 | 1/128 with 0 at 26880 | FUEL_TIMING: xxx.xx |
| | FUEL_TIMING shall display the start of the main fuel injection relative to Top Dead Center (TDC). Positive degrees indicate Before TDC, negative degrees indicate After TDC. | | | | | |

TABLE B75 - PID $5E DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 5E | Engine Fuel Rate | A,B | 0 L/h | 3,276.75 L/h | 0.05 L/h per bit | FUEL_RATE: xxx.xx L/h |
| | FUEL_RATE shall indicate the amount of fuel consumed by engine per unit of time in liters per hour. | | | | | |
| | NOTE: FUEL_RATE shall indicate zero L/h when the engine is not running. | | | | | |

TABLE B76 - PID $5F DEFINITION

| PID (hex) | Description | Data Byte | Scaling | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|
| 5F | Emission requirements to which vehicle is designed | A (hex) | State Encoded Variable | EMIS_SUP: |
| | ISO/SAE reserved | 00 – 0D | | |
| | Heavy Duty Vehicles (EURO IV) B1 | 0E | | EURO IV B1 |
| | Heavy Duty Vehicles (EURO V) B2 | 0F | | EURO V B2 |
| | Heavy Duty Vehicles (EURO EEV) C | 10 | | EURO C |
| | ISO/SAE reserved | 11 - FF | | |
| | NOTE: This data was previously contained in PID $1C. | | | |

TABLE B77 - PID $61 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 61 | Driver's Demand Engine - Percent Torque | A | -125% | 130% | 1%/bit with -125 offset | TQ_DD: xxx.x % |
| | TQ_DD shall display the requested torque output of the engine by the driver, i.e. flywheel torque. It can be based on input from the following requestors external to the engine: operator (via the accelerator pedal), cruise control and/or road speed limit governor, transmission, etc. | | | | | |

TABLE B78 - PID $62 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 62 | Actual Engine - Percent Torque | A | -125% | 130% | 1%/bit with -125 offset | TQ_ACT: xxx.x % |
| | TQ_ACT shall display the calculated output torque of the engine. The data is transmitted in indicated torque as a percent of engine reference torque (see PID $63).  The engine percent torque value will not be less than zero. | | | | | |

TABLE B79 - PID $63 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 63 | Engine Reference Torque | A,B | 0 Nm | 65,535 Nm | 1 Nm/bit | TQ_REF: xxx.x Nm |
| | TQ_REF shall display engine reference torque. This PID is the 100% reference value for all defined indicated engine torque parameters. It is only defined once and doesn't change if a different engine torque map becomes valid. | | | | | |

TABLE B80 - PID $64 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 64 | Engine Percent Torque Data | | | | | |
| | Engine Percent Torque At Idle, Point 1 | A | -125% | 130% | 1%/bit with -125 offset | TQ_MAX1: xxx.x % |
| | The torque limit that indicates the available engine torque which can be provided by the engine at idle speed.  This parameter may be influenced by engine temperature (after power up) and other stationary changes (calibration offsets, sensor failures, etc. | | | | | |
| | Engine Percent Torque At Point 2 | B | -125% | 130% | 1%/bit with -125 offset | TQ_MAX2: xxx.x % |
| | The torque limit that indicates the available engine torque which can be provided by the engine at point 2 of the engine map. | | | | | |
| | Engine Percent Torque At Point 3 | C | -125% | 130% | 1%/bit with -125 offset | TQ_MAX3: xxx.x % |
| | The torque limit that indicates the available engine torque which can be provided by the engine at point 3 of the engine map. | | | | | |
| | Engine Percent Torque At Point 4 | D | -125% | 130% | 1%/bit with -125 offset | TQ_MAX4: xxx.x % |
| | The torque limit that indicates the available engine torque which can be provided by the engine at point 4 of the engine map. | | | | | |
| | Engine Percent Torque At Point 5 | E | -125% | 130% | 1%/bit with -125 offset | TQ_MAX5: xxx.x % |
| | The torque limit that indicates the available engine torque which can be provided by the engine at point 5 of the engine map. | | | | | |

TABLE B81 - PID $65 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 65 | Auxiliary Inputs / Outputs | | | | | |
| | Auxiliary Inputs / Outputs Supported | A (bit) | Byte 1 of 2 | | | |
| | Power Take Off (PTO) Status Supported | A, bit 0 | 0 | 1 | 1 = PTO status data supported | |
| | Auto Trans Neutral Drive Status Supported | A, bit 1 | 0 | 1 | 1 = Auto Trans Neutral/Drive status data supported | |
| | Manual Trans Neutral Gear Status Supported | A, bit 2 | 0 | 1 | 1 = Manual Trans Neutral/Gear status data supported | |
| | Glow Plug Lamp Status Supported | A, bit 3 | 0 | 1 | 1 = Glow Plug Lamp Status data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Auxiliary Inputs / Outputs Status | B (bit) | Byte 2 of 2 | | | |
| | Power Take Off (PTO) Status | B, bit 0 | 0 | 1 | 0 = PTO not active (OFF); 1 = PTO active (on) | PTO_STAT: OFF or ON |
| | Power Take Off status shall display whether the PTO is active (On) or not active (Off) | | | | | |
| | Auto Trans Neutral Drive Status | B, bit 1 | 0 | 1 | 0 = Auto Trans in Park/Neutral, 1 = Auto Trans in Forward/ Reverse Gear | N/D_STAT: NEUT or DRIVE |
| | Automatic transmission Neutral/Drive status shall indicate whether the transmission is in Park/Neutral (in neutral) or in a forward/reverse gear (in drive). | | | | | |
| | Manual Trans Neutral Gear Status | B, bit 2 | 0 | 1 | 0 = Manual Trans in Neutral and/or clutch depressed, 1 = Manual Trans in Gear | N/G_STAT: NEUT or GEAR |
| | Manual transmission Neutral/Gear status shall indicate whether the transmission is in neutral (clutch depressed and/or trans in neutral gear) or in gear. | | | | | |
| | Glow Plug Lamp Status | B, bit 3 | 0 | 1 | 0 = Glow Plug Lamp Off, 1 = Glow Plug Lamp ("Wait to Start") On | GPL_STAT: OFF or ON |
| | Glow plug lamp status shall indicate whether the glow plugs are on ("Wait To Start" lamp is illuminated) or off. | | | | | |
| | reserved (bits shall be reported as '0') | B, bits 4 - 7 | 0 | 0 | | |

TABLE B82 - PID $66 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 66 | Mass Air Flow Sensor | | | | | |
| | Support of Mass Air Flow Sensor Data | A (bit) | Byte 1 of 5 | | | |
| | MAF Sensor A supported | A, bit 0 | 0 | 1 | 1 = MAF Sensor A data supported | |
| | MAF Sensor B supported | A, bit 1 | 0 | 1 | 1 = MAF Sensor B data supported | |
| | reserved (bits shall be reported as '0') | A, bits 2 - 7 | 0 | 0 | | |
| | Mass Air Flow Sensor A | B,C | 0 g/s | 2047.96875 g/s | 0.03125 g/s | MAFA: xxx.xx g/s (xxxx.x lb/min) |
| | MAF A shall display the airflow rate as measured by a vehicle that utilizes a MAF sensor or an equivalent source. If the engine is off and the ignition is on, the actual sensor value reading shall be reported. If the actual sensor reading can not be reported the MAF value shall be reported as 0.00 g/s. Vehicles that utilize two MAF sensors should use MAF A and MAF B. | | | | | |
| | Mass Air Flow Sensor B | D,E | 0 g/s | 2047.96875 g/s | 0.03125 g/s | MAFB: xxx.xx g/s (xxxx.x lb/min) |
| | MAF B shall display the airflow rate as measured by a vehicle that utilizes a MAF sensor or an equivalent source. If the engine is off and the ignition is on, the actual sensor value reading shall be reported. If the actual sensor reading can not be reported the MAF value shall be reported as 0.00 g/s. Vehicles that utilize two MAF sensors should use MAF A and MAF B. | | | | | |

TABLE B83 - PID $67 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 67 | Engine Coolant Temperature | | | | | |
| | Support of Engine Coolant Temperature Sensor Data | A (bit) | Byte 1 of 3 | | | |
| | ECT Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = ECT 1 data supported | |
| | ECT Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = ECT 2 data supported | |
| | reserved (bits shall be reported as '0') | A, bits 2 - 7 | 0 | 0 | | |
| | Engine Coolant Temperature 1 | B | -40 °C | 215 °C | 1 °C with -40 °C offset | ECT 1: xxx °C (xxx °F) |
| | ECT 1 shall display engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor. | | | | | |
| | Engine Coolant Temperature 2 | C | -40 °C | 215 °C | 1 °C with -40 °C offset | ECT 2: xxx °C (xxx °F) |
| | ECT 2 shall display engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor. | | | | | |

TABLE B84 - PID $68 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 68 | Intake Air Temperature Sensor | | | | | |
| | Support of Intake Air Temperature Sensor Data | A (bit) | Byte 1 of 7 | | | |
| | IAT Bank 1, Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = IAT Bank 1, Sensor 1 data supported | |
| | IAT Bank 1, Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = IAT Bank 1, Sensor 2 data supported | |
| | IAT Bank 1, Sensor 3 supported | A, bit 2 | 0 | 1 | 1 = IAT Bank 1, Sensor 3 data supported | |
| | IAT Bank 2, Sensor 1 supported | A, bit 3 | 0 | 1 | 1 = IAT Bank 2, Sensor 1 data supported | |
| | IAT Bank 2, Sensor 2 supported | A, bit 4 | 0 | 1 | 1 = IAT Bank 2, Sensor 2 data supported | |
| | IAT Bank 2, Sensor 3 supported | A, bit 5 | 0 | 1 | 1 = IAT Bank 2, Sensor 3 data supported | |
| | reserved (bits shall be reported as '0') | A, bits 6 - 7 | 0 | 0 | | |
| | Intake Air Temperature Bank 1, Sensor 1 | B | -40 °C | 215 °C | 1 °C with -40 °C offset | IAT 11: xxx °C (xxx °F) |
| | IAT Bank 1, Sensor 1 shall display intake manifold air temperature. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Intake Air Temperature Bank 1, Sensor 2 | C | -40 °C | 215 °C | 1 °C with -40 °C offset | IAT 12: xxx °C (xxx °F) |
| | IAT Bank 1, Sensor 2 shall display intake manifold air temperature. | | | | | |
| | Intake Air Temperature Bank 1, Sensor 3 | D | -40 °C | 215 °C | 1 °C with -40 °C offset | IAT 13: xxx °C (xxx °F) |
| | IAT Bank 1, Sensor 3 shall display intake manifold air temperature. | | | | | |
| | Intake Air Temperature Bank 2, Sensor 1 | E | -40 °C | 215 °C | 1 °C with -40 °C offset | IAT 21: xxx °C (xxx °F) |
| | IAT Bank 2, Sensor 1 shall display intake manifold air temperature. | | | | | |
| | Intake Air Temperature Bank 2, Sensor 2 | F | -40 °C | 215 °C | 1 °C with -40 °C offset | IAT 22: xxx °C (xxx °F) |
| | IAT Bank 2, Sensor 2 shall display intake manifold air temperature. | | | | | |
| | Intake Air Temperature Bank 2, Sensor 3 | G | -40 °C | 215 °C | 1 °C with -40 °C offset | IAT 23: xxx °C (xxx °F) |
| | IAT Bank 2, Sensor 3 shall display intake manifold air temperature. | | | | | |

TABLE B85 - PID $69 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 69 | Commanded EGR and EGR Error | | | | | |
| | Support of EGR System Data | A (bit) | Byte 1 of 7 | | | |
| | Commanded EGR A Duty Cycle/Position Supported | A, bit 0 | 0 | 1 | 1 = Cmd EGR A Duty Cycle/Position data supported | |
| | Actual EGR A Duty Cycle/Position Supported | A, bit 1 | 0 | 1 | 1 = Actual EGR A Duty Cycle/Position data supported | |
| | EGR A Error Supported | A, bit 2 | 0 | 1 | 1 = EGR A Error data supported | |
| | Commanded EGR B Duty Cycle/Position Supported | A, bit 3 | 0 | 1 | 1 = Cmd EGR B Duty Cycle/Position data supported | |
| | Actual EGR B Duty Cycle/Position Supported | A, bit 4 | 0 | 1 | 1 = Actual EGR B Duty Cycle/Position data supported | |
| | EGR B Error Supported | A, bit 5 | 0 | 1 | 1 = EGR B Error data supported | |
| | reserved (bits shall be reported as '0') | A, bits 6 - 7 | 0 | 0 | | |
| | Commanded EGR A Duty Cycle/Position | B | 0% (no flow) | 100% (max flow) | 100/255 % | EGR_A_CMD: xxx.x% |
| | Commanded EGR displayed as a percent. EGR_A_CMD shall be normalized to the maximum EGR commanded output control parameter. EGR systems use a variety of methods to control the amount of EGR delivered to the engine. 1) If an on/off solenoid is used, EGR_A_CMD shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on. 2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%; the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 4) Any other actuation method shall be normalized to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position. | | | | | |
| | Actual EGR A Duty Cycle/Position | C | 0% (no flow/ closed) | 100% (max flow/ full open) | 100/255 % | EGR_A_ACT: xxx.x% |

TABLE B85 - PID $69 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 69 | Actual EGR displayed as a percent. EGR_A_ACT shall be normalized to the maximum EGR output. EGR systems use a variety of methods to control the amount of EGR delivered to the engine. <br><br>1) If an on/off solenoid is used, EGR_A_ACT shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on. <br><br>2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed. <br><br>3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%; the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). <br><br>4) Any other actuation method shall be normalized to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position. | | | | | |
| | EGR A Error | D | -100 % (less than cmd.) | +99.22 % (more than cmd.) | 100/128 % (0% at 128) | EGR_A_ERR: xxx.x% |
| | EGR_A_ERR, EGR error, as a percent of commanded EGR. Often, EGR valve control outputs are not in the same engineering units as the EGR feedback input sensors. For example, an EGR valve can be controlled using a duty-cycled vacuum solenoid; however, the feedback input sensor is a position sensor. This makes it impossible to display "actual" versus "commanded" in the same engineering units. EGR error solved this problem by displaying a normalized (non-dimensional) EGR system feedback parameter. EGR error is defined to be: <br><br>((EGR actual - EGR commanded) / EGR Commanded) * 100% <br><br>For example if 10% EGR is commanded and 5% is delivered to the engine, the EGR_A_ERR is <br><br>((5% - 10%) / 10%) * 100% = -50% error. <br><br>EGR_A_ERR may be computed using various control parameters such as position, steps, counts, etc. All EGR systems must react to quickly changing conditions in the engine; therefore, EGR_A_ERR will generally show errors during transient conditions. Under steady condition, the error will be minimized (not necessarily zero, however) if the EGR system is under control. <br><br>If the control system does not use closed loop control, EGR_A_ERR shall not be supported. <br><br>When commanded EGR is 0%, EGR error is technically undefined. In this case EGR error should be set to 0% when actual EGR = 0% or EGR error should be set to 99.2% when actual EGR > 0%. | | | | | |
| | Commanded EGR B Duty Cycle/Position | E | 0% (no flow) | 100% (max flow) | 100/255 % | EGR_B_CMD: xxx.x% |
| | Commanded EGR displayed as a percent. EGR_B_CMD shall be normalized to the maximum EGR commanded output control parameter. EGR systems use a variety of methods to control the amount of EGR delivered to the engine. <br><br>1) If an on/off solenoid is used, EGR_B_CMD shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on. <br><br>2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed. <br><br>3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%; the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). <br><br>4) Any other actuation method shall be normalized to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position. | | | | | |

TABLE B85 - PID $69 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 69 | Actual EGR B Duty Cycle/Position | F | 0% (no flow/ closed) | 100% (max flow/ full open) | 100/255 % | EGR_B_ACT: xxx.x% |

Actual EGR displayed as a percent. EGR_B_ACT shall be normalized to the maximum EGR output. EGR systems use a variety of methods to control the amount of EGR delivered to the engine.

1) If an on/off solenoid is used, EGR_B_ACT shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on.

2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed.

3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%; the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80).

4) Any other actuation method shall be normalized to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position.

| | EGR B Error | G | -100 % (less than cmd.) | +99.22 % (more than cmd.) | 100/128 % (0% at 128) | EGR_B_ERR: xxx.x% |

EGR_B_ERR, EGR error, as a percent of commanded EGR. Often, EGR valve control outputs are not in the same engineering units as the EGR feedback input sensors. For example, an EGR valve can be controlled using a duty-cycled vacuum solenoid; however, the feedback input sensor is a position sensor. This makes it impossible to display "actual" versus "commanded" in the same engineering units. EGR error solved this problem by displaying a normalized (non-dimensional) EGR system feedback parameter. EGR error is defined to be:

((EGR actual - EGR commanded) / EGR Commanded) * 100%

For example if 10% EGR is commanded and 5% is delivered to the engine, the EGR_B_ERR is

((5% - 10%) / 10%) * 100% = -50% error.

EGR_B_ERR may be computed using various control parameters such as position, steps, counts, etc. All EGR systems must react to quickly changing conditions in the engine; therefore, EGR_B_ERR will generally show errors during transient conditions. Under steady condition, the error will be minimized (not necessarily zero, however) if the EGR system is under control.

If the control system does not use closed loop control, EGR_B_ERR shall not be supported.

When commanded EGR is 0%, EGR error is technically undefined. In this case EGR error should be set to 0% when actual EGR = 0% or EGR error should be set to 99.2% when actual EGR > 0%.

TABLE B86 - PID $6A DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 6A | Commanded Diesel Intake Air Flow Control and Relative Intake Air Flow Position | | | | | |
| | Support of Intake Air Flow Control System Data | A (bit) | Byte 1 of 5 | | | |
| | Commanded Intake Air Flow A Control supported | A, bit 0 | 0 | 1 | 1 = Cmd Intake Air Flow A Control data supported | |
| | Relative Intake Air Flow A Position supported | A, bit 1 | 0 | 1 | 1 = Relative Intake Air Flow A Position data supported | |
| | Commanded Intake Air Flow B Control supported | A, bit 2 | 0 | 1 | 1 = Cmd Intake Air Flow B Control data supported | |
| | Relative Intake Air Flow B Position supported | A, bit 3 | 0 | 1 | 1 = Relative Intake Air Flow B Position data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Commanded Intake Air Flow A Control | B | 0 % (closed throttle) | 100 % (wide open throttle) | 100/255 % | IAF_A_CMD: xxx.x% |

Commanded Intake Air Flow displayed as a percent. Intake Air Flow is also known as EGR Throttle on compression ignition vehicles. Intake air flow controls are typically used to induct EGR into a compression ignition engine. IAF_A_CMD shall be normalized to the maximum IAF commanded output control parameter. IAF systems can use different methods to control the throttle plate angle.

1) If a linear or stepper motor valve is used, the fully closed position (minimum, normally 0 degree throttle angle) shall be displayed as 0%, the fully open position (maximum, normally 90 degrees throttle angle) shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor that moves from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80).

2) Any other actuation method shall be normalized to display 0% when no IAF is commanded and 100% at the maximum commanded IAF position.

| | Relative Intake Air Flow A Position | C | 0 % | 100 % | 100/255 % | IAF_A_REL: xxx.x % |

Actual Intake Air Flow position displayed as a percent. Intake Air Flow position is also known as EGR Throttle Position on compression ignition vehicles. Intake air flow controls are typically used to induct EGR into a compression ignition engine.

Relative or "learned" IAF_A_REL position shall be displayed as a normalized value, scaled from 0 to 100%. IAF_A_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, IAF_A_REL shall display (1.0 – 1.0 / 5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate less than 100%.

For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.

TABLE B86 - PID $6A DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 6A | Commanded Intake Air Flow B Control | D | 0 % (closed throttle) | 100 % (wide open throttle) | 100/255 % | IAF_B_CMD: xxx.x% |
| | Commanded Intake Air Flow displayed as a percent. Intake Air Flow is also known as EGR Throttle on compression ignition vehicles. Intake air flow controls are typically used to induct EGR into a compression ignition engine. IAF_B_CMD shall be normalized to the maximum IAF commanded output control parameter. IAF systems can use different methods to control the throttle plate angle. 1) If a linear or stepper motor valve is used, the fully closed position (minimum, normally 0 degree throttle angle) shall be displayed as 0%, the fully open position (maximum, normally 90 degrees throttle angle) shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor that moves from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 2) Any other actuation method shall be normalized to display 0% when no IAF is commanded and 100% at the maximum commanded IAF position. |||||||
| | Relative Intake Air Flow B Position | E | 0 % | 100 % | 100/255 % | IAF_B_REL: xxx.x % |
| | Actual Intake Air Flow position displayed as a percent. Intake Air Flow position is also known as EGR Throttle Position on compression ignition vehicles. Intake air flow controls are typically used to induct EGR into a compression ignition engine. Relative or "learned" IAF_B_REL position shall be displayed as a normalized value, scaled from 0 to 100%. IAF_B_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, IAF_B_REL shall display (1.0 – 1.0 / 5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. |||||||

TABLE B87 - PID $6B DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 6B | Exhaust Gas Recirculation Temperature | | | | | |
| | Support of EGR Temperature Sensor Data | A (bit) | Byte 1 of 5 | | | |
| | EGR Temperature Bank 1, Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = EGR Temperature Bank 1, Sensor 1 data supported, 1 °C with -40 °C offset scaling | |
| | EGR Temperature Bank 1, Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = EGR Temperature Bank 1, Sensor 2 data supported, 1 °C with -40 °C offset scaling | |
| | EGR Temperature Bank 2, Sensor 1 supported | A, bit 2 | 0 | 1 | 1 = EGR Temperature Bank 2, Sensor 1 data supported, 1 °C with -40 °C offset scaling | |
| | EGR Temperature Bank 2, Sensor 2 supported | A, bit 3 | 0 | 1 | 1 = EGR Temperature Bank 2, Sensor 2 data supported, 1 °C with -40 °C offset scaling | |
| | EGR Temperature Bank 1, Sensor 1 Wide Range supported | A, bit 4 | 0 | 1 | 1 = EGR Temperature Bank 1, Sensor 1 data supported, 4 °C with -40 °C offset scaling | |
| | EGR Temperature Bank 1, Sensor 2 Wide Range supported | A, bit 5 | 0 | 1 | 1 = EGR Temperature Bank 1, Sensor 2 data supported, 4 °C with -40 °C offset scaling | |
| | EGR Temperature Bank 2, Sensor 1 Wide Range supported | A, bit 6 | 0 | 1 | 1 = EGR Temperature Bank 2, Sensor 1 data supported, 4 °C with -40 °C offset scaling | |
| | EGR Temperature Bank 2, Sensor 2 Wide Range supported | A, bit 7 | 0 | 1 | 1 = EGR Temperature Bank 2, Sensor 2 data supported, 4 °C with -40 °C offset scaling | |
| | Exhaust Gas Recirculation Temp Bank 1, Sensor 1 | B | -40 °C | 215 °C or 980 °C | 1 °C or 4 °C with -40 °C offset | EGRT11: xxx °C (xxx °F) |
| | EGRT11 shall display EGR gas temperature. | | | | | |
| | Exhaust Gas Recirculation Temp Bank 1, Sensor 2 | C | -40 °C | 215 °C or 980 °C | 1 °C or 4 °C with -40 °C offset | EGRT12: xxx °C (xxx °F) |
| | EGRT12 shall display EGR gas temperature. | | | | | |
| | Exhaust Gas Recirculation Temp Bank 2, Sensor 1 | D | -40 °C | 215 °C or 980 °C | 1 °C or 4 °C with -40 °C offset | EGRT21: xxx °C (xxx °F) |
| | EGRT21 shall display EGR gas temperature. | | | | | |
| | Exhaust Gas Recirculation Temp Bank 2, Sensor 2 | E | -40 °C | 215 °C or 980 °C | 1 °C or 4 °C with -40 °C offset | EGRT22: xxx °C (xxx °F) |
| | EGRT22 shall display EGR gas temperature. | | | | | |

TABLE B88 - PID $6C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 6C | Commanded Throttle Actuator Control and Relative Throttle Position | | | | | |
| | Support of Throttle Actuator Control System Data | A | Byte 1 of 5 | | | |
| | Commanded Throttle Actuator A Control supported | A, bit 0 | 0 | 1 | 1 = Cmd Throttle Actuator A Control data supported | |
| | Relative Throttle A Position supported | A, bit 1 | 0 | 1 | 1 = Relative Throttle A Position data supported | |
| | Commanded Throttle Actuator B Control supported | A, bit 2 | 0 | 1 | 1 = Cmd Throttle Actuator B Control data supported | |
| | Relative Throttle B Position supported | A, bit 3 | 0 | 1 | 1 = Relative Throttle B Position data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Commanded Throttle Actuator A Control | B | 0 % (closed throttle) | 100 % (wide open throttle) | 100/255 % | TAC_A_CMD: xxx.x% |
| | Commanded TAC displayed as a percent. TAC_A_CMD shall be normalized to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening. 1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 2) Any other actuation method shall be normalized to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open. | | | | | |
| | Relative Throttle A Position | C | 0 % | 100 % | 100/255 % | TP_A_REL: xxx.x % |
| | Relative or "learned" throttle position shall be displayed as a normalized value, scaled from 0 to 100%. TP_A_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, TP_A_REL shall display (1.0 – 1.0 / 5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID $11 for a definition of Absolute Throttle Position. | | | | | |
| | Commanded Throttle Actuator B Control | D | 0 % (closed throttle) | 100 % (wide open throttle) | 100/255 % | TAC_B_CMD: xxx.x% |

TABLE B88 - PID $6C DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|-----------|-------------|-----------|------------|------------|-------------|--------------------------------------------------------|
| 6C | Commanded TAC displayed as a percent. TAC_B_CMD shall be normalized to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening. 1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 2) Any other actuation method shall be normalized to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open. | | | | | |
| | Relative Throttle B Position | E | 0 % | 100 % | 100/255 % | TP_B_REL: xxx.x % |
| | Relative or "learned" throttle position shall be displayed as a normalized value, scaled from 0 to 100%. TP_B_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, TP_B_REL shall display (1.0 – 1.0 / 5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID $11 for a definition of Absolute Throttle Position. | | | | | |

TABLE B89 - PID $6D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 6D | Fuel Pressure Control System | | | | | |
| | Support of Fuel Pressure Control System Data | A (bit) | Byte 1 of 11 | | | |
| | Commanded Fuel Rail Pressure A supported | A, bit 0 | 0 | 1 | 1 = Commanded Fuel Rail Pressure A data supported | |
| | Fuel Rail Pressure A supported | A, bit 1 | 0 | 1 | 1 = Fuel Rail Pressure A data supported | |
| | Fuel Temperature A supported | A, bit 2 | 0 | 1 | 1 = Fuel Temperature A data supported | |
| | Commanded Fuel Rail Pressure B supported | A, bit 3 | 0 | 1 | 1 = Commanded Fuel Rail Pressure B data supported | |
| | Fuel Rail Pressure B supported | A, bit 4 | 0 | 1 | 1 = Fuel Rail Pressure B data supported | |
| | Fuel Temperature B supported | A, bit 5 | 0 | 1 | 1 = Fuel Temperature B data supported | |
| | reserved (bits shall be reported as '0') | A, bits 6 - 7 | 0 | 0 | | |
| | Commanded Fuel Rail Pressure A | B,C | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | FRP_A_CMD: xxxxxx kPa (xxxxx.x PSI) |
| | FRP_A_CMD shall display commanded fuel rail pressure when the reading is referenced to atmosphere (gauge pressure). | | | | | |
| | Fuel Rail Pressure A | D,E | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | FRP_A: xxxxxx kPa (xxxxx.x PSI) |
| | FRP_A shall display fuel rail pressure when the reading is referenced to atmosphere (gauge pressure). | | | | | |
| | Fuel Rail Temperature A | F | -40 °C | 215 °C | 1 °C with -40 °C offset | FRT_A: xxx °C (xxx °F) |
| | FRT_A shall display fuel rail temperature. | | | | | |
| | Commanded Fuel Rail Pressure B | G,H | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | FRP_B_CMD: xxxxxx kPa (xxxxx.x PSI) |
| | FRP_B_CMD shall display commanded fuel rail pressure when the reading is referenced to atmosphere (gauge pressure). | | | | | |
| | Fuel Rail Pressure B | I,J | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | FRP_B: xxxxxx kPa (xxxxx.x PSI) |
| | FRP_B shall display fuel rail pressure when the reading is referenced to atmosphere (gauge pressure). | | | | | |
| | Fuel Rail Temperature B | K | -40 °C | 215 °C | 1 °C with -40 °C offset | FRT_B: xxx °C (xxx °F) |
| | FRT_B shall display fuel rail temperature. | | | | | |

TABLE B90 - PID $6E DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 6E | Injection Pressure Control System | | | | | |
| | Support of Injection Pressure Control System Data | A (bit) | Byte 1 of 9 | | | |
| | Commanded Injection Control Pressure A supported | A, bit 0 | 0 | 1 | 1 = Commanded Injection Control Pressure A data supported | |
| | Injection Control Pressure A supported | A, bit 1 | 0 | 1 | 1 = Injection Control Pressure A data supported | |
| | Commanded Injection Control Pressure B supported | A, bit 2 | 0 | 1 | 1 = Commanded Injection Control Pressure B data supported | |
| | Injection Control Pressure B supported | A, bit 3 | 0 | 1 | 1 = Injection Control Pressure B data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Commanded Injection Control Pressure A | B,C | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | ICP_A_CMD: xxxxxx kPa (xxxxx.x PSI) |
| | ICP_A_CMD shall display commanded injection control pressure. | | | | | |
| | Injection Control Pressure A | D,E | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | ICP_A: xxxxxx kPa (xxxxx.x PSI) |
| | ICP_A shall display injection control pressure. | | | | | |
| | Commanded Injection Control Pressure B | F,G | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | ICP_B_CMD: xxxxxx kPa (xxxxx.x PSI) |
| | ICP_B_CMD shall display commanded injection control pressure. | | | | | |
| | Injection Control Pressure B | H,I | 0 kPa | 655350 kPa | 10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI | ICP_B: xxxxxx kPa (xxxxx.x PSI) |
| | ICP_B shall display injection control pressure. | | | | | |

TABLE B91 - PID $6F DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 6F | Turbocharger Compressor Inlet Pressure | | | | | |
| | Support of Turbocharger Compressor Inlet Pressure Sensor Data | A (bit) | Byte 1 of 3 | | | |
| | Turbocharger Compressor Inlet Pressure Sensor A supported | A, bit 0 | 0 | 1 | 1=Turbocharger Compressor Inlet Pressure Sensor A supported, 1 kPa per bit scaling | |
| | Turbocharger Compressor Inlet Pressure Sensor B supported | A, bit 1 | 0 | 1 | 1=Turbocharger Compressor Inlet Pressure Sensor B supported, 1 kPa per bit scaling | |
| | Turbocharger Compressor Inlet Pressure Sensor A Wide Range supported | A, bit 2 | 0 | 1 | 1=Turbocharger Compressor Inlet Pressure Sensor A supported, 8 kPa per bit scaling | |
| | Turbocharger Compressor Inlet Pressure Sensor B Wide Range supported | A, bit 3 | 0 | 1 | 1=Turbocharger Compressor Inlet Pressure Sensor B supported, 8 kPa per bit scaling | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Turbocharger Compressor Inlet Pressure Sensor A | B | 0 kPa (absolute) | 255 kPa or 2040 kPa (absolute) | 1 kPa per bit or 8 kPa per bit | TCA_CINP: xxx kPa (xx.x inHg) |
| | TCA_CINP shall display turbocharger A compressor inlet pressure. | | | | | |
| | Turbocharger Compressor Inlet Pressure Sensor B | C | 0 kPa (absolute) | 255 kPa or 2040 kPa (absolute) | 1 kPa per bit or 8 kPa per bit | TCB_CINP: xxx kPa (xx.x inHg) |
| | TCB_CINP shall display turbocharger B compressor inlet pressure. | | | | | |

TABLE B92 - PID $70 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 70 | Boost Pressure Control | | | | | |
| | Support of Boost Pressure Control Data | A (bit) | Byte 1 of 10 | | | |
| | Commanded Boost Pressure A supported | A, bit 0 | 0 | 1 | 1 = Cmd Boost Pressure Control A data supported | |
| | Boost Pressure Sensor A supported | A, bit 1 | 0 | 1 | 1 = Boost Pressure Sensor A data supported | |
| | Boost Pressure A Control Status supported | A, bit 2 | 0 | 1 | 1 = Boost Pressure A Control Status supported | |
| | Commanded Boost Pressure B supported | A, bit 3 | 0 | 1 | 1 = Cmd Boost Pressure Control B data supported | |
| | Boost Pressure Sensor B supported | A, bit 4 | 0 | 1 | 1 = Boost Pressure Sensor B data supported | |
| | Boost Pressure B Control Status supported | A, bit 5 | 0 | 1 | 1 = Boost Pressure B Control Status supported | |
| | reserved (bits shall be reported as '0') | A, bits 6 - 7 | 0 | 0 | | |
| | Commanded Boost Pressure A | B,C | 0 kPa | 2047.968 75 kPa | 0.03125 kPa/bit | BP_A_CMD xxx.xx kPa (xx.xx PSI) |
| | BP_A_CMD shall display turbocharger/supercharger A commanded boost pressure. | | | | | |
| | Boost Pressure Sensor A | D,E | 0 kPa | 2047.968 75 kPa | 0.03125 kPa/bit | BP_A_ACT xxx.xx kPa (xx.xx PSI) |
| | BP_A_ACT shall display actual turbocharger/supercharger A boost pressure. BP_A_ACT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Commanded Boost Pressure B | F,G | 0 kPa | 2047.968 75 kPa | 0.03125 kPa/bit | BP_B_CMD xxx.xx kPa (xx.xx PSI) |
| | BP_B_CMD shall display turbocharger/supercharger B commanded boost pressure. | | | | | |
| | Boost Pressure Sensor B | H,I | 0 kPa | 2047.968 75 kPa | 0.03125 kPa/bit | BP_B_ACT xxx.xx kPa (xx.xx PSI) |
| | BP_B_ACT shall display actual turbocharger/supercharger B boost pressure. BP_B_ACT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Boost Pressure Control Status | J | Byte 10 of 10 | | | |
| | Boost Pressure A Control Status | J, bits 0 – 1 | 00 | 11 | 00 = reserved, not defined 01 = Open Loop (no fault present) 10 = Closed Loop (no fault present) 11 = Fault present (boost data unreliable) | BP_A_OL  BP_A_CL  BP_A_FAULT |

TABLE B92 - PID $70 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 70 | Boost Pressure B Control Status | J, bits 2 - 3 | 00 | 11 | 00 = reserved, not defined<br>01 = Open Loop (no fault present)<br>10 = Closed Loop (no fault present)<br>11 = Fault present (boost data unreliable) | BP_B_OL<br><br>BP_B_CL<br><br>BP_B_FAULT |
| | reserved (bits shall be reported as '0') | J, bits 4 - 7 | 00 | 00 | 00 = reserved, not defined | |

TABLE B93 - PID $71 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 71 | Variable Geometry Turbo (VGT) Control | | | | | |
| | Support of Variable Geometry Turbo Control Data | A (bit) | Byte 1 of 6 | | | |
| | Commanded VGT A Position supported | A, bit 0 | 0 | 1 | 1 = Commanded VGT A Position data supported | |
| | VGT A Position supported | A, bit 1 | 0 | 1 | 1 = VGT A Position data supported | |
| | VGT A Control Status supported | A, bit 2 | 0 | 1 | 1 = VGT A Control Status supported | |
| | Commanded VGT B Position supported | A, bit 3 | 0 | 1 | 1 = Commanded VGT B Position data supported | |
| | VGT B Position supported | A, bit 4 | 0 | 1 | 1 = VGT B Position data supported | |
| | VGT B Control Status supported | A, bit 5 | 0 | 1 | 1 = VGT B Control Status supported | |
| | reserved (bits shall be reported as '0') | A, bits 6 - 7 | 0 | 0 | | |

TABLE B93 - PID $71 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 71 | Commanded Variable Geometry Turbo A Position | B | 0% (vanes bypassed) | 100% (not bypassed) | 100/255 % | VGT_A_CMD: xxx.x% |
| | VGT_A_CMD shall display variable geometry turbocharger commanded vane position as a percent. VGT_A_CMD shall be normalized to the maximum VGT commanded output control parameter. VGT systems use a variety of methods to control vane position, hence boost pressure. 1) If a linear or stepper motor is used, the fully bypassed vane position shall be displayed as 0%, the fully utilized vane position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the fully utilized vane position. For example, a stepper-motor VGT that moves the throttle from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 2) Any other actuation method shall be normalized to display 0% when the vanes are fully bypassed and 100% when the vanes are fully utilized. | | | | | |
| | Variable Geometry Turbo A Position | C | 0% (vanes bypassed) | 100% (vanes not bypassed) | 100/255 % | VGT_A_ACT: xxx.x% |
| | VGT_A_ACT shall display variable geometry turbocharger actual vane position as a percent. VGT_A_ACT shall be normalized to the maximum VGT commanded output parameter. Vane position shall be normalized to display 0% when the vanes are fully bypassed and 100% when the vanes are fully utilized. | | | | | |
| | Commanded Variable Geometry Turbo B Position | D | 0% (vanes bypassed) | 100% (vanes not bypassed) | 100/255 % | VGT_B_CMD: xxx.x% |
| | VGT_B_CMD shall display variable geometry turbocharger commanded vane position as a percent. VGT_B_CMD shall be normalized to the maximum VGT commanded output control parameter. VGT systems use a variety of methods to control vane position, hence boost pressure. 1) If a linear or stepper motor is used, the fully bypassed vane position shall be displayed as 0%, the fully utilized vane position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the fully utilized vane position. For example, a stepper-motor VGT that moves the throttle from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 2) Any other actuation method shall be normalized to display 0% when the vanes are fully bypassed and 100% when the vanes are fully utilized. | | | | | |
| | Variable Geometry Turbo B Position | E | 0% (vanes bypassed) | 100% (vanes not bypassed) | 100/255 % | VGT_B_ACT: xxx.x% |
| | VGT_B_ACT shall display variable geometry turbocharger actual vane position as a percent. VGT_B_ACT shall be normalized to the maximum VGT commanded output parameter. Vane position shall be normalized to display 0% when the vanes are fully bypassed and 100% when the vanes are fully utilized. | | | | | |

TABLE B93 - PID $71 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 71 | VGT Control Status | F | Byte 6 of 6 | | | |
| | VGT A Control Status | F, bits 0 – 1 | 00 | 11 | 00 = reserved, not defined 01 = Open Loop (no fault present) 10 = Closed Loop (no fault present) 11 = Fault present (VGT data unreliable) | VGT_A_OL VGT_A_CL VGT_A_FAULT |
| | VGT B Control Status | F, bits 2 - 3 | 00 | 11 | 00 = reserved, not defined 01 = Open Loop (no fault present) 10 = Closed Loop (no fault present) 11 = Fault present (VGT data unreliable) | VGT_B_OL VGT_B_CL VGT_B_FAULT |
| | reserved (bits shall be reported as '0') | F, bits 4 - 7 | 00 | 00 | 00 = reserved, not defined | |

TABLE B94 - PID $72 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 72 | Wastegate Control | | | | | |
| | Support of Wastegate Control Data | A (bit) | Byte 1 of 5 | | | |
| | Commanded Wastegate A Position supported | A, bit 0 | 0 | 1 | 1 = Commanded Wastegate A Position data supported | |
| | Wastegate A Position supported | A, bit 1 | 0 | 1 | 1 = Wastegate A Position data supported | |
| | Commanded Wastegate B Position supported | A, bit 2 | 0 | 1 | 1 = Commanded Wastegate B Position data supported | |
| | Wastegate B Position supported | A, bit 3 | 0 | 1 | 1 = Wastegate B Position data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |

TABLE B94 - PID $72 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 72 | Commanded Wastegate A Position | B | 0% (no flow/ closed) | 100% (max flow/ full open) | 100/255 % | WG_A_CMD: xxx.x% |
| | WG_A_CMD shall display wastegate commanded position as a percent. WG_A_CMD shall be normalized to the maximum wastegate commanded output control parameter. Wastegate systems use a variety of methods to control wastegate position, hence boost pressure. 1) If an on/off solenoid is used, WG_A_CMD shall display 0% when the WG is commanded off (allow full boost), 100% when the WG system is commanded on (dump boost). 2) If a vacuum solenoid is duty cycled, the WG duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position (full boost) shall be displayed as 0%, the fully open position (dump boost) shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. 4) Any other actuation method shall be normalized to display 0% when the WG is commanded off and 100% when the WG is commanded on. | | | | | |
| | Wastegate A Position | C | 0% (no flow/ closed) | 100% (max flow/ full open) | 100/255 % | WG_A_ACT: xxx.x% |
| | WG_A_ACT shall display wastegate actual position as a percent. WG_A_ACT shall be normalized to the maximum wastegate commanded output control parameter. Wastegate systems use a variety of methods to control wastegate position, hence boost pressure. 1) If an on/off solenoid is used, WG_A_ACT shall display 0% when the WG is commanded off (allow full boost), 100% when the WG system is commanded on (dump boost). 2) If a vacuum solenoid is duty cycled, the WG duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position (full boost) shall be displayed as 0%, the fully open position (dump boost) shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. 4) Any other actuation method shall be normalized to display 0% when the WG is commanded off and 100% when the WG is commanded on. | | | | | |
| | Commanded Wastegate B Position | D | 0% (no flow/ closed) | 100% (max flow/ full open) | 100/255 % | WG_ B_CMD: xxx.x% |
| | WG_B_CMD shall display wastegate commanded position as a percent. WG_B_CMD shall be normalized to the maximum wastegate commanded output control parameter. Wastegate systems use a variety of methods to control wastegate position, hence boost pressure. 1) If an on/off solenoid is used, WG_B_CMD shall display 0% when the WG is commanded off (allow full boost), 100% when the WG system is commanded on (dump boost). 2) If a vacuum solenoid is duty cycled, the WG duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position (full boost) shall be displayed as 0%, the fully open position (dump boost) shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. 4) Any other actuation method shall be normalized to display 0% when the WG is commanded off and 100% when the WG is commanded on. | | | | | |

TABLE B94 - PID $72 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 72 | Wastegate B Position | E | 0% (no flow/ closed) | 100% (max flow/ full open) | 100/255 % | WG_B_ACT: xxx.x% |

WG_B_ACT shall display wastegate actual position as a percent. WG_B_ACT shall be normalized to the maximum wastegate commanded output control parameter.
Wastegate systems use a variety of methods to control wastegate position, hence boost pressure.

1) If an on/off solenoid is used, WG_B_ACT shall display 0% when the WG is commanded off (allow full boost), 100% when the WG system is commanded on (dump boost).

2) If a vacuum solenoid is duty cycled, the WG duty cycle from 0 to 100% shall be displayed.

3) If a linear or stepper motor valve is used, the fully closed position (full boost) shall be displayed as 0%, the fully open position (dump boost) shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position.

4) Any other actuation method shall be normalized to display 0% when the WG is commanded off and 100% when the WG is commanded on.

TABLE B95 - PID $73 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 73 | Exhaust Pressure | | | | | |
| | Support of Exhaust Pressure Sensor Data | A (bit) | Byte 1 of 5 | | | |
| | Exhaust Pressure Sensor Bank 1 supported | A, bit 0 | 0 | 1 | 1 = Exhaust Pressure Sensor Bank 1 data supported | |
| | Exhaust Pressure Sensor Bank 2 supported | A, bit 1 | 0 | 1 | 1 = Exhaust Pressure Sensor Bank 2 data supported | |
| | reserved (bits shall be reported as '0') | A, bits 2 - 7 | 0 | 0 | | |
| | Exhaust Pressure Sensor Bank 1 | B,C | 0 kPa | 655.35 kPa | 0.01 kPa per bit | EP_1: xxxx.xx kPa (xx.xxx PSI) |
| | EP_1 shall display Bank 1 exhaust pressure. | | | | | |
| | Exhaust Pressure Sensor Bank 2 | D,E | 0 kPa | 655.35 kPa | 0.01 kPa per bit | EP_2: xxxx.xx kPa (xx.xxx PSI) |
| | EP_2 shall display Bank 2 exhaust pressure. | | | | | |

TABLE B96 - PID $74 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 74 | Turbocharger RPM | | | | | |
| | Support of Turbocharger RPM Data | A (bit) | Byte 1 of 5 | | | |
| | Turbo A RPM supported | A, bit 0 | 0 | 1 | 1 = Turbo A RPM data supported | |
| | Turbo B RPM supported | A, bit 1 | 0 | 1 | 1 = Turbo B RPM data supported | |
| | reserved (bits shall be reported as '0') | A, bits 2 - 7 | 0 | 0 | | |
| | Turbocharger A RPM | B,C | 0 min$^{-1}$ | 655,350 min$^{-1}$ | 10 rpm per bit | TCA_RPM: xxxxx min$^{-1}$ |
| | TCA_RPM shall display revolutions per minute of the engine turbocharger A. | | | | | |
| | Turbocharger B RPM | D,E | 0 min$^{-1}$ | 655,350 min$^{-1}$ | 10 rpm per bit | TCB_RPM: xxxxx min$^{-1}$ |
| | TCB_RPM shall display revolutions per minute of the engine turbocharger B. | | | | | |

TABLE B97 - PID $75 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 75 | Turbocharger A Temperature | | | | | |
| | Support of Turbocharger Temperature Data | A (bit) | Byte 1 of 7 | | | |
| | Turbo A Compressor Inlet Temperature supported | A, bit 0 | 0 | 1 | 1 = Turbo A Compressor Inlet Temperature data supported | |
| | Turbo A Compressor Outlet Temperature supported | A, bit 1 | 0 | 1 | 1 = Turbo A Compressor Outlet Temperature data supported | |
| | Turbo A Turbine Inlet Temperature supported | A, bit 2 | 0 | 1 | 1 = Turbo A Turbine Inlet Temperature data supported | |
| | Turbo A Turbine Outlet Temperature supported | A, bit 3 | 0 | 1 | 1 = Turbo A Turbine Outlet Temperature data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Turbocharger A Compressor Inlet Temperature | B | -40 °C | 215 °C | 1 °C with -40 °C offset | TCA_CINT: xxx °C (xxx °F) |
| | TCA_CINT shall display turbocharger A compressor inlet temperature. | | | | | |
| | Turbocharger A Compressor Outlet Temperature | C | -40 °C | 215 °C | 1 °C with -40 °C offset | TCA_COUTT: xxx °C (xxx °F) |
| | TCA_COUTT shall display turbocharger A compressor outlet temperature. | | | | | |
| | Turbocharger A Turbine Inlet Temperature | D,E | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | TCA_TINT: xxx °C (xxx °F) |
| | TCA_TINT shall display turbocharger A turbine inlet temperature. | | | | | |
| | Turbocharger A Turbine Outlet Temperature | F,G | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | TCA_TOUTT: xxx °C (xxx °F) |
| | TCA_TOUTT shall display turbocharger A turbine outlet temperature. | | | | | |

TABLE B98 - PID $76 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 76 | Turbocharger B Temperature | | | | | |
| | Support of Turbocharger Temperature Data | A (bit) | Byte 1 of 7 | | | |
| | Turbo B Compressor Inlet Temperature supported | A, bit 0 | 0 | 1 | 1 = Turbo B Compressor Inlet Temperature data supported | |
| | Turbo B Compressor Outlet Temperature supported | A, bit 1 | 0 | 1 | 1 = Turbo B Compressor Outlet Temperature data supported | |
| | Turbo B Turbine Inlet Temperature supported | A, bit 2 | 0 | 1 | 1 = Turbo B Turbine Inlet Temperature data supported | |
| | Turbo B Turbine Outlet Temperature supported | A, bit 3 | 0 | 1 | 1 = Turbo B Turbine Outlet Temperature data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Turbocharger B Compressor Inlet Temperature | B | -40 °C | 215 °C | 1 °C with -40 °C offset | TCB_CINT: xxx °C (xxx °F) |
| | TCB_CINT shall display turbocharger B compressor inlet temperature. | | | | | |
| | Turbocharger B Compressor Outlet Temperature | C | -40 °C | 215 °C | 1 °C with -40 °C offset | TCB_COUTT: xxx °C (xxx °F) |
| | TCB_COUTT shall display turbocharger B compressor outlet temperature. | | | | | |
| | Turbocharger B Turbine Inlet Temperature | D,E | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | TCB_TINT: xxx °C (xxx °F) |
| | TCB_TINT shall display turbocharger B turbine inlet temperature. | | | | | |
| | Turbocharger B Turbine Outlet Temperature | F,G | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | TCB_TOUTT: xxx °C (xxx °F) |
| | TCB_TOUTT shall display turbocharger B turbine outlet temperature. | | | | | |

TABLE B99 - PID $77 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 77 | Charge Air Cooler Temperature (CACT) | | | | | |
| | Support of Charge Air Cooler Temperature Data | A (bit) | Byte 1 of 5 | | | |
| | CACT Bank 1, Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = CACT Bank 1, Sensor 1 data supported | |
| | CACT Bank 1, Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = CACT Bank 1, Sensor 2 data supported | |
| | CACT Bank 2, Sensor 1 supported | A, bit 2 | 0 | 1 | 1 = CACT Bank 2, Sensor 1 data supported | |
| | CACT Bank 2, Sensor 2 supported | A, bit 3 | 0 | 1 | 1 = CACT Bank 2, Sensor 2 data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Charge Air Cooler Temperature Bank 1, Sensor 1 | B | -40 °C | 215 °C | 1 °C with -40 °C offset | CACT 11: xxx °C (xxx °F) |
| | CACT Bank 1, Sensor 1 shall display charge air cooler temperature. | | | | | |
| | Charge Air Cooler Temperature Bank 1, Sensor 2 | C | -40 °C | 215 °C | 1 °C with -40 °C offset | CACT 12: xxx °C (xxx °F) |
| | CACT Bank 1, Sensor 2 shall display charge air cooler temperature. | | | | | |
| | Charge Air Cooler Temperature Bank 2, Sensor 1 | D | -40 °C | 215 °C | 1 °C with -40 °C offset | CACT 21: xxx °C (xxx °F) |
| | CACT Bank 2, Sensor 1 shall display charge air cooler temperature. | | | | | |
| | Charge Air Cooler Temperature Bank 2, Sensor 2 | E | -40 °C | 215 °C | 1 °C with -40 °C offset | CACT 22: xxx °C (xxx °F) |
| | CACT Bank 2, Sensor 2 shall display charge air cooler temperature. | | | | | |

TABLE B100 - PID $78 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 78 | Exhaust Gas Temperature (EGT) Bank 1 | | | | | |
| | Support of Exhaust Gas Temperature Sensor Data | A (bit) | Byte 1 of 9 | | | |
| | EGT Bank 1, Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = EGT Bank 1, Sensor 1 data supported | |
| | EGT Bank 1, Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = EGT Bank 1, Sensor 2 data supported | |
| | EGT Bank 1, Sensor 3 supported | A, bit 2 | 0 | 1 | 1 = EGT Bank 1, Sensor 3 data supported | |
| | EGT Bank 1, Sensor 4 supported | A, bit 3 | 0 | 1 | 1 = EGT Bank 1, Sensor 4 data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Exhaust Gas Temperature Bank 1, Sensor 1 | B,C | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT11: xxxx.x °C (xxxx.x °F) |
| | EGT11 shall display exhaust gas temperature for bank 1, sensor 1. EGT11 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Exhaust Gas Temperature Bank 1, Sensor 2 | D,E | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT12: xxxx.x °C (xxxx.x °F) |
| | EGT12 shall display exhaust gas temperature for bank 1, sensor 2. EGT12 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Exhaust Gas Temperature Bank 1, Sensor 3 | F,G | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT13: xxxx.x °C (xxxx.x °F) |
| | EGT13 shall display exhaust gas temperature for bank 1, sensor 3. EGT13 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Exhaust Gas Temperature Bank 1, Sensor 4 | H,I | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT14: xxxx.x °C (xxxx.x °F) |
| | EGT14 shall display exhaust gas temperature for bank 1, sensor 4. EGT14 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B101 - PID $79 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 79 | Exhaust Gas Temperature (EGT) Bank 2 | | | | | |
| | Support of Exhaust Gas Temperature Sensor Data | A (bit) | Byte 1 of 9 | | | |
| | EGT Bank 2, Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = EGT Bank 2, Sensor 1 data supported | |
| | EGT Bank 2, Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = EGT Bank 2, Sensor 2 data supported | |
| | EGT Bank 2, Sensor 3 supported | A, bit 2 | 0 | 1 | 1 = EGT Bank 2, Sensor 3 data supported | |
| | EGT Bank 2, Sensor 4 supported | A, bit 3 | 0 | 1 | 1 = EGT Bank 2, Sensor 4 data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Exhaust Gas Temperature Bank 2, Sensor 1 | B,C | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT21: xxxx.x °C (xxxx.x °F) |
| | EGT21 shall display exhaust gas temperature for bank 2, sensor 1. EGT21 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Exhaust Gas Temperature Bank 2, Sensor 2 | D,E | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT22: xxxx.x °C (xxxx.x °F) |
| | EGT22 shall display exhaust gas temperature for bank 2, sensor 2. EGT22 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Exhaust Gas Temperature Bank 2, Sensor 3 | F,G | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT23: xxxx.x °C (xxxx.x °F) |
| | EGT23 shall display exhaust gas temperature for bank 2, sensor 3. EGT23 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |
| | Exhaust Gas Temperature Bank 2, Sensor 4 | H,I | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | EGT24: xxxx.x °C (xxxx.x °F) |
| | EGT24 shall display exhaust gas temperature for bank 2, sensor 4. EGT24 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B102 - PID $7A DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 7A | Diesel Particulate Filter (DPF) Bank 1 | | | | | |
| | Support of DPF System Data | A (bit) | Byte 1 of 7 | | | |
| | DPF Bank 1 Delta Pressure Supported | A, bit 0 | 0 | 1 | 1 = DPF Bank 1 Delta Pressure data supported | |
| | DPF Bank 1 Inlet Pressure Supported | A, bit 1 | 0 | 1 | 1 = DPF Bank 1 Inlet Pressure data supported | |
| | DPF Bank 1 Outlet Pressure Supported | A, bit 2 | 0 | 1 | 1 = DPF Bank 1 Outlet Pressure data supported | |
| | reserved (bits shall be reported as '0') | A, bits 3 - 7 | 0 | 0 | | |
| | Diesel Particulate Filter Bank 1 Delta Pressure | B,C | ($8000) -327.68 kPa | ($7FFF) 327.67 kPa | 0.01 kPa per bit signed | DPF1_DP: xxxx.xx kPa (xx.xxx PSI) |
| | DPF1_DP shall display DPF Bank 1 delta pressure. | | | | | |
| | Diesel Particulate Filter Bank 1 Inlet Pressure | D,E | 0 kPa | 655.35 kPa | 0.01 kPa per bit | DPF1_INP: xxxx.xx kPa (xx.xxx PSI) |
| | DPF1_INP shall display DPF Bank 1 inlet pressure. | | | | | |
| | Diesel Particulate Filter Bank 1 Outlet Pressure | F,G | 0 kPa | 655.35 kPa | 0.01 kPa per bit | DPF1_OUTP: xxxx.xx kPa (xx.xxx PSI) |
| | DPF1_OUTP shall display DPF Bank 1 outlet pressure. | | | | | |

TABLE B103 - PID $7B DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 7B | Diesel Particulate Filter (DPF) Bank 2 | | | | | |
| | Support of DPF System Data | A (bit) | Byte 1 of 7 | | | |
| | DPF Bank 2 Delta Pressure Supported | A, bit 0 | 0 | 1 | 1 = DPF Bank 2 Delta Pressure data supported | |
| | DPF Bank 2 Inlet Pressure Supported | A, bit 1 | 0 | 1 | 1 = DPF Bank 2 Inlet Pressure data supported | |
| | DPF Bank 2 Outlet Pressure Supported | A, bit 2 | 0 | 1 | 1 = DPF Bank 2 Outlet Pressure data supported | |
| | reserved (bits shall be reported as '0') | A, bits 3 - 7 | 0 | 0 | | |
| | Diesel Particulate Filter Bank 2 Delta Pressure | B,C | ($8000) -327.68 kPa | ($7FFF) 327.67 kPa | 0.01 kPa per bit signed | DPF2_DP: xxxx.xx kPa (xx.xxx PSI) |
| | DPF2_DP shall display DPF Bank 2 delta pressure. | | | | | |
| | Diesel Particulate Filter Bank 2 Inlet Pressure | D,E | 0 kPa | 655.35 kPa | 0.01 kPa per bit | DPF2_INP: xxxx.xx kPa (xx.xxx PSI) |
| | DPF2_INP shall display DPF Bank 2 inlet pressure. | | | | | |
| | Diesel Particulate Filter Bank 2 Outlet Pressure | F,G | 0 kPa | 655.35 kPa | 0.01 kPa per bit | DPF2_OUTP: xxxx.xx kPa (xx.xxx PSI) |
| | DPF2_OUTP shall display DPF Bank 2 outlet pressure. | | | | | |

TABLE B104 - PID $7C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 7C | Diesel Particulate Filter (DPF) Temperature | | | | | |
| | Support of DPF Temperature Data | A (bit) | Byte 1 of 9 | | | |
| | DPF Bank 1 Inlet Temperature Supported | A, bit 0 | 0 | 1 | 1 = DPF Bank 1 Inlet Temperature data supported | |
| | DPF Bank 1 Outlet Temperature Supported | A, bit 1 | 0 | 1 | 1 = DPF Bank 1 Outlet Temperature data supported | |
| | DPF Bank 2 Inlet Temperature Supported | A, bit 2 | 0 | 1 | 1 = DPF Bank 2 Inlet Temperature data supported | |
| | DPF Bank 2 Outlet Temperature Supported | A, bit 3 | 0 | 1 | 1 = DPF Bank 2 Outlet Temperature data supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | DPF Bank 1 Inlet Temperature Sensor | B,C | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | DPF1_INT: xxxx.x °C (xxxx.x °F) |
| | DPF1_INT shall display DPF Bank 1 inlet temperature. | | | | | |
| | DPF Bank 1 Outlet Temperature Sensor | D,E | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | DPF1_OUTT: xxxx.x °C (xxxx.x °F) |
| | DPF1_OUTT shall display DPF Bank 1 outlet temperature. | | | | | |
| | DPF Bank 2 Inlet Temperature Sensor | F,G | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | DPF2_INT: xxxx.x °C (xxxx.x °F) |
| | DPF2_INT shall display DPF Bank 2 inlet temperature. | | | | | |
| | DPF Bank 2 Outlet Temperature Sensor | H,I | -40 °C | 6513.5 °C | 0.1 °C / bit with -40 °C offset | DPF2_OUTT: xxxx.x °C (xxxx.x °F) |
| | DPF2_OUTT shall display DPF Bank 2 outlet temperature. | | | | | |

TABLE B105 - PID $7D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 7D | NOx NTE control area status | A (bit) | Byte 1 of 1 | | | |
| | Inside NOx control area | A, bit 0 | 0 | 1 | 1 = inside control area | NNTE: IN |
| | Indicates that engine is operating inside the NOx control area | | | | | |
| | Outside NOx control area | A, bit 1 | 0 | 1 | 1 = outside control area | NNTE: OUT |
| | Indicates that engine is operating outside the NOx control area | | | | | |
| | Inside manufacturer-specific NOx NTE carve-out area | A, bit 2 | 0 | 1 | 1 = inside manufacturer-specific NOx NTE carve-out area | NNTE: CAA |
| | Indicates that engine is operating inside the manufacturer-specific NOx NTE carve-out area | | | | | |
| | NTE deficiency for NOx active area | A, bit 3 | 0 | 1 | 1 = NTE deficiency for NOx active area | NNTE: DEF |
| | Indicates that engine is operating inside the NTE deficiency for NOx active area | | | | | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | | | | | | |

TABLE B106 - PID $7E DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 7E | PM NTE control area status | A (bit) | Byte 1 of 1 | | | |
| | Inside PM control area | A, bit 0 | 0 | 1 | 1 = inside control area | PNTE: IN |
| | Indicates that engine is operating inside the PM control area | | | | | |
| | Outside PM control area | A, bit 1 | 0 | 1 | 1 = outside control area | PNTE: OUT |
| | Indicates that engine is operating outside the PM control area | | | | | |
| | Inside manufacturer-specific PM NTE carve-out area | A, bit 2 | 0 | 1 | 1 = inside manufacturer-specific PM NTE carve-out area | PNTE: CAA |
| | Indicates that engine is operating inside the manufacturer-specific PM NTE carve-out area | | | | | |
| | NTE deficiency for PM active area | A, bit 3 | 0 | 1 | 1 = NTE deficiency for PM active area | PNTE: DEF |
| | Indicates that engine is operating inside the NTE deficiency for PM active area | | | | | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | | | | | | |

TABLE B107 - PID $7F DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 7F | Engine Run Time | | | | | |
| | Support of Engine Run Time | A (bit) | Byte 1 of 13 | | | |
| | Total Engine Run Time supported | A, bit 0 | 0 | 1 | 1 = Total Engine Run Time supported | |
| | Total Idle Run Time supported | A, bit 1 | 0 | 1 | 1 = Total Idle Run Time supported | |
| | Total Run Time With PTO Active supported | A, bit 2 | 0 | 1 | 1 = Total Run Time With PTO Active supported | |
| | reserved (bits shall be reported as '0') | A, bits 3 - 7 | 0 | 0 | | |
| | Total Engine Run Time | B,C,D,E | 0 sec | 4,294,967,295 sec | 1 sec/bit | RUN_TIME: xxxxxxx hrs, xx min |
| | RUN_TIME shall display the total engine run time. RUN_TIME shall increment while the engine is running. It shall freeze if the engine stalls. | | | | | |
| | Total Idle Run Time | F,G,H,I | 0 sec | 4,294,967,295 sec | 1 sec/bit | IDLE_TIME: xxxxxxx hrs, xx min |
| | IDLE_TIME shall display the total time the vehicle has been operated at idle. IDLE_TIME shall increment while the accelerator pedal is released by the driver, engine speed is greater than or equal to 50 to 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for vehicles equipped with an automatic transmission), PTO not active, and either vehicle speed less than or equal to 1.6 kph (1 mph) or engine speed less than or equal to 200 rpm above normal warmed-up idle. It shall freeze if the engine stalls or the engine is no longer at idle. | | | | | |
| | Total Run Time With PTO Active | J,K,L,M | 0 sec | 4,294,967,295 sec | 1 sec/bit | PTO_TIME: xxxxxxx hrs, xx min |
| | PTO_TIME shall display the total engine run time with PTO engaged. PTO_TIME shall increment while the engine is running with PTO engaged. It shall freeze if the engine stalls the PTO is disengaged. | | | | | |
| | NOTE:  Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event). Numbers may not be reset to zero under any other circumstances, including when a scan tool (generic or enhanced) command to clear fault codes or reset KAM is received. If any of the individual counters reach the maximum value, all counters shall be divided by two before any are incremented again to avoid overflow problems. | | | | | |

TABLE B108 - PID $81 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 81 | Engine Run Time for AECD #1 - #5 | | | | | |
| | Support of Run Time for AECD #1 - #5 | A (bit) | Byte 1 of 41 | | | |
| | Total run time with EI-AECD #1 active supported | A, bit 0 | 0 | 1 | 1 = Total run time with EI-AECD #1 active supported | |
| | Total run time with EI-AECD #2 active supported | A, bit 1 | 0 | 1 | 1 = Total run time with EI-AECD #2 active supported | |
| | Total run time with EI-AECD #3 active supported | A, bit 2 | 0 | 1 | 1 = Total run time with EI-AECD #3 active supported | |
| | Total run time with EI-AECD #4 active supported | A, bit 3 | 0 | 1 | 1 = Total run time with EI-AECD #4 active supported | |
| | Total run time with EI-AECD #5 active supported | A, bit 4 | 0 | 1 | 1 = Total run time with EI-AECD #5 active supported | |
| | Reserved (bits shall be reported as '0') | A, bits 5 - 7 | 0 | 0 | | |
| | Total run time with EI-AECD #1 Timer 1 active | B1,B2, B3,B4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD1_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #1 Timer 2 active | C1,C2, C3,C4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD1_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #2 Timer 1 active | D1,D2, D3,D4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD2_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #2 Timer 2 active | E1,E2, E3,E4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD2_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #3 Timer 1 active | F1,F2, F3,F4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD3_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #3 Timer 2 active | G1,G2, G3,G4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD3_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #4 Timer 1 active | H1,H2, H3,H4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD4_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #4 Timer 2 active | I1,I2, I3,I4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD4_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #5 Timer 1 active | J1,J2, J3,J4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD5_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #5 Timer 2 active | K1,K2, K3,K4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD5_TIME2: xxxxxxx hrs, xx min |

**The following reporting criteria and description of the operation of the timers specified in this PID also apply to the timers specified in PIDs $82, $89, and $8A.**

AECDx_TIME1 shall display the total engine run time with Emission Increasing Auxiliary Emission Control Device #x active. AECDx_TIME1 shall increment while the engine is running with EI-AECD #x active. It shall freeze if the engine stalls. For EI-AECDs requiring only a single timer, Timer 1 shall be used to report the total engine run time for the EI-AECD. For EI-AECDs requiring two timers, Timer 1 shall report the total engine hours when the EI-AECD is commanding reduced emission control effectiveness up to but not including 75 percent of the maximum reduced emission control effectiveness of that EI-AECD.

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| | AECDx_TIME2 shall display the total engine run time with Emission Increasing Auxiliary Emission Control Device #x active. AECDx_TIME2 shall increment while the engine is running with EI-AECD #x active. It shall freeze if the engine stalls. For EI-AECDs requiring only a single timer, Timer 2 shall be reported as "Not Available" using the value 4,294,967,295 seconds. For EI-AECDs requiring two timers, Timer 2 shall report the total engine hours when the EI-AECD is commanding reduced emission control effectiveness of 75 percent or more of the maximum reduced emission control effectiveness of that EI-AECD. | | | | | |
| | NOTE: Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event). Numbers may not be reset to zero under any other circumstances including when a scan tool (generic or enhanced) command to clear fault codes or reset KAM is received. If any of the individual counters reach the maximum value, all counters shall be divided by two before any are incremented again to avoid overflow problems. | | | | | |

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TABLE B109 - PID $82 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 82 | Engine Run Time for AECD #6 - #10 | | | | | |
| | Support of Run Time for AECD #6 - #10 | A (bit) | Byte 1 of 41 | | | |
| | Total run time with EI-AECD #6 active supported | A, bit 0 | 0 | 1 | 1 = Total run time with EI-AECD #6 active supported | |
| | Total run time with EI-AECD #7 active supported | A, bit 1 | 0 | 1 | 1 = Total run time with EI-AECD #7 active supported | |
| | Total run time with EI-AECD #8 active supported | A, bit 2 | 0 | 1 | 1 = Total run time with EI-AECD #8 active supported | |
| | Total run time with EI-AECD #9 active supported | A, bit 3 | 0 | 1 | 1 = Total run time with EI-AECD #9 active supported | |
| | Total run time with EI-AECD #10 active supported | A, bit 4 | 0 | 1 | 1 = Total run time with EI-AECD #10 active supported | |
| | reserved (bits shall be reported as '0') | A, bits 5 - 7 | 0 | 0 | | |
| | Total run time with EI-AECD #6 Timer 1 active | B1,B2, B3,B4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD6_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #6 Timer 2 active | C1,C2, C3,C4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD6_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #7 Timer 1 active | D1,D2, D3,D4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD7_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #7 Timer 2 active | E1,E2, E3,E4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD7_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #8 Timer 1 active | F1,F2, F3,F4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD8_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #8 Timer 2 active | G1,G2, G3,G4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD8_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #9 Timer 1 active | H1,H2, H3,H4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD9_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #9 Timer 2 active | I1,I2, I3,I4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD9_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #10 Timer 1 active | J1,J2, J3,J4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD10_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #10 Timer 2 active | K1,K2, K3,K4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD10_TIME2: xxxxxxx hrs, xx min |
| | Note: See PID $81 for the reporting criteria and description of the operation of the timers specified in this PID. | | | | | |

TABLE B110 - PID $83 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 83 | NOx Sensor | | | | | |
| | Support of NOx Sensor Data | A (bit) | Byte 1 of 9 | | | |
| | NOx Sensor Concentration Bank 1 Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = NOx Sensor concentration Bank 1 Sensor 1 supported | |
| | NOx Sensor Concentration Bank 1 Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = NOx Sensor concentration Bank 1 Sensor 2 supported | |
| | NOx Sensor Concentration Bank 2 Sensor 1 supported | A, bit 2 | 0 | 1 | 1 = NOx Sensor concentration Bank 2 Sensor 1 supported | |
| | NOx Sensor Concentration Bank 2 Sensor 2 supported | A, bit 3 | 0 | 1 | 1 = NOx Sensor concentration Bank 2 Sensor 2 supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | NOx Sensor Concentration Bank 1 Sensor 1 | B,C | 0 ppm | 65535 ppm | 1 part per million/bit | NOX11: xxxxx ppm |
| | NOX11 shall display NOx concentration for Bank 1 Sensor 1. | | | | | |
| | NOx Sensor Concentration Bank 1 Sensor 2 | D,E | 0 ppm | 65535 ppm | 1 part per million/bit | NOX12: xxxxx ppm |
| | NOX12 shall display NOx concentration for Bank 1 Sensor 2. | | | | | |
| | NOx Sensor Concentration Bank 2 Sensor 1 | F,G | 0 ppm | 65535 ppm | 1 part per million/bit | NOX21: xxxxx ppm |
| | NOX21 shall display NOx concentration for Bank 2 Sensor 1. | | | | | |
| | NOx Sensor Concentration Bank 2 Sensor 2 | H,I | 0 ppm | 65535 ppm | 1 part per million/bit | NOX22: xxxxx ppm |
| | NOX22 shall display NOx concentration for Bank 2 Sensor 2. | | | | | |
| | | | | | | |

TABLE B111 - PID $84 DEFINITION

| PID (hex) | Description | Data byte | Min. value | Max. value | Scaling/bit | External test equipment SI (Metric) / English display |
|---|---|---|---|---|---|---|
| 84 | Manifold Surface Temperature | A | – 40 °C | +215 °C | 1 °C with – 40 °C offset | MST: xxx °C (xxx °F) |
| | MST shall display intake manifold surface temperature. MST may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs. | | | | | |

TABLE B112 - PID $85 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 85 | NOx Control System | | | | | |
| | Support of NOx Reagent System Data | A (bit) | Byte 1 of 10 | | | |
| | Average Reagent Consumption Supported | A, bit 0 | 0 | 1 | 1 = Average Reagent Consumption Supported | |
| | Average Demanded Reagent Consumption Supported | A, bit 1 | 0 | 1 | 1 = Average Demanded Reagent Consumption Supported | |
| | Reagent Tank Level Supported | A, bit 2 | 0 | 1 | 1 = Reagent Tank Level Supported | |
| | Minutes run by the engine while NOx warning mode is activated supported | A, bit 3 | 0 | 1 | 1 = Minutes run by the engine while NOx warning mode is activated supported | |
| | reserved (bits shall be reported as '0') | A, bits 4 - 7 | 0 | 0 | | |
| | Average Reagent Consumption | B,C | 0 L/h | 327.675 L/h | 0.005 L/h per bit | REAG_RATE: xxx.xx L/h |
| | REAG_RATE shall indicate average reagent consumption in liters per hour by the engine system either over the previous complete 48 hour period of engine operation or the period needed for a demanded reagent consumption of at least 15 liters, whichever is longer. Note: REAG_RATE shall indicate zero L/h when the engine is not running. | | | | | |
| | Average Demanded Reagent Consumption | D,E | 0 L/h | 327.675 L/h | 0.005 L/h per bit | REAG_DEMD: xxx.xx L/h |
| | REAG_DEMD shall indicate average demanded reagent consumption in liters per hour by the engine system either over the previous complete 48 hour period of engine operation or the period needed for a demanded reagent consumption of at least 15 liters, whichever is longer. Note: REAG_DEMD shall indicate zero L/h when the engine is not running. | | | | | |
| | Reagent Tank Level | F | 0% (no reagent) | 100% (max reagent cap.) | 100/255 % | REAG_LVL: xxx.x % |
| | REAG_LVL shall indicate nominal reagent tank liquid fill capacity as a percent of maximum. For systems that have discreet level sensing, e.g. Full (100%, Low (20%) and Empty (0%), REAG_LVL shall indicate the actual level at each discreet point and the average level of the discreet points when operating between discreet points. In the example above, REAG_LVL would indicate 60% when operating between 100% and 20% and 10% when operating between 20% and 0%. | | | | | |
| | Total run time by the engine while NOx warning mode is activated | G,H,I,J | 0 sec | 4,294,967,295 sec | at 1 sec/bit | NWI_TIME: xxxxxxx hrs, xx min |

TABLE B112 - PID $85 DEFINITION (CONTINUED)

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 85 | NOx Warning Indicator Time - Conditions for "Total run time run by the engine while NOx warning indicator is activated" counter:<br> - reset to $00000000 when warning indicator state changes from deactivated to activated.<br> - accumulate counts in seconds if warning indicator is activated (ON)<br> - do not change value while warning indicator is not activated (OFF)<br> - reset to $00000000 if warning indicator has not been activated for 400 days or 9600 hours of engine operation<br> - do not wrap to $00000000 if value is $FFFFFFFF<br> - counter shall not be erasable by any scan tool command | | | | | |

TABLE B113 - PID $86 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 86 | Particulate Matter (PM) Sensor | | | | | |
| | Support of PM Sensor Data | A (bit) | Byte 1 of 5 | | | |
| | PM Sensor Mass Concentration Bank 1 Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = PM Sensor Mass Concentration Bank 1 Sensor 1 supported | |
| | PM Sensor Mass Concentration Bank 2 Sensor 1 supported | A, bit 1 | 0 | 1 | 1 = PM Sensor Mass Concentration Bank 2 Sensor 1 supported | |
| | reserved (bits shall be reported as '0') | A, bits 2 - 7 | 0 | 0 | | |
| | PM Sensor Mass Concentration Bank 1 Sensor 1 | B,C | 0 mg/m$^3$ | 819.1875 mg/m$^3$ | 0.0125 per bit | PM11: xxx.xx mg/m$^3$ |
| | PM11 shall display PM mass concentration for Bank 1 Sensor 1. | | | | | |
| | PM Sensor Mass Concentration Bank 2 Sensor 1 | D,E | 0 mg/m$^3$ | 819.1875 mg/m$^3$ | 0.0125 per bit | PM21: xxx.xx mg/m$^3$ |
| | PM21 shall display PM mass concentration for Bank 2 Sensor 1. | | | | | |

TABLE B114 - PID $87 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 87 | Intake Manifold Absolute Pressure | | | | | |
| | Support of Intake Manifold Absolute Pressure Data | A (bit) | Byte 1 of 5 | | | |
| | Intake Manifold Absolute Pressure A supported | A, bit 0 | 0 | 1 | 1 = Intake Manifold Absolute Pressure A supported | |
| | Intake Manifold Absolute Pressure B supported | A, bit 1 | 0 | 1 | 1 = Intake Manifold Absolute Pressure B supported | |
| | reserved (bits shall be reported as '0') | A, bits 2 - 7 | 0 | 0 | | |
| | Intake Manifold Absolute Pressure A | B,C | 0 kPa | 2047.96875 kPa | at 0.03125 kPa/bit | MAP_A xxx.xx kPa (xx.xx PSI) |
| | MAP_A shall display manifold pressure derived from a Manifold Absolute Pressure sensor, if a sensor is utilized. If a vehicle uses both a MAP and MAF sensor, both the MAP and MAF PIDs shall be supported. | | | | | |
| | Intake Manifold Absolute Pressure B | D,E | 0 kPa | 2047.96875 kPa | at 0.03125 kPa/bit | MAP_B xxx.xx kPa (xx.xx PSI) |
| | MAP_B shall display manifold pressure derived from a Manifold Absolute Pressure sensor, if a sensor is utilized. If a vehicle uses both a MAP and MAF sensor, both the MAP and MAF PIDs shall be supported. | | | | | |

TABLE B115 - PID $88 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 88 | SCR inducement system actual state | A(bit) | | | | SCR_INDUCE_SYSTEM: |
| | | 0 | 0 | 1 | 1 = reagent level too low | LEVEL_LOW |
| | | 1 | 0 | 1 | 1 = incorrect reagent | INCORR_REAG |
| | | 2 | 0 | 1 | 1 = deviation of reagent consumption | CONSUMP_DEVIATION |
| | | 3 | 0 | 1 | 1 = NOx emissions too high | NOx_LEVEL |
| | reserved (bits shall be reported as '0') | 4-6 | | | | |
| | | 7 | 0 | 1 | 1 = inducement system active | ACTIVE |
| | Conditions for "SCR inducement system actual state": indicate if system is currently activated using bit 7 indicate reason(s) for current activation (bit 0 - 3) all bits shall indicate 0 when inducement system is not active | | | | | |
| | SCR inducement system state 10K history (0 – 10,000 km) | B(bit) | | | | SCR_INDUCE_SYSTEM_HIST1: |
| | | 0 | 0 | 1 | 1 = reagent level too low | LEVEL_LOW1 |
| | | 1 | 0 | 1 | 1 = incorrect reagent | INCORR_REAG1 |
| | | 2 | 0 | 1 | 1 = deviation of reagent consumption | CONSUMP_D EVIATION1 |
| | | 3 | 0 | 1 | 1 = NOx emissions too high | NOx_LEVEL1 |
| | SCR inducement system state 20K history (10,000 – 20,000 km) | B (bit) | | | | SCR_INDUCE_SYSTEM_HIST2: |
| | | 4 | 0 | 1 | 1 = reagent level too low | LEVEL_LOW2 |
| | | 5 | 0 | 1 | 1 = incorrect reagent | INCORR_REAG2 |
| | | 6 | 0 | 1 | 1 = deviation of reagent consumption | CONSUMP_DEVIATION2 |
| | | 7 | 0 | 1 | 1 = NOx emissions too high | NOx_LEVEL2 |
| | Conditions for "SCR inducement system state history": indicate reason(s) for activation (bit 0 - 3) do not reset bit 0 - 3 when reason(s) disappear(s) do not reset upon code clearing (Service$04) | | | | | |

TABLE B115 - PID $88 DEFINITION (CONTINUED)

| SCR inducement system state 30K history (20,000 - 30,000 km) | C(bit) | | | | SCR_INDUCE_SYSTEM_HIST3: |
|---|---|---|---|---|---|
| | 0 | 0 | 1 | 1 = reagent level too low | LEVEL_LOW3 |
| | 1 | 0 | 1 | 1 = incorrect reagent | INCORR_REAG3 |
| | 2 | 0 | 1 | 1 = deviation of reagent consumption | CONSUMP_DEVIATION3 |
| | 3 | 0 | 1 | 1 = NOx emissions too high | NOx_LEVEL3 |
| SCR inducement system state 40K history (30,000 – 40,000 km) | C(bit) | | | | SCR_INDUCE_SYSTEM_HIST4: |
| | 4 | 0 | 1 | 1 = reagent level too low | LEVEL_LOW4 |
| | 5 | 0 | 1 | 1 = incorrect reagent | INCORR_REAG4 |
| | 6 | 0 | 1 | 1 = deviation of reagent consumption | CONSUMP_DEVIATION4 |
| | 7 | 0 | 1 | 1 = NOx emissions too high | NOx_LEVEL4 |
| Conditions for "SCR inducement system state history": indicate reason(s) for activation (bit 0 - 3) do not reset bit 0 - 3 when reason(s) disappear(s) do not reset upon code clearing (Service$04) | | | | | |

TABLE B115 - PID $88 DEFINITION (CONTINUED)

| | | | | | | |
|---|---|---|---|---|---|---|
| | Distance travelled while inducement system active in current 10K block (0 – 10,000 km) | D,E | 0 km | 65535 km | 1 km per count | SCR_IND_DIST_1N: xxxxx km (xxxxx miles) |
| | Distance travelled in current 10 K block (0 - 10,000 km block) | F,G | 0 km | 65535 km | 1 km per count | SCR_IND_DIST_1D: xxxxx km (xxxxx miles) |
| | Distance travelled while inducement system active in 20K block (10 – 20,000 km) | H,I | 0 km | 65535 km | 1 km per count | SCR_IND_DIST_2N: xxxxx km (xxxxx miles) |
| | Distance travelled while inducement system active in 30K block (20 – 30,000 km) | J,K | 0 km | 65535 km | 1 km per count | SCR_IND_DIST_3N: xxxxx km (xxxxx miles) |
| | Distance travelled while inducement system active in 40K block (30 – 40,000 km) | L,M | 0 km | 65535 km | 1 km per count | SCR_IND_DIST_4N: xxxxx km (xxxxx miles) |
| | Conditions for inducement system numerator and denominator counters: Initial values for numerators and denominators are zero. Accumulate counts in km After every km, increment the denominator, SCR_IND_DIST_1D If the inducement system is active, increment the numerator, SCR_IND_DIST_1N If the inducement system is not active, freeze SCR_IND_DIST_1N. Do not reset any bits in the status history. If the inducement system is active, set the appropriate bit for the SCR_INDUCE_SYSTEM_HISTORY1 (Note: if the reasons change, multiple bits will be set). When SCR_IND_DIST_1D reaches 10,000 km, freeze the values for the numerator and history, and copy each set of data (SCR_IND_DIST_xD and SCR_INDUCE_SYSTEM_HISTORYX) into the next older set of data (SCR_IND_DIST_x+1D and SCR_INDUCE_SYSTEM_HISTORYx+1). The denominators for SCR_IND_DIST_2N, SCR_IND_DIST_3N and SCR_IND_DIST_4N would always 10,000 km and do not need to be calculated or displayed. If the data in the oldest block (SCR_IND_DIST_4N and SCR_INDUCE_SYSTEM_HISTORY4) is displaced by new data, it can be discarded. Reset SCR_IND_DIST_1D and SCR_INDUCE_SYSTEM_HISTORY1 and begin accumulating mileage and inducement status again for the current 10,000 block register. Do not reset any values upon code clearing (Service $04) or battery disconnect NOTE:  Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event). Data may not be reset to zero under any other circumstances, including when a scan tool (generic or enhanced) command to clear fault codes or reset KAM is received. | | | | | |

TABLE B116 - PID $89 DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 89 | Engine Run Time for AECD #11 - #15 | | | | | |
| | Support of Run Time for AECD #11 - #15 | A (bit) | Byte 1 of 41 | | | |
| | Total run time with EI-AECD #11 active supported | A, bit 0 | 0 | 1 | 1 = Total run time with EI-AECD #11 active supported | |
| | Total run time with EI-AECD #12 active supported | A, bit 1 | 0 | 1 | 1 = Total run time with EI-AECD #12 active supported | |
| | Total run time with EI-AECD #13 active supported | A, bit 2 | 0 | 1 | 1 = Total run time with EI-AECD #13 active supported | |
| | Total run time with EI-AECD #14 active supported | A, bit 3 | 0 | 1 | 1 = Total run time with EI-AECD #14 active supported | |
| | Total run time with EI-AECD #15 active supported | A, bit 4 | 0 | 1 | 1 = Total run time with EI-AECD #15 active supported | |
| | Reserved (bits shall be reported as '0') | A, bits 5 - 7 | 0 | 0 | | |
| | Total run time with EI-AECD #11 Timer 1 active | B1,B2, B3,B4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD11_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #11 Timer 2 active | C1,C2, C3,C4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD11_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #12 Timer 1 active | D1,D2, D3,D4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD12_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #12 Timer 2 active | E1,E2, E3,E4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD12_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #13 Timer 1 active | F1,F2, F3,F4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD13_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #13 Timer 2 active | G1,G2, G3,G4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD13_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #14 Timer 1 active | H1,H2, H3,H4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD14_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #14 Timer 2 active | I1,I2, I3,I4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD14_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #15 Timer 1 active | J1,J2, J3,J4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD15_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #15 Timer 2 active | K1,K2, K3,K4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD15_TIME2: xxxxxxx hrs, xx min |
| | Note: See PID $81 for the reporting criteria and description of the operation of the timers specified in this PID. | | | | | |

TABLE B117 - PID $8A DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 8A | Engine Run Time for AECD #16 - #20 | | | | | |
| | Support of Run Time for AECD #16 - #20 | A (bit) | Byte 1 of 41 | | | |
| | Total run time with EI-AECD #16 active supported | A, bit 0 | 0 | 1 | 1 = Total run time with EI-AECD #16 active supported | |
| | Total run time with EI-AECD #17 active supported | A, bit 1 | 0 | 1 | 1 = Total run time with EI-AECD #17 active supported | |
| | Total run time with EI-AECD #18 active supported | A, bit 2 | 0 | 1 | 1 = Total run time with EI-AECD #18 active supported | |
| | Total run time with EI-AECD #19 active supported | A, bit 3 | 0 | 1 | 1 = Total run time with EI-AECD #19 active supported | |
| | Total run time with EI-AECD #20 active supported | A, bit 4 | 0 | 1 | 1 = Total run time with EI-AECD #20 active supported | |
| | reserved (bits shall be reported as '0') | A, bits 5 - 7 | 0 | 0 | | |
| | Total run time with EI-AECD #16 Timer 1 active | B1,B2, B3,B4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD16_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #16 Timer 2 active | C1,C2, C3,C4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD16_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #17 Timer 1 active | D1,D2, D3,D4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD17_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #17 Timer 2 active | E1,E2, E3,E4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD17_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #18 Timer 1 active | F1,F2, F3,F4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD18_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #18 Timer 2 active | G1,G2, G3,G4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD18_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #19 Timer 1 active | H1,H2, H3,H4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD19_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #19 Timer 2 active | I1,I2, I3,I4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD19_TIME2: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #20 Timer 1 active | J1,J2, J3,J4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD20_TIME1: xxxxxxx hrs, xx min |
| | Total run time with EI-AECD #20 Timer 2 active | K1,K2, K3,K4 | 0 sec | 4,294,967,295 sec | 1 sec/bit | AECD20_TIME2: xxxxxxx hrs, xx min |
| | Note: See PID $81 for the reporting criteria and description of the operation of the timers specified in this PID. | | | | | |

TABLE B118 - PID $8B DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 8B | Diesel Aftertreatment Status | | | | | |
| | Diesel Aftertreatment Status Supported | A (bit) | Byte 1 of 7 | | | |
| | Diesel Particulate Filter (DPF) Regen Status Supported | A, bit 0 | 0 | 1 | 1 = DPF regen status data supported | |
| | Diesel Particulate Filter (DPF) Regen Type Supported | A, bit 1 | 0 | 1 | 1 = DPF regen type data supported | |
| | NOx Adsorber Regen Status Supported | A, bit 2 | 0 | 1 | 1 = NOx adsorber regen data supported | |
| | NOx Adsorber Desulfurization Status Supported | A, bit 3 | 0 | 1 | 1 = NOx adsorber desulfurization data supported | |
| | Normalized trigger for DPF regen supported | A, bit 4 | 0 | 1 | 1 = Normalized trigger for DPF regen supported | |
| | Average time between DPF regens supported | A, bit 5 | 0 | 1 | 1 = Average time between DPF regens supported | |
| | Average distance between DPF regens supported | A, bit 6 | 0 | 1 | 1 = Average distance between DPF regens supported | |
| | Reserved (bits shall be reported as '0') | A, bit 7 | 0 | 0 | | |
| | Diesel Aftertreatment Status | B (bit) | Byte 2 of 7 | | | |
| | Diesel Particulate Filter (DPF) Regen Status | B, bit 0 | 0 | 1 | 1 = DPF Regen in progress; 0 = DPF Regen not in progress | DPF_REGEN: YES or NO |
| | Diesel Particulate Filter (DPF) Regen Type | B, bit 1 | 0 | 1 | 1 = Active DPF Regen; 0 = Passive DPF Regen | DPF_REGEN: ACTIVE or PASSIVE |
| | NOx Adsorber Regen Status | B, bit 2 | 0 | 1 | 1 = Desorption (regen) in progress, 0 = Adsorption in progress (no regen) | NOX_ADS_REGEN: YES or NO |
| | NOx Adsorber Desulfurization Status | B, bit 3 | 0 | 1 | 1 = Desulfurization in progress; 0 = Desulfurization not in progress | NOX_ADS_DESULF: YES or NO |
| | Reserved (bits shall be reported as '0') | B, bits 4 - 7 | 0 | 0 | | |
| | Normalized Trigger for DPF Regen | C | 0 % | 100 % | 100/255 % | DPF_REGEN_PCT: xxx.x % |

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| | DPF_REGEN_PCT shall indicate the normalized DPF loading, time, distance, drive cycles or other criteria before the next DPF regen where 0% means the DPF is clean (a complete regen just occurred) and 100% means the DPF is ready to be regenerated. When there are multiple criteria to trigger a regen, the one that is closest to triggering the regen shall be displayed. | | | | | |
| | Average Time Between DPF Regens | D,E | 0 min | 65535 min | 1 min per count | DPF_REGEN_AVGT: xxxx hrs, xx min |
| | DPF_REGEN_AVGT shall indicate the EWMA filtered time between successful, active triggered DPF regens. The weighting factor shall be chosen to  produce a representative value after 6 regen cycles (~0.5) | | | | | |
| | Average Distance Between DPF Regens | F,G | 0 km | 65535 km | 1 km per count | DPF_REGEN_AVGD: xxxxx km (xxxxx miles) |
| | DPF_REGEN_AVGD shall indicate the EWMA filtered distance between successful, active triggered DPF regens. The weighting factor shall be chosen to  produce a representative value after 6 regen cycles (~0.5) | | | | | |

TABLE B119 - PID $8C DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 8C | O2 Sensor (Wide Range) | | | | | |
| | Support of O2 Sensor Data | A (bit) | Byte 1 of 17 | | | |
| | O2 Sensor Concentration Bank 1 Sensor 1 supported | A, bit 0 | 0 | 1 | 1 = O2 Sensor Concentration Bank 1 Sensor 1 supported | |
| | O2 Sensor Concentration Bank 1 Sensor 2 supported | A, bit 1 | 0 | 1 | 1 = O2 Sensor Concentration Bank 1 Sensor 2 supported | |
| | O2 Sensor Concentration Bank 2 Sensor 1 supported | A, bit 2 | 0 | 1 | 1 = O2 Sensor Concentration Bank 2 Sensor 1 supported | |
| | O2 Sensor Concentration Bank 2 Sensor 2 supported | A, bit 3 | | | 1 = O2 Sensor Concentration Bank 2 Sensor 2 supported | |
| | O2 Sensor Lambda Bank 1 Sensor 1 supported | A, bit 4 | | | 1 = O2 Sensor Lambda Bank 1 Sensor 1 supported | |
| | O2 Sensor Lambda Bank 1 Sensor 2 supported | A, bit 5 | | | 1 = O2 Sensor Lambda Bank 1 Sensor 2 supported | |
| | O2 Sensor Lambda Bank 2 Sensor 1 supported | A, bit 6 | | | 1 = O2 Sensor Lambda Bank 2 Sensor 1 supported | |
| | O2 Sensor Lambda Bank 2 Sensor 2 supported | A, bit 7 | 0 | 1 | 1 = O2 Sensor Lambda Bank 2 Sensor 2 supported | |
| | O2 Sensor Concentration Bank 1 Sensor 1 | B,C | 0% | 100% | 0.001526 %/bit | O2S11_PCT xxx.xxxxxx % |
| | O2S11 shall display O2 concentration for Bank 1 Sensor 1. | | | | | |
| | O2 Sensor Concentration Bank 1 Sensor 2 | D,E | 0% | 100% | 0.001526 %/bit | O2S12_PCT xxx.xxxxxx % |
| | O2S12 shall display O2 concentration for Bank 1 Sensor 2. | | | | | |
| | O2 Sensor Concentration Bank 2 Sensor 1 | F,G | 0% | 100% | 0.001526 %/bit | O2S21_PCT xxx.xxxxxx % |
| | O2S21 shall display O2 concentration for Bank 2 Sensor 1. | | | | | |
| | O2 Sensor Concentration Bank 2 Sensor 2 | H,I | 0% | 100% | 0.001526 %/bit | O2S22_PCT xxx.xxxxxx % |
| | O2S22 shall display O2 concentration for Bank 2 Sensor 2. | | | | | |
| | O2 Sensor Lambda Bank 1 Sensor 1 | J,K | 0 | 7.99 | 0.000122 lambda//bit | LAMBDA11: x.xxx |
| | O2S11 shall display O2 Lambda for Bank 1 Sensor 1. | | | | | |
| | O2 Sensor Lambda Bank 1 Sensor 2 | L,M | 0 | 7.99 | 0.000122 lambda//bit | LAMBDA12: x.xxx |
| | O2S12 shall display O2 Lambda for Bank 1 Sensor 2. | | | | | |
| | O2 Sensor Lambda Bank 2 Sensor 1 | N,O | 0 | 7.99 | 0.000122 lambda//bit | LAMBDA21: x.xxx |
| | O2S21 shall display O2 Lambda for Bank 2 Sensor 1. | | | | | |
| | O2 Sensor Lambda Bank 2 Sensor 2 | P,Q | 0 | 7.99 | 0.000122 lambda//bit | LAMBDA22: x.xxx |
| | O2S22 shall display O2 Lambda for Bank 2 Sensor 2. | | | | | |

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| | PIDs $8C shall be used for linear or wide-ratio oxygen sensors on compression ignition vehicles that can be stand-alone sensors or part of the NOx sensor (See PID $83 for NOx PIDs). The O2S outputs can be Lambda (typically 0 to 4 for a compression ignition engine) and/or O2 concentration (typically 0 to 25%) NOTE: Compression ignition vehicles do not use the O2 sensor location PIDs $13 or $1D to define the oxygen sensor location. | | | | | |

TABLE B120 - PID $8D DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 8D | Absolute Throttle Position G | A | 0 % | 100 % | 100/255 % | TP_G: xxx.x % |
| | Absolute throttle position G, if utilized by the control module, (not "relative" or "learned" throttle position) shall be displayed as a normalized value, scaled from 0 to 100 %. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed-throttle position is at 1.0 volts, TP_G shall display (1.0 / 5.0) = 20 % at closed throttle and 50 % at 2.5 volts. Throttle position at idle will usually indicate greater than 0 %, and throttle position at wide-open throttle will usually indicate less than 100 %. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input reference voltage. A single throttle plate could have up to three throttle position sensors, A, B and C. A dual throttle plate system could have up to four throttle position sensors, A, B, C and G. | | | | | |

TABLE B121 - PID $8E - $FF DEFINITION

| PID (hex) | Description | Data Byte | Min. Value | Max. Value | Scaling/Bit | External Test Equipment SI (Metric) / English Display |
|---|---|---|---|---|---|---|
| 8E – FF | ISO/SAE reserved | — | — | — | — | — |

APPENDIX C - (NORMATIVE)
TIDS (TEST ID) SCALING DESCRIPTION

Table C1 defines standardized Test IDs. Applies only to SAE J1850, ISO 9141-2, and ISO 14230-2.

TABLE C1 - TEST ID SCALING DESCRIPTION

| Test ID | Description | Min. ($00) | Max. ($FF) | Scaling/Bit |
|---------|-------------|-----------|-----------|-------------|
| $01 | Rich to lean sensor threshold voltage (constant) | 0 V | 1.275 V | 0.005 V |
| $02 | Lean to rich sensor threshold voltage (constant) | 0 V | 1.275 V | 0.005 V |
| $03 | Low sensor voltage for switch time calculation (constant) | 0 V | 1.275 V | 0.005 V |
| $04 | High sensor voltage for switch time calculation (constant) | 0 V | 1.275 V | 0.005 V |
| $05 | Rich to lean sensor switch time (calculated) | 0 s | 1.02 s | 0.004 s |
| $06 | Lean to rich sensor switch time (calculated) | 0 s | 1.02 s | 0.004 s |
| $07 | Minimum sensor voltage for test cycle (calculated) | 0 V | 1.275 V | 0.005 V |
| $08 | Maximum sensor voltage for test cycle (calculated) | 0 V | 1.275 V | 0.005 V |
| $09 | Time between sensor transitions (calculated) | 0 s | 10.2 s | 0.04 s |
| $0A | Sensor period (calculated) | 0 s | 10.2 s | 0.04 s |
| $0B | Not applicable for SAE J1850, ISO 9141-2, and 14230-2 | | | |
| $0C | Not applicable for SAE J1850, ISO 9141-2, and 14230-2 | | | |
| $0D-$1F | ISO/SAE reserved | | | |
| $21-$2F | manufacturer Test ID description | 0 s | 1.02 s | 0.004 s |
| $30-$3F | : | 0 s | 10.2 s | 0.04 s |
| $41-$4F | : | 0 V | 1.275 V | 0.005 V |
| $50-$5F | : | 0 V | 12.75 V | 0.05 V |
| $61-$6F | : | 0 Hz | 25.5 Hz | 0.1 Hz |
| $70-$7F | : | 0 counts | 255 counts | 1 count |
| $81-$9F | manufacturer Test ID description | manufacturer specific values / units | | |
| $A1-$BF | : | : | | |
| $C1-$DF | : | : | | |
| $E1-$FE | : | : | | |
| $FF | ISO/SAE reserved | | | |

Table C2 defines standardized Test IDs. Applies only to ISO 15765-4.

TABLE C2 - TEST ID SCALING DESCRIPTION

| Test ID | Description | Min. ($0000) | Max. ($FFFF) | Scaling/Bit |
|---|---|---|---|---|
| $01 | Rich to lean sensor threshold voltage (constant) | 0 V | 7.999 V | 0.122 mV |
| $02 | Lean to rich sensor threshold voltage (constant) | 0 V | 7.999 V | 0.122 mV |
| $03 | Low sensor voltage for switch time calculation (constant) | 0 V | 7.999 V | 0.122 mV |
| $04 | High sensor voltage for switch time calculation (constant) | 0 V | 7.999 V | 0.122 mV |
| $05 | Rich to lean sensor switch time (calculated) | 0 s | 65.535 s | 1.0 ms |
| $06 | Lean to rich sensor switch time (calculated) | 0 s | 65.535 s | 1.0 ms |
| $07 | Minimum sensor voltage for test cycle (calculated) | 0 V | 7.999 V | 0.122 mV |
| $08 | Maximum sensor voltage for test cycle (calculated) | 0 V | 7.999 V | 0.122 mV |
| $09 | Time between sensor transitions (calculated) | 0 s | 65.535 s | 1.0 ms |
| $0A | Sensor period (calculated)<br><br>(Use scaling ID $0A for voltage, Scaling ID $10 for time) | 0 s | 65.535 s | 1.0 ms |
| $0B | EWMA (Exponential Weighted Moving Average) misfire counts for previous driving cycles (calculated, rounded to an integer value)<br><br>General EWMA calculation: 0.1 * (current misfire counts) + 0.9 * (previous misfire counts average)<br><br>Initial value for (previous misfire counts average) = 0<br><br>NOTE: Internal ECU calculation registers with precision higher than one count must be used and retained to calculate the contents of registers $0B and $0C to prevent rounding errors. If this is not done, these registers will never count back down to zero after misfire stops. The calculations must be done using the high-precision registers, and then rounded to the nearest integer value to be output as register $0B and $0C.<br><br>High_Precision_EWMA_Misfire_Counts $_{current}$ = Rounded [(0.1) * High_Precision_Misfire_Counts $_{current}$ + (0.9) * High_Precision_EWMA_Misfire_Counts $_{previous}$]<br><br>Where: Rounded means rounded to the nearest integer. The high-precision values are never reported, they are only used for internal calculations.<br>This TEST ID shall be reported with OBD Monitor IDs $A2 – $AD (refer to Appendix D and/or SAE J1979-DA) and the Scaling ID $24 (refer to Appendix E and/or SAE J1979-DA). (Use Scaling ID $24) | 0 counts | 65535 counts | 1 count/bit |
| $0C | Misfire counts for last/current driving cycles (calculated, rounded to an integer value)<br>This TEST ID shall be reported with OBD Monitor IDs $A2 – $AD (refer to Appendix D and/or SAE J1979-DA) and the Scaling ID $24 (refer to Appendix E and/or SAE J1979-DA). (Use Scaling ID $24) | 0 counts | 65535 counts | 1 count/bit |
| $0D-$7F | Reserved for future standardization | | | |
| $80 - $FE | Manufacturer Defined Test ID range — This parameter is an identifier for the test performed within the On-Board Diagnostic Monitor. | | | |
| $FF | ISO/SAE reserved | | | |

APPENDIX D - (NORMATIVE)
OBDMIDS (ON-BOARD DIAGNOSTIC MONITOR ID) DEFINITION FOR SERVICE $06

This Appendix only applies to ISO 15765-4.

TABLE D1 - STANDARD ON-BOARD DIAGNOSTIC MONITOR ID DEFINITION

| OBDMID (Hex) | On-Board Diagnostic Monitor ID Name |
|---|---|
| 00 | OBD Monitor IDs supported ($01 - $20) |
| 01 | Exhaust Gas Sensor Monitor Bank 1 – Sensor 1 |
| 02 | Exhaust Gas Sensor Monitor Bank 1 – Sensor 2 |
| 03 | Exhaust Gas Sensor Monitor Bank 1 – Sensor 3 |
| 04 | Exhaust Gas Sensor Monitor Bank 1 – Sensor 4 |
| 05 | Exhaust Gas Sensor Monitor Bank 2 – Sensor 1 |
| 06 | Exhaust Gas Sensor Monitor Bank 2 – Sensor 2 |
| 07 | Exhaust Gas Sensor Monitor Bank 2 – Sensor 3 |
| 08 | Exhaust Gas Sensor Monitor Bank 2 – Sensor 4 |
| 09 | Exhaust Gas Sensor Monitor Bank 3 – Sensor 1 |
| 0A | Exhaust Gas Sensor Monitor Bank 3 – Sensor 2 |
| 0B | Exhaust Gas Sensor Monitor Bank 3 – Sensor 3 |
| 0C | Exhaust Gas Sensor Monitor Bank 3 – Sensor 4 |
| 0D | Exhaust Gas Sensor Monitor Bank 4 – Sensor 1 |
| 0E | Exhaust Gas Sensor Monitor Bank 4 – Sensor 2 |
| 0F | Exhaust Gas Sensor Monitor Bank 4 – Sensor 3 |
| 10 | Exhaust Gas Sensor Monitor Bank 4 – Sensor 4 |
| 11 – 1F | ISO/SAE reserved |
| 20 | OBD Monitor IDs supported ($21 – $40) |
| 21 | Catalyst Monitor Bank 1 |
| 22 | Catalyst Monitor Bank 2 |
| 23 | Catalyst Monitor Bank 3 |
| 24 | Catalyst Monitor Bank 4 |
| 25 – 30 | ISO/SAE reserved |
| 31 | EGR Monitor Bank 1 |
| 32 | EGR Monitor Bank 2 |
| 33 | EGR Monitor Bank 3 |
| 34 | EGR Monitor Bank 4 |
| 35 | VVT Monitor Bank 1 |
| 36 | VVT Monitor Bank 2 |
| 37 | VVT Monitor Bank 3 |
| 38 | VVT Monitor Bank 4 |
| 39 | EVAP Monitor (Cap Off / 0.150") |
| 3A | EVAP Monitor (0.090") |
| 3B | EVAP Monitor (0.040") |
| 3C | EVAP Monitor (0.020") |
| 3D | Purge Flow Monitor |
| 3E – 3F | ISO/SAE reserved |
| 40 | OBD Monitor IDs supported ($41 – $60) |
| 41 | Exhaust Gas Sensor Heater Monitor Bank 1 – Sensor 1 |
| 42 | Exhaust Gas Sensor Heater Monitor Bank 1 – Sensor 2 |
| 43 | Exhaust Gas Sensor Heater Monitor Bank 1 – Sensor 3 |
| 44 | Exhaust Gas Sensor Heater Monitor Bank 1 – Sensor 4 |
| 45 | Exhaust Gas Sensor Heater Monitor Bank 2 – Sensor 1 |
| 46 | Exhaust Gas Sensor Heater Monitor Bank 2 – Sensor 2 |

TABLE D1 - STANDARD ON-BOARD DIAGNOSTIC MONITOR ID DEFINITION (CONTINUED)

| OBDMID (Hex) | On-Board Diagnostic Monitor ID Name |
|---|---|
| 47 | Exhaust Gas Sensor Heater Monitor Bank 2 – Sensor 3 |
| 48 | Exhaust Gas Sensor Heater Monitor Bank 2 – Sensor 4 |
| 49 | Exhaust Gas Sensor Heater Monitor Bank 3 – Sensor 1 |
| 4A | Exhaust Gas Sensor Heater Monitor Bank 3 – Sensor 2 |
| 4B | Exhaust Gas Sensor Heater Monitor Bank 3 – Sensor 3 |
| 4C | Exhaust Gas Sensor Heater Monitor Bank 3 – Sensor 4 |
| 4D | Exhaust Gas Sensor Heater Monitor Bank 4 – Sensor 1 |
| 4E | Exhaust Gas Sensor Heater Monitor Bank 4 – Sensor 2 |
| 4F | Exhaust Gas Sensor Heater Monitor Bank 4 – Sensor 3 |
| 50 | Exhaust Gas Sensor Heater Monitor Bank 4 – Sensor 4 |
| 51 – 5F | ISO/SAE reserved |
| 60 | OBD Monitor IDs supported ($61 – $80) |
| 61 | Heated Catalyst Monitor Bank 1 |
| 62 | Heated Catalyst Monitor Bank 2 |
| 63 | Heated Catalyst Monitor Bank 3 |
| 64 | Heated Catalyst Monitor Bank 4 |
| 65 – 70 | ISO/SAE reserved |
| 71 | Secondary Air Monitor 1 |
| 72 | Secondary Air Monitor 2 |
| 73 | Secondary Air Monitor 3 |
| 74 | Secondary Air Monitor 4 |
| 75 – 7F | ISO/SAE reserved |
| 80 | OBD Monitor IDs supported ($81 – $A0) |
| 81 | Fuel System Monitor Bank 1 |
| 82 | Fuel System Monitor Bank 2 |
| 83 | Fuel System Monitor Bank 3 |
| 84 | Fuel System Monitor Bank 4 |
| 85 | Boost Pressure Control Monitor Bank 1 |
| 86 | Boost Pressure Control Monitor Bank 2 |
| 87 – 8F | ISO/SAE reserved |
| 90 | NOx Adsorber Monitor Bank 1 |
| 91 | NOx Adsorber Monitor Bank 2 |
| 92 – 97 | ISO/SAE reserved |
| 98 | NOx/SCR Catalyst Monitor Bank 1 |
| 99 | NOx/SCR Catalyst Monitor Bank 2 |
| 9A – 9F | ISO/SAE reserved |
| A0 | OBD Monitor IDs supported ($A1 – $C0) |
| A1 | Misfire Monitor General Data |
| A2 | Misfire Cylinder 1 Data |
| A3 | Misfire Cylinder 2 Data |
| A4 | Misfire Cylinder 3 Data |
| A5 | Misfire Cylinder 4 Data |
| A6 | Misfire Cylinder 5 Data |
| A7 | Misfire Cylinder 6 Data |
| A8 | Misfire Cylinder 7 Data |
| A9 | Misfire Cylinder 8 Data |
| AA | Misfire Cylinder 9 Data |
| AB | Misfire Cylinder 10 Data |
| AC | Misfire Cylinder 11 Data |
| AD | Misfire Cylinder 12 Data |

TABLE D1 - STANDARD ON-BOARD DIAGNOSTIC MONITOR ID DEFINITION (CONTINUED)

| OBDMID (Hex) | On-Board Diagnostic Monitor ID Name |
|---|---|
| AE | Misfire Cylinder 13 Data |
| AF | Misfire Cylinder 14 Data |
| B0 | Misfire Cylinder 15 Data |
| B1 | Misfire Cylinder 16 Data |
| B2 | PM Filter Monitor Bank 1 |
| B3 | PM Filter Monitor Bank 2 |
| B4 - BF | ISO/SAE reserved |
| C0 | OBD Monitor IDs supported ($C1 – $E0) |
| C1 – DF | ISO/SAE reserved |
| E0 | OBD Monitor IDs supported ($E1 – $FF) |
| E1 – FF | Vehicle manufacturer defined OBDMIDs |

The following figures are examples of sensor and catalyst configurations. The cylinder most remote of the flywheel is defined as cylinder number 1. Bank 1 contains cylinder number1.
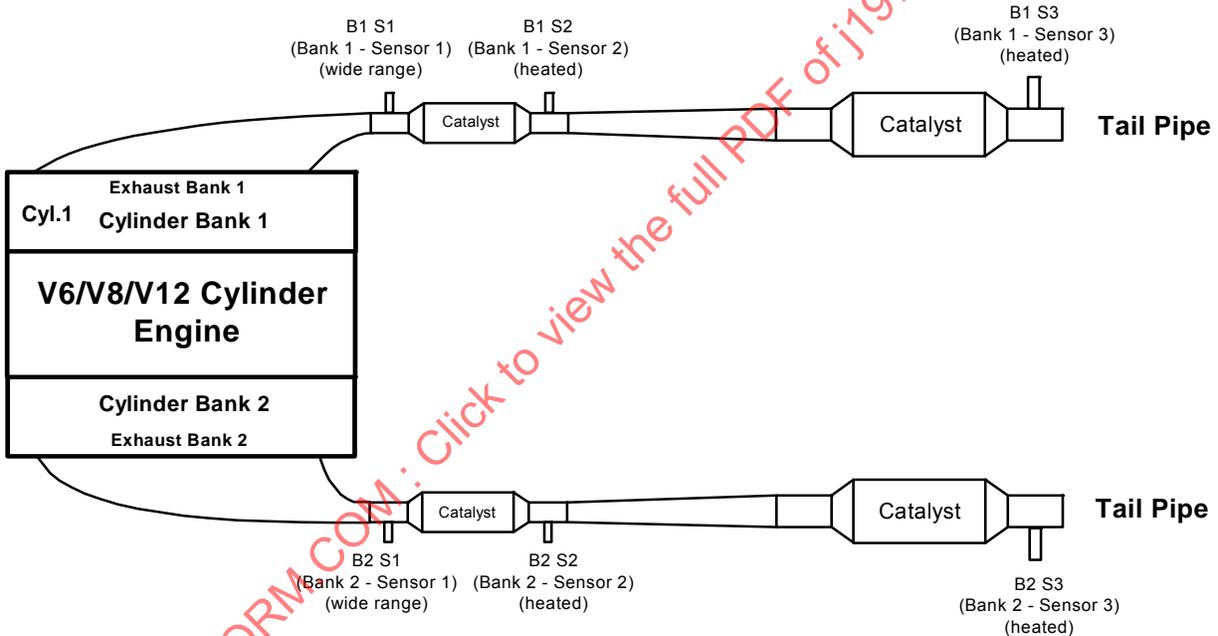


FIGURE D1 - V6/V8/V12 CYLINDER ENGINE WITH 2 EXHAUST BANKS AND 4 CATALYSTS EXAMPLE
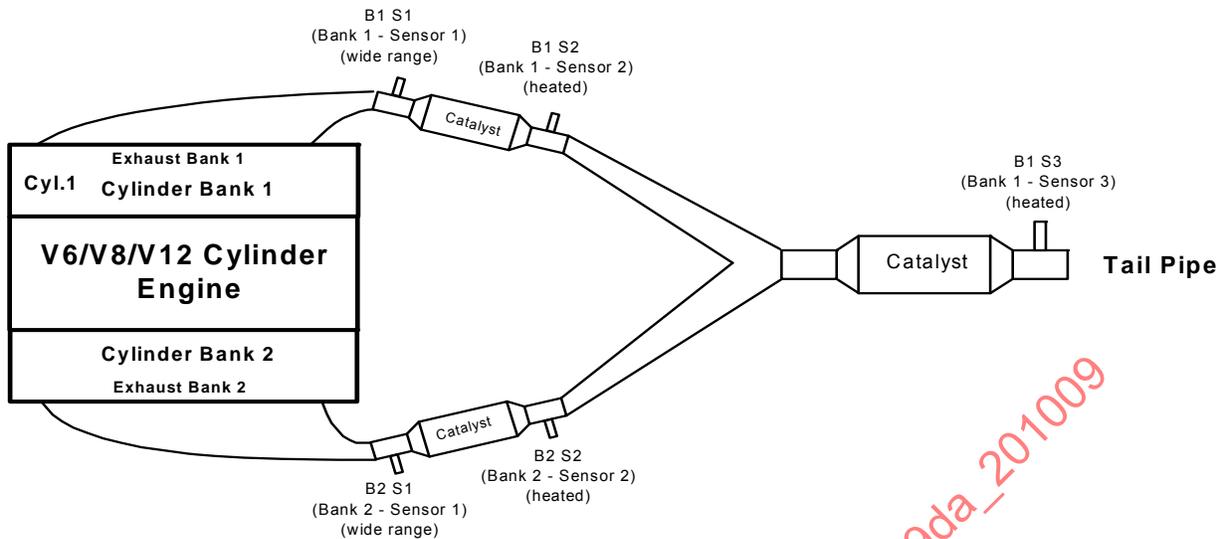
FIGURE D2 - V6V8/V12 CYLINDER ENGINE WITH 2 EXHAUST BANKS AND 3 CATALYSTS EXAMPLE
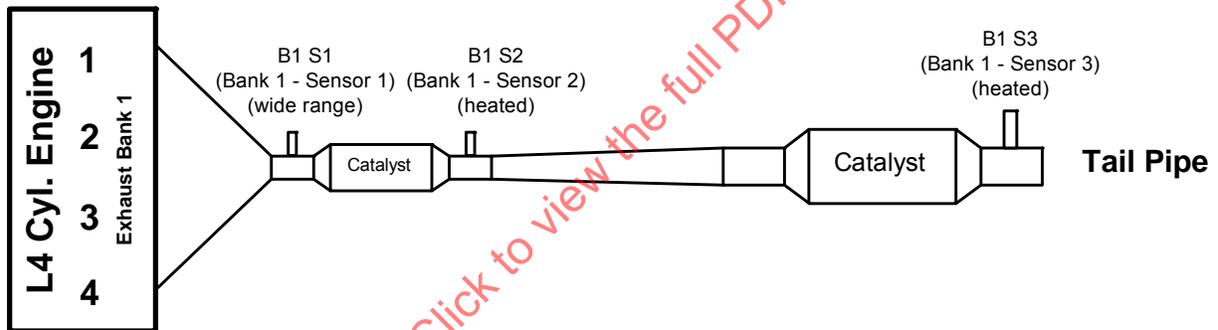


FIGURE D3 - L4 CYLINDER ENGINE WITH 1 EXHAUST BANK AND 2 CATALYSTS EXAMPLE
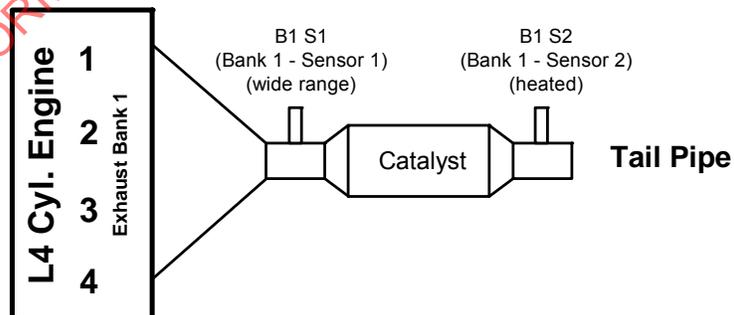


FIGURE D4 - L4 CYLINDER ENGINE WITH 1 EXHAUST BANK AND 1 CATALYST EXAMPLE

APPENDIX E - (NORMATIVE)
UNIT AND SCALING DEFINITION FOR SERVICE $06

This Appendix only applies to ISO 15765-4. The Unit and Scaling IDs are separated into two ranges; $01 - $7F are unsigned Scaling Identifiers, and $80 - $FE are signed Scaling Identifiers. Unit and Scaling IDs $00 and $FF are ISO/SAE reserved for future definition and shall not be defined as Unit and Scaling Identifiers.

| Bit 7 = '0' | **unsigned** Scaling Identifier range |
|---|---|
| Bit 7 = '1' | **signed** Scaling Identifier range |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|

FIGURE E1 - UNSIGNED/SIGNED SCALING IDENTIFIER RANGE ENCODING

E.1    UNSIGNED UNIT AND SCALING IDENTIFIERS DEFINITION

TABLE E1 - UNIT AND SCALING ID $01 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 01 | Raw Value | 1 per bit | 0000 | 0 | FFFF | 65535 | xxxxx |
| | | hex to decimal | Data Range examples: | | | | Display examples: |
| | | unsigned | $0000 | | 0 | | 0 |
| | | | $FFFF | | + 65535 | | 65535 |

TABLE E2 - UNIT AND SCALING ID $02 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 02 | Raw Value | 0.1 per bit | 0000 | 0 | FFFF | 6553.5 | xxxx.x |
| | | hex to decimal | Data Range examples: | | | | Display examples: |
| | | unsigned | $0000 | | 0 | | 0.0 |
| | | | $FFFF | | + 6553.5 | | 6553.5 |

TABLE E3 - UNIT AND SCALING ID $03 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 03 | Raw Value | 0.01 per bit | 0000 | 0 | FFFF | 655.35 | xxx.xx |
| | | hex to decimal | Data Range examples: | | | | Display examples: |
| | | unsigned | $0000 | | 0 | | 0.00 |
| | | | $FFFF | | + 655.35 | | 655.35 |

TABLE E4 - UNIT AND SCALING ID $04 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 04 | Raw Value | 0.001 per bit | 0000 | 0 | FFFF | 65.535 | xx.xxx |
| | | hex to decimal | Data Range examples: | | | | Display examples: |
| | | unsigned | $0000 | | 0 | | 0.000 |
| | | | $FFFF | | + 65.535 | | 65.535 |

TABLE E5 - UNIT AND SCALING ID $05 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 05 | Raw Value | 0.0000305 per bit hex to decimal unsigned | 0000 | 0 | FFFF | 1.999 | x.xxxxxxx |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 | | 0.0000000 |
| | | | $FFFF | | + 1.999969 | | 1.9999695 |

TABLE E6 - UNIT AND SCALING ID $06 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 06 | Raw Value | 0.000305 per bit hex to decimal unsigned | 0000 | 0 | FFFF | 19.988 | xx.xxxxxx |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 | | 0.000000 |
| | | | $FFFF | | 19.988 | | 19.988175 |

TABLE E7 - UNIT AND SCALING ID $07 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 07 | rotational frequency | 0.25 rpm per bit unsigned | 0000 | 0 rpm | FFFF | 16384 rpm | xxxxx.xx rpm |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 rpm | | 0.00 rpm |
| | | | $0002 | | + 0.5 rpm | | 0.50 rpm |
| | | | $FFFC | | + 16383 rpm | | 16383.00 rpm |
| | | | $FFFD | | + 16383.25 rpm | | 16383.25 rpm |
| | | | $FFFE | | + 16383.50 rpm | | 16383.50 rpm |
| | | | $FFFF | | + 16383.75 rpm | | 16383.75 rpm |

TABLE E8 - UNIT AND SCALING ID $08 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 08 | Speed | 0.01 km/h per bit unsigned | 0000 | 0 km/h | FFFF | 655.35 km/h | xxx.xx km/h (xxx.xx mph) |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion km/h -> mph: | | $0000 | | 0 km/h | | 0.00 km/h     (0.00 mph) |
| | 1 km/h = 0.62137 mph | | $0064 | | + 1 km/h | | 1.00 km/h     (0.62 mph) |
| | | | $03E7 | | + 9.99 km/h | | 9.99 km/h     (6.21 mph) |
| | | | $FFFF | | + 655.35 km/h | | 655.35 km/h   (407.21 mph) |

TABLE E9 - UNIT AND SCALING ID $09 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 09 | Speed | 1 km/h per bit unsigned | 0000 | 0 km/h | FFFF | 65535 km/h | xxxxx km/h (xxxxx mph) |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion km/h -> mph: | | $0000 | | 0 km/h | | 0 km/h        (0 mph) |
| | 1 km/h = 0.62137 mph | | $0064 | | + 100 km/h | | 100 km/h      (62 mph) |
| | | | $03E7 | | + 999 km/h | | 999 km/h      (621 mph) |
| | | | $FFFF | | + 65535 km/h | | 65535 km/h    (40721 mph) |

TABLE E10 - UNIT AND SCALING ID $0A DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 0A | Voltage | 0.122 mV per bit unsigned | 0000 | 0 V | FFFF | 7.99 V | x.xxxxxx V |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion mV -> V: 1000 mV = 1 V | | $0000 | 0 mV | | | 0.000000 V |
| | | | $0001 | + 0.122 mV | | | 0.000122 V |
| | | | $2004 | + 1000.488 mV | | | 1.000488 V |
| | | | $FFFF | + 7999 mV | | | 7.999878 V |

TABLE E11 - UNIT AND SCALING ID $0B DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 0B | Voltage | 0.001 V per bit unsigned | 0000 | 0 V | FFFF | 65.535 V | xx.xxx V |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion mV -> V: 1000 mV = 1 V | | $0000 | 0 mV | | | 0.000 V |
| | | | $0001 | + 1 mV | | | 0.001 V |
| | | | $FFFF | + 65535 mV | | | 65.535 V |

TABLE E12 - UNIT AND SCALING ID $0C DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 0C | Voltage | 0.01 V per bit unsigned | 0000 | 0 V | FFFF | 655.35 V | xxx.xx V |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion mV -> V: 1000 mV = 1 V | | $0000 | 0 mV | | | 0.00 V |
| | | | $0001 | + 10 mV | | | 0.01 V |
| | | | $FFFF | + 655350 mV | | | 655.35 V |

TABLE E13 - UNIT AND SCALING ID $0D DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 0D | Current | 0.00390625 mA per bit, unsigned | 0000 | 0 A | FFFF | 255.996 mA | xxx.xxxxxxxx mA |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | 0 mA | | | 0.00000000 mA |
| | | | $0001 | 0.004 mA | | | 0.00390625 mA |
| | | | $8000 | + 128 mA | | | 128.0000000 mA |
| | | | $FFFF | + 255.996 mA | | | 255.9960938 mA |

TABLE E14 - UNIT AND SCALING ID $0E DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 0E | Current | 0.001 A per bit unsigned | 0000 | 0 A | FFFF | 65.535 A | xx.xxx A |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion mA -> A: 1000 mA = 1 A | | $0000 | 0 A | | | 0.000 A |
| | | | $8000 | + 32.768 A | | | 32.768 A |
| | | | $FFFF | + 65.535 A | | | 65.535 A |

TABLE E15 - UNIT AND SCALING ID $0F DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 0F | Current | 0.01 A per bit unsigned | 0000 | 0 A | FFFF | 655.35 A | xxx.xx A |
| | | Conversion mA -> A: 1000 mA = 1 A | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 mA | | 0.00 A |
| | | | $0001 | | + 10 mA | | 0.01 A |
| | | | $FFFF | | + 655350 mA | | 655.35 A |

TABLE E16 - UNIT AND SCALING ID $10 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 10 | Time | 1 ms per bit unsigned | 0000 | 0 ms | FFFF | 65535 ms | xx.xxx s (x min, xx s) |
| | | Conversion s -> min -> h: 60 s = 1 min 60 min = 1 h | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 ms | | 0.000 s (0 min, 0 s) |
| | | | $8000 | | + 32768 ms | | 32.768 s (0 min, 33 s) |
| | | | $EA60 | | + 60000 ms (1 min) | | 60.000 s (1 min, 0 s) |
| | | | $FFFF | | + 65535 ms (1 min, 6 s) | | 65.535 s (1 min, 6 s) |

TABLE E17 - UNIT AND SCALING ID $11 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 11 | Time | 100 ms per bit unsigned | 0000 | 0 s | FFFF | 6553.5 s | xxxx.x s (x h, x min, xx s) |
| | | Conversion s -> min -> h: 60 s = 1 min 60 min = 1 h | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 s | | 0.000 s (0 h, 0 min, 0 s) |
| | | | $8000 | | + 3276.8 s | | 3276.8 s (0 h, 54 min, 37 s) |
| | | | $EA60 | | + 6000 s (1 h 40 min ) | | 6000 s (1 h, 40 min, 0 s) |
| | | | $FFFF | | + 6553.5 s (1h, 49 min 13 s) | | 6553.5 s (1 h, 49 min, 13 s) |

TABLE E18 - UNIT AND SCALING ID $12 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 12 | Time | 1 second per bit unsigned | 0000 | 0 s | FFFF | 65535 s | xxxxx s (xx h, xx min xx s) |
| | | Conversion s -> min -> h: 60 s = 1 min 60 min = 1 h | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 s | | 0 s (0 h, 0 min, 0 s) |
| | | | $003C | | + 60 s | | 60 s (0 h, 1 min, 0 s) |
| | | | $0E10 | | + 3600 s | | 3600 s (1 h, 0 min, 0 s) |
| | | | $FFFF | | + 65535 s | | 65535 s (18 h, 12 min, 15 s) |

TABLE E19 - UNIT AND SCALING ID $13 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 13 | Resistance | 1 mOhm per bit unsigned | 0000 | 0 mOhm | FFFF | 65535 mOhm | xx.xxx Ohm |
| | | Conversion mOhm -> Ohm: 1000 mOhm = 1 Ohm | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 mOhm | | 0.000 Ohm |
| | | | $0001 | | + 1 mOhm | | 0.001 Ohm |
| | | | $8000 | | + 32768 mOhm | | 32.768 Ohm |
| | | | $FFFF | | + 65535 mOhm | | 65.535 Ohm |

TABLE E20 - UNIT AND SCALING ID $14 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | (dec.) | Max. Value (hex) | (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 14 | Resistance | 1 Ohm per bit unsigned | 0000 | 0 Ohm | FFFF | 65535 Ohm | xx.xxx kOhm |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion Ohm -> kOhm: 1000 Ohm = 1 kOhm | | $0000 | | 0 Ohm | | 0.000 kOhm |
| | | | $0001 | | + 1 Ohm | | 0.001 kOhm |
| | | | $8000 | | + 32768 Ohm | | 32.768 kOhm |
| | | | $FFFF | | + 65535 Ohm | | 65.535 kOhm |

TABLE E21 - UNIT AND SCALING ID $15 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | (dec.) | Max. Value (hex) | (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 15 | Resistance | 1 kOhm per bit | 0000 | 0 kOhm | FFFF | 65535 kOhm | xxxxx kOhm |
| | | unsigned | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 kOhm | | 0 kOhm |
| | | | $0001 | | + 1 kOhm | | 1 kOhm |
| | | | $8000 | | + 32768 kOhm | | 32768 kOhm |
| | | | $FFFF | | + 65535 kOhm | | 65535 kOhm |

TABLE E22 - UNIT AND SCALING ID $16 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | (dec.) | Max. Value (hex) | (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 16 | Temperature | (0.1 °C per bit) - 40 °C unsigned | 0000 | – 40 °C | FFFF | + 6513.5 °C | xxxx.x °C (xxxxx.x °F) |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | – 40 °C | | – 40.0 °C   (– 40.0 °F) |
| | Conversion °C -> °F: °F = °C * 1.8 + 32 °C | | $0001 | | – 39.9 °C | | – 39.9 °C   (– 39.8 °F) |
| | | | $00DC | | – 18.0 °C | | – 18.0 °C   (– 0.4 °F) |
| | | | $0190 | | 0 °C | | 0.0 °C   (32.0 °F) |
| | | | $FFFF | | + 6513.5 °C | | 6513.5 °C   (11756.3 °F) |

TABLE E23 - UNIT AND SCALING ID $17 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | (dec.) | Max. Value (hex) | (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 17 | Pressure (Gauge) | 0.01 kPa per bit unsigned | 0000 | 0 kPa | FFFF | 655.35 kPa | xxx.xx kPa (Gauge) (xx.x PSI) |
| | Conversion kPa -> PSI: 1 kPa (10 HPa) = 0.1450377 PSI | | Data Range examples: | | | | Display examples: |
| | Additional Conversions: | | $0000 | | 0 kPa | | 0.00 kPa   (0.0 PSI ) |
| 1 kPa = 4.0146309 inH2O | | | $0001 | | + 0.01 kPa | | 0.01 kPa   (0.0 PSI ) |
| 1 kPa = 101.9716213 mmH2O (millimeter of water) | | | $FFFF | | + 655.35 kPa | | 655.35 kPa   (95.1 PSI) |
| 1 kPa = 7.5006151 mmHg (millimeter of mercury) | | | | | | | |
| 1 kPa = 0.010 bar | | | | | | | |

TABLE E24 - UNIT AND SCALING ID $18 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 18 | Pressure (Air pressure) | 0.0117 kPa per bit unsigned | 0000 | 0 kPa | FFFF | 766.76 kPa | xxx.xxxx kPa (Air) (xxx.x PSI) |
| Conversion kPa -> PSI: 1 kPa (10 HPa) = 0.1450377 PSI Additional Conversions: 1 kPa = 4.0146309 inH2O 1 kPa = 101.9716213 mmH2O (millimeter of water) 1 kPa = 7.5006151 mmHg (millimeter of mercury) 1 kPa = 0.010 bar | | | Data Range examples: $0000   0 kPa $0001   + 0.0117 kPa $FFFF   + 766.7595 kPa | | | | Display examples: 0.0000 kPa   (0.0 PSI) 0.0117 kPa   (0.0 PSI) 766.7595 kPa   (111.2 PSI) |

TABLE E25 - UNIT AND SCALING ID $19 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 19 | Pressure (Fuel pressure) | 0.079 kPa per bit unsigned | 0000 | 0 kPa | FFFF | 5177.27 kPa | xxxx.xxx kPa (Gauge) (xxx.x PSI) |
| Conversion kPa -> PSI: 1 kPa (10 HPa) = 0.1450377 PSI Additional Conversions: 1 kPa = 4.0146309 inH2O 1 kPa = 101.9716213 mmH2O (millimeter of water) 1 kPa = 7.5006151 mmHg (millimeter of mercury) 1 kPa = 0.010 bar | | | Data Range examples: $0000   0 kPa $0001   + 0.079 kPa $FFFF   + 5177.265 kPa | | | | Display examples: 0.000 kPa   (0.0 PSI) 0.079 kPa   (0.0 PSI) 5177.265 kPa   (750.9 PSI) |

TABLE E26 - UNIT AND SCALING ID $1A DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 1A | Pressure (Gauge) | 1 kPa per bit unsigned | 0000 | 0 kPa | FFFF | 65535 kPa | xxxxx kPa (Gauge) (xxxx.x PSI) |
| Conversion kPa -> PSI: 1 kPa (10 HPa) = 0.1450377 PSI Additional Conversions: 1 kPa = 4.0146309 inH2O 1 kPa = 101.9716213 mmH2O (millimeter of water) 1 kPa = 7.5006151 mmHg (millimeter of mercury) 1 kPa = 0.010 bar | | | Data Range examples: $0000   0 kPa $0001   + 1 kPa $FFFF   + 65535 kPa | | | | Display examples: 0 kPa   (0.0 PSI) 1 kPa   (0.1 PSI) 65535 kPa   (9505.0 PSI) |

TABLE E27 - UNIT AND SCALING ID $1B DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 1B | Pressure (Diesel pressure) | 10 kPa per bit unsigned | 0000 | 0 kPa | FFFF | 655350 kPa | xxxxxx kPa (Gauge) (xxxxx.x PSI) |
| Conversion kPa ->: PSI 1 kPa (10 HPa) = 0.1450377 PSI Additional Conversions: 1 kPa = 4.0146309 inH2O 1 kPa = 101.9716213 mmH2O (millimeter of water) 1 kPa = 7.5006151 mmHg (millimeter of mercury) 1 kPa = 0.010 bar | | | Data Range examples: $0000   0 kPa $0001   + 10 kPa $FFFF   + 655350 kPa | | | | Display examples: 0 kPa   (0.0 PSI) 10 kPa   (1.5 PSI) 655350 kPa   (95050.5 PSI) |

TABLE E28 - UNIT AND SCALING ID $1C DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 1C | Angle | 0.01 ° per bit unsigned | 0000 | 0 ° | FFFF | 655.35 ° | xxx.xx ° |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 ° | | 0.00 ° |
| | | | $0001 | | + 0.01 ° | | 0.01 ° |
| | | | $8CA0 | | + 360 ° | | 360.00 ° |
| | | | $FFFF | | + 655.35 ° | | 655.35 ° |

TABLE E29 - UNIT AND SCALING ID $1D DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 1D | Angle | 0.5 ° per bit unsigned | 0000 | 0 ° | FFFF | 32767.5 ° | xxxxx.x ° |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 ° | | 0.0 ° |
| | | | $0001 | | 0.5 ° | | 0.5 ° |
| | | | $FFFF | | 32767.5 ° | | 32767.5 ° |

TABLE E30 - UNIT AND SCALING ID $1E DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 1E | Equivalence ratio (lambda) | 0.0000305 per bit unsigned | 0000 | 0 | FFFF | 1.999 | x.xxxxxxx lambda |
| | | | Data Range examples: | | | | Display examples: |
| | measured Air/Fuel ratio divided by the stoichiometric Air/Fuel ratio (14.64 for gasoline) | | $0000 | | 0 | | 0.0000000 lambda |
| | | | $8013 | | 1 | | 1.0005798 lambda |
| | | | $FFFF | | 1.999 | | 1.9999695 lambda |

TABLE E31 - UNIT AND SCALING ID $1F DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 1F | Air/Fuel Ratio | 0.05 per bit unsigned | 0000 | 0 | FFFF | 3276.75 | xxxx.xx A/F ratio |
| | | | Data Range examples: | | | | Display examples: |
| | measured Air/Fuel ratio NOT divided by the stoichiometric Air/Fuel ratio (14.64 for gasoline) | | $0000 | | 0 | | 0.00 A/F ratio |
| | | | $0001 | | 0.05 | | 0.05 A/F ratio |
| | | | $0014 | | 1.00 | | 1.00 A/F ratio |
| | | | $0126 | | 14.7 | | 14.70 A/F ratio |
| | | | $FFFF | | 3276.75 | | 3276.75 A/F ratio |

TABLE E32 - UNIT AND SCALING ID $20 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value (hex) | Min. Value (dec.) | Max. Value (hex) | Max. Value (dec.) | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| 20 | Ratio | 0.00390625 per bit unsigned | 0000 | 0 | FFFF | 255.993 | xxx.xxxxxxx |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 | | 0.0000000 |
| | | | $0001 | | 0.0039062 | | 0.0039063 |
| | | | $FFFF | | 255.993 | | 255.9960938 |

TABLE E33 - UNIT AND SCALING ID $21 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value | | Max. Value | | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| | | | (hex) | (dec.) | (hex) | (dec.) | |
| 21 | Frequency | 1 mHz per bit unsigned | 0000 | 0 | FFFF | 65.535 | xx.xxx Hz |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion mHz -> Hz -> kHz: 1000 mHz = 1 Hz | | $0000 | | 0 mHz | | 0.000 Hz |
| | | | $8000 | | 32768 mHz | | 32.768 Hz |
| | | | $FFFF | | 65535 mHz | | 65.535 Hz |

TABLE E34 - UNIT AND SCALING ID $22 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value | | Max. Value | | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| | | | (hex) | (dec.) | (hex) | (dec.) | |
| 22 | Frequency | 1 Hz per bit unsigned | 0000 | 0 Hz | FFFF | 65535 Hz | xxxxx Hz |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion Hz -> KHz -> MHz: 1000 Hz = 1 KHz 1000 KHz = 1 MHz | | $0000 | | 0 Hz | | 0 Hz |
| | | | $8000 | | 32768 Hz | | 32768 Hz |
| | | | $FFFF | | 65535 Hz | | 65535 Hz |

TABLE E35 - UNIT AND SCALING ID $23 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value | | Max. Value | | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| | | | (hex) | (dec.) | (hex) | (dec.) | |
| 23 | Frequency | 1 KHz per bit unsigned | 0000 | 0 KHz | FFFF | 65535 KHz | xx.xxx MHz |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion Hz -> KHz -> MHz: 1000 Hz = 1 KHz 1000 KHz = 1 MHz | | $0000 | | 0 KHz | | 0.000 MHz |
| | | | $8000 | | 32768 KHz | | 32.768 MHz |
| | | | $FFFF | | 65535 KHz | | 65.535 MHz |

TABLE E36 - UNIT AND SCALING ID $24 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value | | Max. Value | | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| | | | (hex) | (dec.) | (hex) | (dec.) | |
| 24 | Counts | 1 count per bit unsigned | 0000 | 0 counts | FFFF | 65535 | xxxxx counts |
| | | | Data Range examples: | | | | Display examples: |
| | | | $0000 | | 0 counts | | 0 counts |
| | | | $FFFF | | 65535 counts | | 65535 counts |

TABLE E37 - UNIT AND SCALING ID $25 DEFINITION

| Unit and Scaling ID (hex) | Description | Scaling/Bit | Min. Value | | Max. Value | | External Test Equipment SI (Metric) Display |
|---|---|---|---|---|---|---|---|
| | | | (hex) | (dec.) | (hex) | (dec.) | |
| 25 | Distance | 1 km per bit unsigned | 0000 | 0 | FFFF | 65535 | xxxxx km (xxxxx miles) |
| | | | Data Range examples: | | | | Display examples: |
| | Conversion km -> mile: 1 km = 0.62137 miles | | $0000 | | 0 km | | 0 km        (0 miles) |
| | | | $FFFF | | 65535 km | | 65535 km   (40721 miles) |