SAE International® SURFACE VEHICLE STANDARD

SAE J1979-DA OCT2011

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Equivalent to J1979 SEP2010

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.

2. NOTES

2.1 Marginal Indicia

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE VEHICLE E E SYSTEM DIAGNOSTIC STANDARDS COMMITTEE

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 Data A bit 6 : Data D bit 0	01 02 : 20	0 = not supported 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. 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).
20	Data A bit 7 Data A bit 6 : Data D bit 0	21 22 : 40	0 = not supported 1 = supported	
40	Data A bit 7 Data A bit 6 : Data D bit 0	41 42 : 60	0 = not supported 1 = supported	
60	Data A bit 7 Data A bit 6 : Data D bit 0	61 62 : 80	0 = not supported 1 = supported	
80	Data A bit 7 Data A bit 6 : Data D bit 0	81 82 : A0	0 = not supported 1 = supported	
A0	Data A bit 7 Data A bit 6 : Data D bit 0	A1 A2 : C0	0 = not supported 1 = supported	
C0	Data A bit 7 Data A bit 6 : Data D bit 0	C1 C2 : E0	0 = not supported 1 = supported	
E0	Data A bit 7 Data A bit 6 : Data D bit 1 Data D bit 0	E1 E2 : FF ISO/SAE reserved (set to 0)	0 = not supported 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".

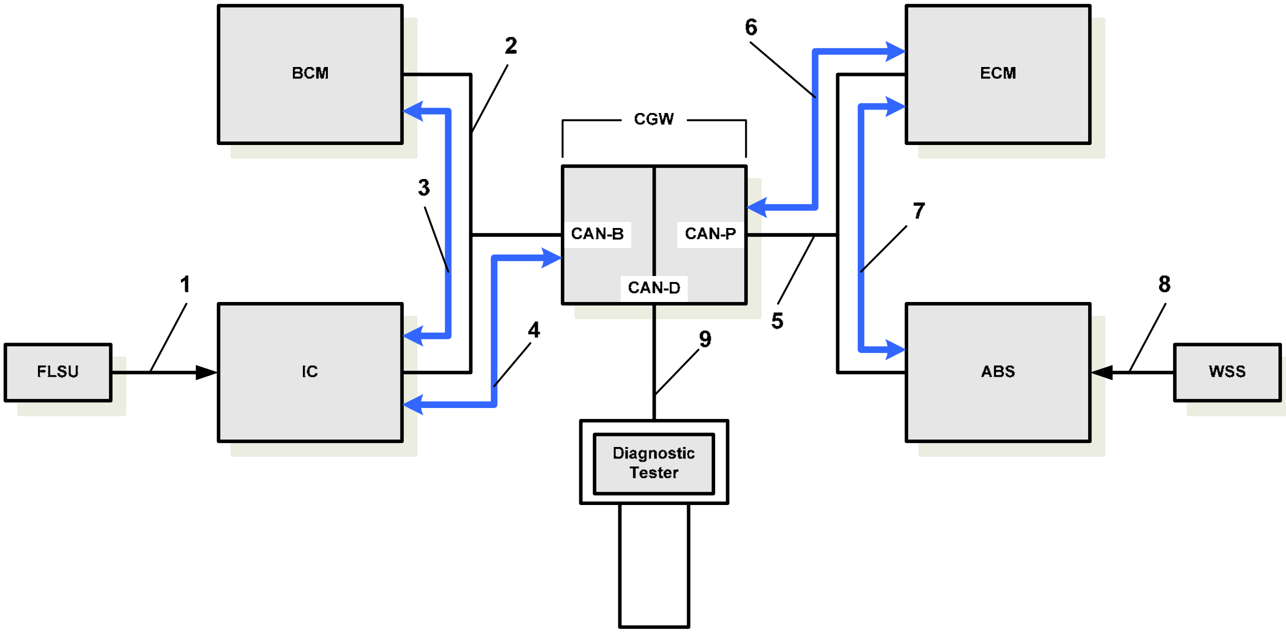
– The OBD ECU may store a network communication DTC after appropriate filtering, if the ECU detects that any remote OBD signal is unavailable or invalid. This means that the remote ECU is still sending a message, but the OBD device hardwired to it is faulted and the data is indicated to be invalid or 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

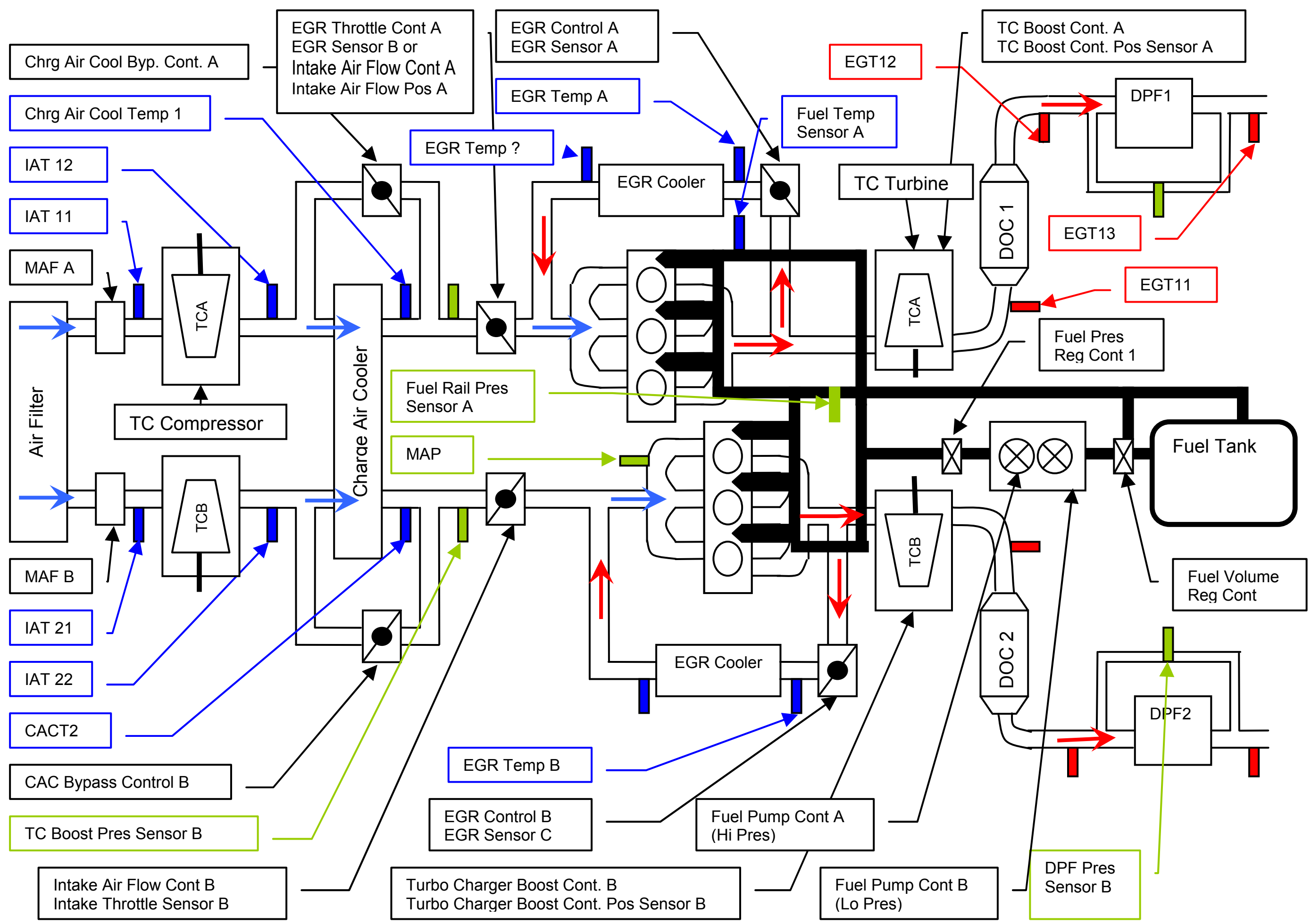
FIGURE B1 - EXAMPLE OF FUEL LEVEL SENDING UNIT INPUT VIA NETWORK MESSAGE

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.



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: – monitor status since DTCs were last cleared, saved in NVRAM or Keep Alive RAM; and – 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. NOTE: Vehicles compliant with WWH-OBD regulations using ISO 27145 shall not support this data. (WWH-OBD uses PIDs $90/$91) The default value reported for Data A shall be $00.			
	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). NOTE: Vehicles compliant with WWH-OBD regulations using ISO 27145 shall not support this data. WWH-OBD uses PIDs $90/$91) The default value reported for Data A shall be $00.			
	Supported monitors (may be continuous or once per trip)	**B (bit)**	**byte 2 of 4 (Low Nibble)**	**Support status of monitors:**
	Misfire monitoring supported	0	0 = monitor not supported (NO) 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) 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) 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 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. The status of Bit 3 is not relevant for ECUs that only support Comprehensive Component Monitoring (Data B bit 2 = 1) because Data B bits 2 and 6 for Comprehensive Components are defined identically in both cases. Typical examples are a TCM or a BECM. All ECUs on a vehicle supporting more than just Comprehensive Components need to ensure that they are reporting the same status for Bit 3 and that it is appropriate for the vehicle.			
	Status of monitors since DTC cleared:	**B (bit)**	**byte 2 of 4 (High Nibble)**	**Completion status of monitors since DTC cleared:**
	Misfire monitoring ready	4	0 = monitor complete, or not applicable (YES) 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) 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	0 = monitor not supported (NO) 1 = monitor supported (YES)	CAT_SUP: NO or YES
	Heated catalyst monitoring supported	1		HCAT_SUP: NO or YES
	Evaporative system monitoring supported NOTE: Evap system monitoring shall be indicated as supported only for those vehicles that utilize an evaporative system leak check to meet the evap system monitoring requirements.	2		EVAP_SUP: NO or YES
	Secondary air system monitoring supported	3		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) 0 = monitor not applicable (N/A) 1 = monitor not complete (NO) NOTE: any monitor reported as 'not supported' in Data Byte C shall be reported as not applicable (N/A) in Data Byte D	CAT_RDY: YES, NO or N/A
	Heated catalyst monitoring ready	1		HCAT_RDY: YES, NO or N/A
	Evaporative system monitoring ready	2		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		—
	Oxygen sensor monitoring ready	5		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	0 = monitor not supported (NO) 1 = monitor supported (YES)	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		BP_SUP: NO or YES
	ISO/SAE reserved (bit shall be reported as “0”)	4		—
	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	0 = monitor complete (YES) 0 = monitor not applicable (N/A) 1 = monitor not complete (NO) NOTE: any monitor reported as ‘not supported’ in Data Byte C shall be reported as not applicable (N/A) in Data Byte D	HCCATRDY: YES, NO or N/A
	NOx/SCR aftertreatment monitoring ready	1		NCAT_RDY: YES, NO or N/A
	ISO/SAE reserved (bit shall be reported as “0”)	2		—
	Boost pressure system monitoring ready	3		BP_RDY: YES, NO or N/A
	ISO/SAE reserved (bit shall be reported as “0”)	4		—
	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 %
	Percent of maximum available engine torque Vehicles which utilize spark ignition and compression ignition engines for propulsion shall use the following definition for calculating LOAD_PCT: LOAD_PCT = [current engine torque] / [(peak engine torque @STP as a function of rpm) * (BARO/29.92) * SQRT(298/(AAT+273))] Alternatively, vehicles with spark ignition engines can use the following definition: LOAD_PCT = [current airflow] / [(peak airflow at WOT@STP as a function of rpm) * (BARO/29.92) * SQRT(298/(AAT+273))] Where: – STP = Standard Temperature and Pressure = 25 °C, 29.92 in Hg BARO, – SQRT = square root; – WOT = wide open throttle; – AAT = Ambient Air Temperature and is in °C Characteristics of LOAD_PCT: – Reaches 100 % at WOT/Wide Open Pedal at any altitude, temperature or rpm for both naturally aspirated and boosted engines. – Indicates percent of peak available torque during normal, fault-free conditions. – For spark ignition engines, linearly correlated with engine vacuum at MBT spark and stoichiometry. Note that hybrid engine controls can independently control torque. – Compression-ignition engines (diesels) shall support this PID using torque. NOTE: At engine off and ignition on the LOAD_PCT = 0 %. If engine torque is negative, LOAD_PCT shall be reported as 0%. For hybrid vehicles, LOAD_PCT reflects the torque produced only by the internal combustion engine, not the torque being delivered by the entire powertrain. All vehicles with internal combustion engines used for propulsion 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

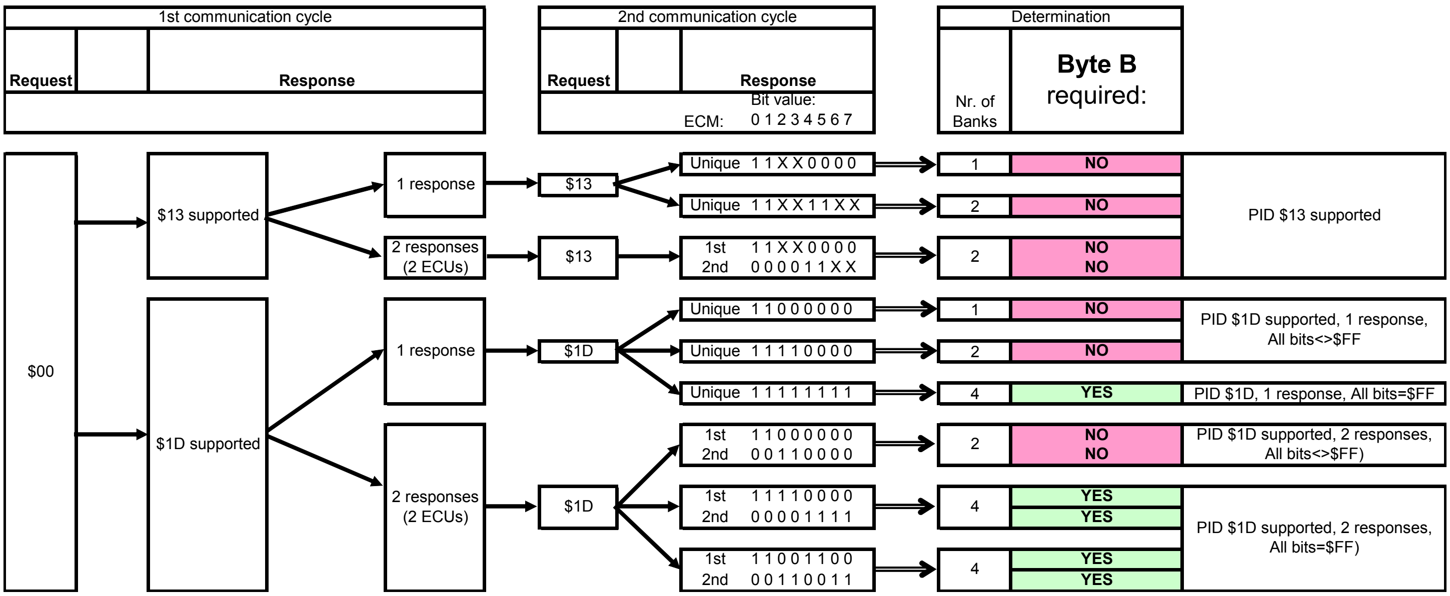


FIGURE B3 - DETERMINATION OF NUMBER OF DATA BYTES FOR PIDS $06 TO $09 AND $55 TO $58

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) Short Term Fuel Trim - Bank 3	A B	–100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT1: xxx.x % 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) Long Term Fuel Trim – Bank 3	A B	–100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT1: xxx.x % 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) Short Term Fuel Trim - Bank 4	A B	–100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT2: xxx.x % 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) Long Term Fuel Trim - Bank 4	A B	–100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT2: xxx.x % 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: xxxx.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 2 3 4 - 7	1 = upstream of first catalytic converter 1 = downstream of first catalytic converter inlet 1 = atmosphere / off 1 = pump commanded on for diagnostics ISO/SAE reserved (Bits shall be reported as ‘0’.)	AIR_STAT: UPS AIR_STAT: DNS AIR_STAT: OFF AIR_STAT: DIAG —

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		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 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 "CAA Sec. 177" 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
	PID $1C may be reported for the vehicle by a single ECU or may be reported by any OBD ECU that activates the MIL. If PID $1C is supported by multiple ECUs on a vehicle, the reported values do not have to be identical for all reporting ECUs, however, each ECU shall accurately report its OBD compliance level. For example, on a vehicle designed to meet OBD II, an ECM reporting $01 (OBD II) and a TCM reporting $03 (OBD and OBD II) would be an acceptable combination but an ECM reporting $01 (OBD II) and a TCM reporting $04 (OBD I) would not.			

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 after the ignition switch is turned to the on position and the engine is running. 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. Conditions for “Distance traveled” counter: • reset to $0000 when MIL state changes from deactivated to activated; • accumulate counts in km if MIL is activated (ON); • do not change value while MIL is not activated (OFF); • reset to $0000 if diagnostic information is cleared either by service $04 or at least 40 warm-up cycles without MIL activated; • 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 Use if PID $13 is Supported!	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment 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. 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. 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 B31 - PID $24 - $2B 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
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. See the explanation of scaling values for PIDs $24 to $2B 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 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

<table>
<tr><th>PID (hex)</th><th>Description</th><th>Data Byte</th><th>Scaling/Bit</th><th>External Test Equipment SI (Metric) / English Display</th></tr>
<tr><td rowspan="2">41</td><td>Monitor status this driving cycle</td><td></td><td></td><td></td></tr>
<tr><td colspan="4">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. Monitor completion criteria is the same as for PID $01 except that the 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.</td></tr>
</table>

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 Fuel system monitoring enabled Comprehensive component monitoring enabled	0 1 2	See PID $01 to determine which monitors are supported. 0 = monitor disabled for rest of this monitoring cycle (NO) 0 = monitor not supported (N/A) 1 = monitor enabled for this monitoring cycle (YES)	MIS_ENA: NO, YES or N/A FUEL_ENA: NO, YES or N/A 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 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 Fuel system monitoring completed Comprehensive component monitoring completed	4 5 6	See PID $01 to determine which monitors are supported. 0 = monitor complete this monitoring cycle (YES) 0 = monitor not supported (N/A) 1 = monitor not complete this monitoring cycle (NO)	MIS_CMPL: YES, NO or N/A FUELCMPL: YES, NO, or N/A 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 Heated catalyst monitoring Evaporative system monitoring Secondary air system monitoring ISO/SAE reserved (bit shall be reported as “0”) Oxygen sensor monitoring Oxygen sensor heater monitoring EGR and/or VVT system monitoring	0 1 2 3 4 5 6 7	See PID $01 to determine which monitors are supported. 0 = monitor disabled for rest of this monitoring cycle (NO) 0 = monitor not supported (N/A) 1 = monitor enabled for this monitoring cycle (YES)	CAT_ENA: NO, YES or N/A HCAT_ENA: NO, YES or N/A EVAP_ENA: NO, YES or N/A AIR_ENA: NO, YES, or N/A — O2S_ENA: NO, YES or N/A HTR_ENA: NO, YES or N/A 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 Heated catalyst monitoring completed Evaporative system monitoring completed Secondary air system monitoring completed ISO/SAE reserved (bit shall be reported as “0”) Oxygen sensor monitoring completed Oxygen sensor heater monitoring completed EGR and/or VVT system monitoring completed	0 1 2 3 4 5 6 7	See PID $01 to determine which monitors are supported. 0 = monitor complete this monitoring cycle (YES) 0 = monitor not supported (N/A) 1 = monitor not complete this monitoring cycle (NO)	CAT_CMPL: YES, NO or N/A HCATCMPL: YES, NO or N/A EVAPCMPL: YES, NO or N/A AIR_CMPL: YES, NO or N/A — — — O2S_CMPL: YES, NO or N/A HTR_CMPL: YES, NO or N/A 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 NOx/SCR aftertreatment monitoring ISO/SAE reserved (bit shall be reported as “0”) Boost pressure system monitoring ISO/SAE reserved (bit shall be reported as “0”) Exhaust gas sensor monitoring PM filter monitoring EGR and/or VVT system monitoring	0 1 2 3 4 5 6 7	See PID $01 to determine which monitors are supported. 0 = monitor disabled for rest of this monitoring cycle (NO) 0 = monitor not supported (N/A) 1 = monitor enabled for this monitoring cycle (YES)	HCCATENA: NO, YES or N/A NCAT_ENA: NO, YES or N/A — — — BP_ENA: NO, YES or N/A — — — EGS_ENA: NO, YES or N/A PM_ENA: NO, YES or N/A EGR_ENA: NO, YES or N/A
	Completion status of monitors this monitoring cycle:	**D (bit)**	**byte 4 of 4**	**Completion status of monitors this monitoring cycle:**
	NMHC catalyst monitoring completed NOx/SCR aftertreatment monitoring completed ISO/SAE reserved (Bit shall be reported as ‘0’.) Boost pressure system monitoring completed ISO/SAE reserved (bit shall be reported as “0”) Exhaust gas sensor monitoring completed PM filter monitoring completed EGR and/or VVT system monitoring completed	0 1 2 3 4 5 6 7	See PID $01 to determine which monitors are supported. 0 = monitor complete this monitoring cycle (YES) 0 = monitor not supported (N/A) 1 = monitor not complete this monitoring cycle (NO)	HCCATCMP: YES, NO or N/A NCATCMPL: YES, NO or N/A — — — BP_CMPL: YES, NO or N/A — — — EGS_CMPL: YES, NO or n/A PM_CMPL: YES, NO or N/A 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 %
	LOAD_ABS is the normalized value of air mass per intake stroke displayed as a percent. The absolute load value has some different characteristics than the LOAD_PCT defined in PID $04. Vehicles which utilize spark or compression ignition engines for propulsion shall use the following definition for calculating LOAD_ABS: LOAD_ABS = [air mass (g / intake stroke)] / [1.184 (g / liter) * cylinder displacement (liters / intake stroke)] 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. NOTE: At engine off and ignition on the LOAD_ABS = 0 %. All vehicles with spark-ignition engines used for propulsion are required to support PID $43. 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: – reset to $0000 when MIL state changes from deactivated to activated by this ECU; – accumulate counts in minutes if MIL is activated (ON); – do not change value while MIL is not activated (OFF); – reset to $0000 if diagnostic information is cleared either by service $04 or at least 40 warm-up cycles without MIL activated; – do not wrap to $0000 if value is $FFFF. For hybrid vehicles or for vehicles that employ engine shutoff strategies (e.g. engine shutoff at idle), the engine run timer for MIL activation shall increment: - after the ignition switch is turned to the on position and the engine is running, - if the vehicle can be started in electric-only mode, after the ignition switch is turned to the on position and the vehicle starts to move. - if the engine is turned off by the vehicle control system during normal operation.					

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

<table>
<tr><th>PID (hex)</th><th>Description</th><th>Data Byte</th><th>Min. Value</th><th>Max. Value</th><th>Scaling/Bit</th><th>External Test Equipment SI (Metric) / English Display</th></tr>
<tr><td rowspan="7">4F</td><td>External Test Equipment Configuration Information #1</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>Maximum value for Equivalence Ratio</td><td>A</td><td>0</td><td>255</td><td>1</td><td>These values are not intended for display to the service technician.</td></tr>
<tr><td colspan="6">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: $LAMBDA11_{(PID24)} = DATA\_A\_B_{(PID24)} * (DATA\_A_{(PID4F)} / 65535)$
New scaling per bit for PID $24 = $DATA\_A_{(PID4F)} / 65535 = 4_{(10)} / 65535_{(10)} = 0.0000610$ per bit
$DATA\_A\_B_{(PID24)}$ = $7D00 = 32000_{10} = value reported by vehicle ECU
$LAMBDA11_{PID24} = 32000 * (4 / 65535) = 1.953$</td></tr>
<tr><td>Maximum value for Oxygen Sensor Voltage</td><td>B</td><td>0 V</td><td>255 V</td><td>1 V</td><td>These values are not intended for display to the service technician.</td></tr>
<tr><td colspan="6">Data B shall be used by the external test equipment to calculate the scaling per bit of PIDs $24 to $2B.

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.

If PIDs $34 to $3B are supported by this ECU, this value shall be reported as $00.

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.

EXAMPLE: $O2S11_{(PID24)} = DATA\_C\_D_{(PID24)} * (DATA\_B_{(PID4F)} * 1 V/ 65535)$
New scaling per bit for PID $24 = $DATA\_B_{(PID4F)} * 1 V / 65535 = 16_{(10)} * 1 V / 65535_{(10)} =$ 0.000244 V per bit
$DATA\_C\_D_{(PID24)}$ = $9C40 = 40000_{10} = value reported by vehicle ECU
$O2S11_{(PID24)} = 40000 * (16 V / 65535) = 9.766 V$</td></tr>
</table>

TABLE B60 - PID $4F DEFINITION (CONTINUED)

<table>
<tr><th>PID (hex)</th><th>Description</th><th>Data Byte</th><th>Min. Value</th><th>Max. Value</th><th>Scaling/Bit</th><th>External Test Equipment SI (Metric) / English Display</th></tr>
<tr><td rowspan="4">4F</td><td>Maximum value for Oxygen Sensor Current</td><td>C</td><td>0 mA</td><td>255 mA</td><td>1 mA</td><td>These values are not intended for display to the service technician.</td></tr>
<tr><td colspan="6">Data C shall be used by the external test equipment to calculate the scaling per bit of PIDs $34 to $3B.

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.

If PIDs $24 to $2B are supported by this ECU, this value shall be reported as $00.

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.

EXAMPLE: $O2S11_{(PID34)}$ = $DATA\_C\_D_{(PID34)}$ * ($DATA\_C_{(PID4F)}$ * 1 mA / 32768)
New scaling per bit for PID $34 = $DATA\_C_{(PID4F)}$ * 1 mA / 32768 = $64_{(10)}$ mA / $32768_{(10)}$ = 0.001953 mA per bit

Positive value reported by vehicle ECU:
$DATA\_C\_D_{(PID34)}$ = $9C40 (applying the appropriate offset $9C40 - $8000) = $7232_{(10)}$
$O2S11_{(PID34)}$ = 7232 * (64 mA / 32768) = +14.125 mA

Negative value reported by vehicle ECU:
$DATA\_C\_D_{(PID34)}$ = $5C40 (applying the appropriate offset $5C40 - $8000) = $-9152_{(10)}$
$O2S11_{(PID34)}$ = -9152 * (64 mA / 32768) = -17.875 mA</td></tr>
<tr><td>Maximum value for Intake Manifold Absolute Pressure</td><td>D</td><td>0 kPa</td><td>2550 kPa</td><td>10 kPa</td><td>These values are not intended for display to the service technician.</td></tr>
<tr><td colspan="6">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</td></tr>
</table>

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	Bi-fuel vehicle using diesel	BI_DSL
		18 – FF	ISO/SAE reserved	—

TABLE B62 - PID $51 DEFINITION (CONTINUED)

PID (hex)	Description	Data Byte	Scaling	External Test Equipment SI (Metric) / English Display
51	The following definitions apply when utilizing this PID: Single-fuel engines are capable of running on only one fuel. Bi-fuel engines are capable of running on two fuels. On internal combustion engines, one fuel is typically gasoline or diesel, and the other is an alternate fuel such as natural gas (CNG), LPG, or hydrogen. The two fuels are stored in separate tanks and the engine runs on one fuel at a time. Bi-fuel vehicles have the capability to switch back and forth from gasoline or diesel to the other fuel, manually or automatically. Flexible-fuel vehicles (FFVs) have engines that are capable of running on a mixture of two fuels. FFVs store the two different fuels mixed together (in potentially any ratio) in the same fuel tank, and the fuel system supplies the resulting blend to the combustion chamber. The most commonly used fuels by FFVs today are unleaded gasoline and ethanol fuel; E85 in North America and E100 in South America. Ethanol FFVs can run on pure gasoline (E0), an ethanol/gasoline mix (E85), pure ethanol (E100) or any combination of these fuels. Dual fuel vehicles are engines capable of running on two different fuels at the same time. For example, on a diesel engine, the primary fuel may be natural gas or LPG, but the engine is designed to operate with diesel as the ignition source. As the engine goes to full load, an increasing amount of CNG or LPG replaces the diesel fuel. Another example is a gasoline turbocharged engine with separate gasoline and ethanol (E85) fuel injectors for each cylinder. The gasoline system mixes fuel and air in the intake manifold using port fuel injection. The second system uses direct injection to introduce small amounts of ethanol directly into the combustion chamber to control premature detonation, or knock, which results from the high temperature and pressure of the turbocharged engine. There are currently no FUEL_TYPE definitions for dual fuel vehicles. Hybrid electric vehicles combine a conventional internal combustion engine propulsion system with an electric propulsion system. Hybrid electric vehicles can be classified according to the way in which power is supplied to the drivetrain, the degree of hybridization as well as provisions for charging the batteries using an external power source (plug in hybrids). This PID shall be utilized by all vehicles. On non-hybrid vehicles, this PID is not intended to indicate whether the engine is running or not and should not reflect Start/Stop engine operation or Decel Fuel Cut Off operation. For a single-fuel vehicle, this PID shall report static data (i.e., always report the fuel that it is designed to be operated on). For an FFV, this PID shall report static data (e.g., $03 Ethanol (FFV)) regardless of what blend of fuel it is currently operating on. It shall be used in conjunction with PID $52 which reports the percentage of alcohol in the fuel currently being used. For a bi-fuel vehicle, this PID shall report the FUEL_TYPE corresponding to the fuel currently in use. For example, a gasoline/CNG bi-fuel vehicle would report $09 while running on gasoline and $0D while running on CNG. NOTE: For bi-fuel and hybrid vehicles, "not available" ($00) may be used during initial ignition on conditions where no fuel is being utilized and the vehicle cannot determine which fuel will be used at engine or vehicle start. Alternatively, the data may reflect the fuel type used by the vehicle at the previous shut down and be updated after the vehicle starts and the fuel type can be determined.			

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 %
	Flexible-fuel vehicles (FFVs) have engines that are capable of running on a mixture of two fuels. FFVs store the two different fuels mixed together (in potentially any ratio) in the same fuel tank, and the fuel system supplies the resulting blend to the combustion chamber. The most commonly used fuels by FFVs today are unleaded gasoline and ethanol fuel; E85 in North America and E100 in South America. Ethanol FFVs can run on pure gasoline (E0), an ethanol/gasoline mix (E85), pure ethanol (E100) or any combination of these fuels. ALCH_PCT shall indicate the percentage of alcohol (ethanol or methanol) in the fuel blend supplied to the combustion chamber.. For example, ethanol fuel in the US (E85) normally contains 85 % ethanol, in which case ALCH_PCT shall display 85.0 % when the vehicle is being fueled solely with E85 fuel. Alcohol percentage can be determined using a sensor or can be inferred by the fuel control software. This PID shall be utilized on flexible fuel vehicles (FFVs) that are designed to run on any blend of gasoline and ethanol, or methanol (up to 85% or 100%). This PID is not required on single fuel vehicles, including gasoline vehicles, which run on gasoline fuels that can contain 10% or even higher percentages of ethanol.					

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_2O)	327.675 kPa (1315.49 inH_2O)	0.005 kPa (1/200), unsigned	EVAP_VPA: xxx.xxx kPa (xxxx.xx inH_2O)
	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_2O)	1 Pa, signed	EVAP_VP: xxxxx Pa (xxx.xx inH_2O)
	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. FUEL_RATE shall be calculated as the average fuel rate over a one second time period. (Liters of Fuel used over 1 second block)/(1 hour/3600 seconds) = xxx.xx L/h 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. It is 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. Excluded from TQ_DD are (1) dynamic commands within the powertrain such as smoke control, noise control, and low and high speed engine governing, and (2) external commands to the engine such as those generated by traction control, ABS, transmission, etc. The data is transmitted as a percent of the reference engine torque (see PID $63). NOTE: The data is transmitted in indicated torque. To obtain the flywheel equivalent of TQ_DD, subtract Friction Torque (PID $8E) from TQ_DD (PID $61). TQ_DD will be approximately zero at idle with zero vehicle speed (no driver demand torque).					

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; also known as indicated torque (torque developed in the cylinders). Indicated Torque is defined as the sum of Net Brake Torque and Friction Torque. The data is transmitted as indicated torque as a percent of engine reference torque (see PID $63). The engine percent torque value will not be less than zero and it includes the torque developed in the cylinders required to overcome friction. NOTE: Net Brake Torque is the torque (or power output) of a “fully equipped” engine. A fully equipped engine is an engine equipped with accessories necessary to perform its intended service. This includes, but is not restricted to, the basic engine, including fuel, oil, and cooling pumps, plus intake air system, exhaust system, cooling system, alternator, starter, emissions, and noise control. Accessories which are not necessary for the operation of the engine, but may be engine mounted, are not considered part of a fully equipped engine. These items include, but are not restricted to, power steering pump systems, vacuum pumps, and compressor systems for air conditioning, brakes, and suspensions. When these accessories are integral with the engine, the torque/power absorbed in an unloaded condition may be determined and added to the net brake torque. (Refer to SAE J1349.) Net Brake Torque is calculated by subtracting Friction Torque (PID $8E) from Indicated Torque (PID $62) for the purposes of this document..					

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					
	This map describes the stationary behavior of the engine and the speed dependent available indicated torque. This map should reflect the effect of changes due to barometric pressure, engine temperature, and any other stationary changes (sensor failures, etc.) which influence the engine torque curve more than 10%. This map is only valid for maximum boost pressure. At low boost pressures the torque limit may be much lower. It is required that one of these points (3, 4, or 5) indicate the peak torque point for the current engine torque map. Points 3, 4, and 5 lie between idle (point 1) and point 2.					
	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. The data is transmitted in indicated torque as a percent of the reference engine torque.					
	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. Point 2 is defined as the kick-in point from which torque is reduced to zero. The data is transmitted in indicated torque as a percent of the reference engine torque.					
	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. The data is transmitted in indicated torque as a percent of the reference engine torque.					
	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. It is required that one of these points indicate the peak torque point for the current engine torque 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. It is required that one of these points indicate the peak torque point for the current engine torque 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)

<table>
<tr><th>PID (hex)</th><th>Description</th><th>Data Byte</th><th>Min. Value</th><th>Max. Value</th><th>Scaling/Bit</th><th>External Test Equipment SI (Metric) / English Display</th></tr>
<tr><td>69</td><td colspan="6">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.

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.

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.</td></tr>
<tr><td></td><td>EGR A Error</td><td>D</td><td>-100 % (less than cmd.)</td><td>+99.22 % (more than cmd.)</td><td>100/128 % (0% at 128)</td><td>EGR_A_ERR: xxx.x%</td></tr>
<tr><td></td><td colspan="6">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:

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

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

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

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.

If the control system does not use closed loop control, EGR_A_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%.</td></tr>
<tr><td></td><td>Commanded EGR B Duty Cycle/Position</td><td>E</td><td>0% (no flow)</td><td>100% (max flow)</td><td>100/255 %</td><td>EGR_B_CMD: xxx.x%</td></tr>
<tr><td></td><td colspan="6">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.

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.

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.</td></tr>
</table>

TABLE B85 - PID $69 DEFINITION (CONTINUED)

<table>
<tr><th>PID (hex)</th><th>Description</th><th>Data Byte</th><th>Min. Value</th><th>Max. Value</th><th>Scaling/Bit</th><th>External Test Equipment SI (Metric) / English Display</th></tr>
<tr><td rowspan="4">69</td><td>Actual EGR B Duty Cycle/Position</td><td>F</td><td>0% (no flow/ closed)</td><td>100% (max flow/ full open)</td><td>100/255 %</td><td>EGR_B_ACT: xxx.x%</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>EGR B Error</td><td>G</td><td>-100 % (less than cmd.)</td><td>+99.22 % (more than cmd.)</td><td>100/128 % (0% at 128)</td><td>EGR_B_ERR: xxx.x%</td></tr>
<tr><td colspan="6">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%.</td></tr>
</table>

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 Sensor A (Bank 1, Sensor 1) supported	A, bit 0	0	1	1 = EGR Temp Sensor A Bank 1, Sensor 1 data supported, 1 °C with -40 °C offset scaling	
	EGR Temperature Sensor C (Bank 1, Sensor 2) supported	A, bit 1	0	1	1 = EGR Temp Sensor C Bank 1, Sensor 2 data supported, 1 °C with -40 °C offset scaling	
	EGR Temperature Sensor B (Bank 2, Sensor 1) supported	A, bit 2	0	1	1 = EGR Temp Sensor B Bank 2, Sensor 1 data supported, 1 °C with -40 °C offset scaling	
	EGR Temperature Sensor D (Bank 2, Sensor 2) supported	A, bit 3	0	1	1 = EGR Temp Sensor D Bank 2, Sensor 2 data supported, 1 °C with -40 °C offset scaling	
	EGR Temperature Sensor A (Bank 1, Sensor 1) Wide Range supported	A, bit 4	0	1	1 = EGR Temp Sensor A Bank 1, Sensor 1 data supported, 4 °C with -40 °C offset scaling	
	EGR Temperature Sensor C (Bank 1, Sensor 2) Wide Range supported	A, bit 5	0	1	1 = EGR Temp Sensor C Bank 1, Sensor 2 data supported, 4 °C with -40 °C offset scaling	
	EGR Temperature Sensor B (Bank 2, Sensor 1) Wide Range supported	A, bit 6	0	1	1 = EGR Temp Sensor B Bank 2, Sensor 1 data supported, 4 °C with -40 °C offset scaling	
	EGR Temperature Sensor D (Bank 2, Sensor 2) Wide Range supported	A, bit 7	0	1	1 = EGR Temp Sensor D Bank 2, Sensor 2 data supported, 4 °C with -40 °C offset scaling	
	Exhaust Gas Recirculation Temp Sensor A (Bank 1, Sensor 1)	B	-40 °C	215 °C or 980 °C	1 °C or 4 °C with -40 °C offset	EGRTA: xxx °C (xxx °F)
	EGRTA shall display EGR gas temperature.					
	Exhaust Gas Recirculation Temp Sensor C (Bank 1, Sensor 2)	C	-40 °C	215 °C or 980 °C	1 °C or 4 °C with -40 °C offset	EGRTC: xxx °C (xxx °F)
	EGRTC shall display EGR gas temperature.					
	Exhaust Gas Recirculation Temp Sensor B (Bank 2, Sensor 1)	D	-40 °C	215 °C or 980 °C	1 °C or 4 °C with -40 °C offset	EGRTB: xxx °C (xxx °F)
	EGRTC shall display EGR gas temperature.					
	Exhaust Gas Recirculation Temp Sensor D (Bank 2, Sensor 2)	E	-40 °C	215 °C or 980 °C	1 °C or 4 °C with -40 °C offset	EGRTD: xxx °C (xxx °F)
	EGRTD 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	2047.96875 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	2047.96875 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	2047.96875 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	2047.96875 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 01 = Open Loop (no fault present) 10 = Closed Loop (no fault present) 11 = Fault present (boost data unreliable)	 BP_B_OL BP_B_CL 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)

<table>
<tr><th>PID (hex)</th><th>Description</th><th>Data Byte</th><th>Min. Value</th><th>Max. Value</th><th>Scaling/Bit</th><th>External Test Equipment SI (Metric) / English Display</th></tr>
<tr><td rowspan="6">72</td><td>Commanded Wastegate A Position</td><td>B</td><td>0% (no flow/ closed)</td><td>100% (max flow/ full open)</td><td>100/255 %</td><td>WG_A_CMD: xxx.x%</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>Wastegate A Position</td><td>C</td><td>0% (no flow/ closed)</td><td>100% (max flow/ full open)</td><td>100/255 %</td><td>WG_A_ACT: xxx.x%</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>Commanded Wastegate B Position</td><td>D</td><td>0% (no flow/ closed)</td><td>100% (max flow/ full open)</td><td>100/255 %</td><td>WG_ B_CMD: xxx.x%</td></tr>
<tr><td colspan="6">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.</td></tr>
</table>

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. NOTE: It is preferable to use EGT sensor PIDs $78, $79, $98 and $99 to preserve the standard exhaust gas sensor numbering convention.					
	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. NOTE: It is preferable to use EGT sensor PIDs $78, $79, $98 and $99 to preserve the standard exhaust gas sensor numbering convention.					
	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. NOTE: It is preferable to use EGT sensor PIDs $78, $79, $98 and $99 to preserve the standard exhaust gas sensor numbering convention.					
	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. NOTE: It is preferable to use EGT sensor PIDs $78, $79, $98 and $99 to preserve the standard exhaust gas sensor numbering convention.					

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.					
	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.					

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%. As an option, for systems with discrete level sensors and urea liquid between two discrete points, REAG_LVL can also be calculated based on urea consumption.					
	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: - reset to $00000000 when warning indicator state changes from deactivated to activated. - accumulate counts in seconds if warning indicator is activated (ON) - do not change value while warning indicator is not activated (OFF) - reset to $00000000 if warning indicator has not been activated for 400 days or 9600 hours of engine operation - do not wrap to $00000000 if value is $FFFFFFFF - 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_DEVIATION1
		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)

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
88		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)

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
88	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 mi les)
	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 %

TABLE B118 - PID $8B DEFINITION (CONTINUED)

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
8b	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.					
	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 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
8E	Engine Friction - Percent Torque	A	-125%	130%	1%/bit with -125 offset	TQ_FR: xxx.x %
	TQ_FR shall display the friction torque of the engine. Friction Torque is the torque required to drive the engine alone as “fully equipped”. The data is transmitted as friction torque as a percent of engine reference torque (see PID $63). The friction percent torque value will not be less than zero. NOTE: Net Brake Torque is the torque (or power output) of a “fully equipped” engine. A fully equipped engine is an engine equipped with accessories necessary to perform its intended service. This includes, but is not restricted to, the basic engine, including fuel, oil, and cooling pumps, plus intake air system, exhaust system, cooling system, alternator, starter, emissions, and noise control. Accessories which are not necessary for the operation of the engine, but may be engine mounted, are not considered part of a fully equipped engine. These items include, but are not restricted to, power steering pump systems, vacuum pumps, and compressor systems for air conditioning, brakes, and suspensions. When these accessories are integral with the engine, the torque/power absorbed in an unloaded condition may be determined and added to the net brake torque. (Refer to SAE J1349.) Net Brake Torque is calculated by subtracting Friction Torque (PID $8E) from Indicated Torque (PID $62) for the purposes of this document.					

TABLE B122 - PID $8F DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
8F	Particulate Matter (PM) Sensor Output					
	Support of PM Sensor Data	A (bit)	Byte 1 of 7			
	PM Sensor operating status Bank 1 Sensor 1 supported	A, bit 0	0	1	1 = PM sensor status Bank 1 Sensor 1 supported	
	PM Sensor signal Bank 1 Sensor 1 supported	A, bit 1	0	1	1 = PM Sensor signal Bank 1 Sensor 1 supported	
	PM Sensor operating status Bank 2 Sensor 1 supported	A, bit 2	0	1	1 = PM sensor status Bank 2 Sensor 1 supported	
	PM Sensor signal Bank 2 Sensor 1 supported	A, bit 3	0	1	1 = PM Sensor signal Bank 2 Sensor 1 supported	
	reserved (bits shall be reported as ‘0’)	A, bits 4 - 7	0	0		
	PM Sensor operating status Bank 1 Sensor 1	B				
	PM Sensor active status Bank 1 Sensor 1	B, bit 0	0	1	1 = Sensor actively measuring (YES)	PM11_ACTIVE (YES or NO)
	PM Sensor regen status Bank 1 Sensor 1	B, bit 1	0	1	1 = Sensor regenerating (YES)	PM11_REGEN (YES or NO)
	Reserved (bits shall be reported as 0)	B, bits 2-7	0	0		
	PM Sensor normalized output value Bank 1 Sensor 1	C,D	-327.68%	327.67 %	0.01 per bit	PM11: xxx.xx %
	PM11 shall display normalized PM sensor output for Bank 1 Sensor 1. Normalization shall be based on sensor output signal (e.g. voltage, resistance, current, impedance etc.). 100% shall represent manufacturer defined sensor soot load level when sensor regeneration is needed. 0% shall represent fully cleaned / regenerated sensor.					
	PM Sensor operating status Bank 2 Sensor 1	E				
	PM Sensor active status Bank 2 Sensor 1	E, bit 0	0	1	1 = Sensor actively measuring (YES)	PM21_ACTIVE (YES or NO)
	PM Sensor regen status Bank 2 Sensor 1	E, bit 1	0	1	1 = Sensor regenerating (YES)	PM21_REGEN (YES or NO)
	Reserved (bits shall be reported as 0)	E, bits 2-7	0	0		
	PM Sensor normalized output value Bank 2 Sensor 1	F,G	-327.68%	327.67 %	0.01 per bit	PM21: xxx.xx %
	PM21 shall display normalized PM sensor output for Bank 2 Sensor 1. Normalization shall be based on sensor output signal (e.g. voltage, resistance, current, impedance etc.). 100% shall represent manufacturer defined sensor soot load level when sensor regeneration is needed. 0% shall represent fully cleaned / regenerated sensor.					

TABLE 123 - PID $90 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
90	WWH-OBD Vehicle OBD System Information					
	Discriminatory/non-discriminatory display strategy	A, bits 0, 1	00	11	00 – All ECUs employ a non-discriminatory MI display strategy 01 – All ECUs employ a discriminatory MI display strategy 10 – Reserved 11 – Not available/Not required of this vehicle	MI_DISP_VOBD
	This data indicates the WWH-OBD display strategy utilized by the vehicle. It shall be supported for WWH-OBD use case 1 (scan tool road worthiness check).					
	Vehicle Malfunction Indicator status	A, bits 2, 3, 4, 5	0000	1111	0000 – MI Activation Mode 1 (MI Off) 0001 – MI Activation Mode 2 (On Demand MI) 0010 – MI Activation Mode 3 (Short MI) 0011 – MI Activation Mode 4 (Continuous MI) 0100 – 1101 Reserved 1110 – Error 1111 – Not available/Not required for this vehicle	MI_MODE_VOBD
	This data indicates the WWH-OBD MI status for the vehicle. It shall reflect the status of the MI lamp displayed to the vehicle operator. It shall be supported for WWH-OBD use case 1 (scan tool road worthiness check).					
	Emission system readiness	A, bit 6	0	1	0 – all vehicle emissions system monitors complete 1- all vehicle emissions system monitors not complete"	VOBD_RDY: YES, NO
	This data indicates the WWH-OBD readiness status of the vehicle. It shall be supported for WWH-OBD use case 1 (scan tool checks for road worthiness check).					
	reserved (bits shall be reported as ‘0’)	A, bit 7	0	0		
	Number of engine operating hours that the continuous MI was active. (Continuous MI counter)	B, C	0	65535	1h/bit	VOBD_MI_TIME
	This data indicates the number of engine operating hours that the continuous MI was active (or is still active). It shall be supported for WWH-OBD use case 1 (scan tool road worthiness check). NOTE: Specific regulatory reset conditions apply for this counter.					

TABLE 124 - PID $91 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
91	WWH-OBD ECU OBD System Information					
	ECU Malfunction Indication status	A, bits 0, 1, 2, 3	0000	1111	0000 – MI Activation Mode 1 (MI Off) 0001 – MI Activation Mode 2 (On Demand MI) 0010 – MI Activation Mode 3 (Short MI) 0011 – MI Activation Mode 4 (Continuous MI) 0100 – 1101 Reserved 1110 – Error 1111 – Not available/Not required for this vehicle	MI_MODE_ECU
	This data indicates the WWH-OBD MI status for each individual ECU. It may reflect a different status than the MI lamp displayed to the vehicle operator. NOTE: For WWH-OBD, PID $01 Data A shall not be supported and always reported as $00.					
	reserved (bits shall be reported as ‘0’)	A, bits 4-7	0	0		
	Number of engine operating hours that the continuous MI was active. (Continuous MI counter)	B, C	0	65535	1h/bit	OBD_MI_TIME
	This data indicates the number of engine operating hours that the continuous MI was active (or is still active) for an individual ECU. NOTE: Specific regulatory reset conditions apply for this counter.					
	Highest ECU B1 counter	D, E	0	65535	1h/bit	OBD_B1_TIME
	This data indicates the highest number of engine operating hours during which a class B1 malfunction was detected by an ECU. This counter shall increment any time the ECU detects a class B1 malfunction in the confirmed active state. NOTE: Specific regulatory reset conditions apply for this counter.					

TABLE B125 - PID $92 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
92	Fuel System Control Status (Compression Ignition)					
	Support of Fuel System 1 Control Status	A (bit)	Byte 1 of 2			
	Fuel Pressure Control 1 supported	A, bit 0	0	1	1 = Fuel Pressure Control 1 data supported	
	Fuel Injection Quantity Control 1 supported	A, bit 1	0	1	1= Fuel Injection Quantity Control 1 data supported	
	Fuel Injection Timing Control 1 supported	A, bit 2	0	1	1= Fuel Injection Timing Control 1 data supported	
	Idle Fuel Balance/Contribution Control 1 supported	A, bit 3	0	1	1 = Idle Fuel Balance/Contribution Control 1 data supported	
	Fuel Pressure Control 2 supported	A, bit 4	0	1	1 = Fuel Pressure Control 2 data supported	
	Fuel Injection Quantity Control 2 supported	A, bit 5	0	1	1= Fuel Injection Quantity Control 2 data supported	
	Fuel Injection Timing Control 2 supported	A, bit 6	0	1	1= Fuel Injection Timing Control 2 data supported	
	Idle Fuel Balance/Contribution Control 2 supported	A, bit 7	0	1	1 = Idle Fuel Balance/Contribution Control 2 data supported	
	Fuel System Status	B				FUELSYS
	Fuel Pressure Control 1 Status	B, bit 0	0	1	1 = Fuel Pressure 1 in closed loop control	FP1_CL
	Fuel Injection Quantity Control 1 Status	B, bit 1	0	1	1 = Fuel Injection Quantity 1 in closed loop control	FIQ1_CL
	Fuel Injection Timing Control 1 Status	B, bit 2	0	1	1 = Fuel Injection Timing 1 in closed loop control	FIT1_CL
	Idle Fuel Balance/Contribution Control 1 Status	B, bit 3	0	1	1 = Idle Fuel Balance/Contribution Control 1 in closed loop	IFB1_CL
	Fuel Pressure Control 2 Status	B, bit 4	0	1	1 = Fuel Pressure 2 in closed loop control	FP2_CL
	Fuel Injection Quantity Control 2 Status	B, bit 5	0	1	1 = Fuel Injection Quantity 2 in closed loop control	FIQ2_CL
	Fuel Injection Timing Control 2 Status	B, bit 6	0	1	1 = Fuel Injection Timing 2 in closed loop control	FIT2_CL
	Idle Fuel Balance/Contribution Control 2 Status	B, bit 7	0	1	1 = Idle Fuel Balance/Contribution Control 2 in closed loop	IFB2_CL
	Fuel system control status shall be supported by compression ignition engines that use any of the closed loop feedback control functions listed. More than one function system can be in closed loop at a time, e.g. fuel pressure control and fuel balance/contribution control in closed loop at the same time. If the engine is off and the ignition is on, all bits in 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 B shall be reported as '0', when the engine is turned off by the vehicle control system. 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 functions.					

TABLE B126 - PID $93 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
93	WWH-OBD Vehicle OBD Counters					
	WWH-OBD Vehicle counters supported	A (bit)	Byte 1 of 3			
	Cumulative continuous MI counter supported	A, bit 0	0	1	1 = Cumulative continuous MI counter data supported	
	reserved (bits shall be reported as ‘0’)	A, bits 1 - 7	0	0		
	Cumulative continuous MI counter	B,C	0 h	65535 h	1bit /h	MI_TIME_CUM
	This data indicates the cumulative number of engine operating hours during which the continuous MI was activated. This counter shall increment at any time the vehicle MI is in the on state. This counter shall not be reset.					

TABLE B127 - PID $94 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
94	NOx control - driver inducement system status and counters					
	NOx warning and inducement systems supported	A (bit)	Byte 1 of 12			
	NOx warning system activation status supported	A, bit 0	0	1	1 = NOx warning system activation status supported	
	Reagent quality counter supported	A, bit 1	0	1	1 = Reagent quality counter supported	
	Reagent consumption counter supported	A, bit 2	0	1	1 = Reagent consumption counter supported	
	Absence of reagent dosing counter supported	A, bit 3	0	1	1 = Absence of reagent dosing counter supported	
	EGR valve counter supported	A, bit 4	0	1	1 = EGR valve counter supported	
	Malfunction of NOx control monitoring system counter supported	A, bit 5	0	1	1 = Malfunction of NOx control monitoring system counter supported	
	reserved (bits shall be reported as ‘0’)	A, bits 6 – 7	0	0		
	System Status	B (bit)	Byte 2 of 12			
	NOx warning system activation status	B, bit 0	0	1	0 - Warning system inactive 1- Warning system active	NOX_WARN_ACT: YES or NO
	NOx warning and inducement system current status (active/inactive)					
	Level one inducement status	B, bit 1,2	00	11	00 - Level one inducement inactive 01 - Level one inducement enabled 10 - Level one inducement active 11 - Level one inducement not supported	INDUC_L1
	Level one inducement current status (e.g. low-level inducement using torque reduction). Status can be inactive (normal operation), enabled (i.e. triggered for activation but not yet active) or active.					
	Level two inducement status	B, bit 3,4	00	11	00 - Level two inducement inactive 01 - Level two inducement enabled 10 - Level two inducement active 11 - Level two inducement not supported	INDUC_L2
	Level two inducement current status (e.g. severe inducement using torque reduction). Status can be inactive (normal operation), enabled (i.e. triggered for activation but not yet active) or active.					
	Level three inducement status	B, bit 5,6	00	11	00 - Level three inducement inactive 01 - Level three inducement enabled 10 - Level three inducement active 11- Level three inducement not supported	INDUC_L3

TABLE B127 - PID $94 DEFINITION (CONTINUED)

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
94	Level three inducement current status (e.g. very severe, vehicle creep mode, engine shut down). Status can be inactive (normal operation), enabled (i.e. triggered for activation but not yet active) or active.					
	reserved (bits shall be reported as ‘0’)	B, bit 7	0	0		
	Reagent quality counter	C,D	0 h	65534 h	1h/bit	REAG_QUAL_TIME
	The reagent quality counter shall count the number of engine operating hours with an incorrect reagent. Refer to the appropriate OBD or emission legislation for direction on incrementing, decrementing or clearing the counter, including values to be utilized after a scan tool clear. Note that the defined range of the counter greatly exceeds the range need to meet the legislated requirements. A value of 65534 hours may be reported when the counter is at its maximum legislated range. A value of 65535 hours shall be reported if the counter is not supported.					
	Reagent Consumption Counter	E,F	0 h	65534 h	1h/bit	REAG_CON_TIME
	The reagent consumption counter shall count the number of engine operating hours which occur with an incorrect reagent consumption Refer to the appropriate OBD or emission legislation for direction on incrementing, decrementing or clearing the counter, including values to be utilized after a scan tool clear. Note that the defined range of the counter greatly exceeds the range need to meet the legislated requirements. A value of 65534 hours may be reported when the counter is at its maximum legislated range. A value of 65535 hours shall be reported if the counter is not supported.					
	Dosing Activity Counter	G,H	0 h	65534 h	1h/bit	REAG_DOSE_TIME
	The dosing activity counter shall count the number of engine operating hours which occur with an interruption of the reagent dosing activity Refer to the appropriate OBD or emission legislation for direction on incrementing, decrementing or clearing the counter, including values to be utilized after a scan tool clear. Note that the defined range of the counter greatly exceeds the range need to meet the legislated requirements. A value of 65534 hours may be reported when the counter is at its maximum legislated range. A value of 65535 hours shall be reported if the counter is not supported.					
	EGR valve counter	I,J	0 h	65534 h	1h/bit	EGR_TIME
	The EGR valve counter shall count the number of engine operating hours when the DTC associated with an impeded EGR valve is confirmed and active. Refer to the appropriate OBD or emission legislation for direction on incrementing, decrementing or clearing the counter, including values to be utilized after a scan tool clear. Note that the defined range of the counter greatly exceeds the range need to meet the legislated requirements. A value of 65534 hours may be reported when the counter is at its maximum legislated range. A value of 65535 hours shall be reported if the counter is not supported.					

TABLE B127 - PID $94 DEFINITION (CONTINUED)

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
94	Monitoring System Counter	K,L	0 h	65534 h	1h/bit	NOX_DTC_TIME
	The monitoring system counter shall count the number of engine operating hours when a DTC associated with a malfunction of the NOx control or monitoring system is confirmed and active. Refer to the appropriate OBD or emission legislation for direction on incrementing, decrementing or clearing the counter, including values to be utilized after a scan tool clear. Note that the defined range of the counter greatly exceeds the range need to meet the legislated requirements. A value of 65534 hours may be reported when the counter is at its maximum legislated range. A value of 65535 hours shall be reported if the counter is not supported.					

TABLE B128 - PID $98 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
98	Exhaust Gas Temperature (EGT) Bank 1					
	Support of Exhaust Gas Temperature Sensor Data	A (bit)	Byte 1 of 9			
	EGT Bank 1, Sensor 5 supported	A, bit 0	0	1	1 = EGT Bank 1, Sensor 5 data supported	
	EGT Bank 1, Sensor 6 supported	A, bit 1	0	1	1 = EGT Bank 1, Sensor 6 data supported	
	EGT Bank 1, Sensor 7 supported	A, bit 2	0	1	1 = EGT Bank 1, Sensor 7 data supported	
	EGT Bank 1, Sensor 8 supported	A, bit 3	0	1	1 = EGT Bank 1, Sensor 8 data supported	
	reserved (bits shall be reported as ‘0’)	A, bits 4 - 7	0	0		
	Exhaust Gas Temperature Bank 1, Sensor 5	B,C	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT15: xxxx.x °C (xxxx.x °F)
	EGT15 shall display exhaust gas temperature for bank 1, sensor 5. EGT15 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 6	D,E	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT16: xxxx.x °C (xxxx.x °F)
	EGT16 shall display exhaust gas temperature for bank 1, sensor 6. EGT16 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 7	F,G	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT17: xxxx.x °C (xxxx.x °F)
	EGT17 shall display exhaust gas temperature for bank 1, sensor 7. EGT17 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 8	H,I	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT18: xxxx.x °C (xxxx.x °F)
	EGT18 shall display exhaust gas temperature for bank 1, sensor 8. EGT18 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

TABLE B129 - PID $99 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
99	Exhaust Gas Temperature (EGT) Bank 2					
	Support of Exhaust Gas Temperature Sensor Data	A (bit)	Byte 1 of 9			
	EGT Bank 2, Sensor 5 supported	A, bit 0	0	1	1 = EGT Bank 2, Sensor 5 data supported	
	EGT Bank 2, Sensor 6 supported	A, bit 1	0	1	1 = EGT Bank 2, Sensor 6 data supported	
	EGT Bank 2, Sensor 7 supported	A, bit 2	0	1	1 = EGT Bank 2, Sensor 7 data supported	
	EGT Bank 2, Sensor 8 supported	A, bit 3	0	1	1 = EGT Bank 2, Sensor 8 data supported	
	reserved (bits shall be reported as ‘0’)	A, bits 4 - 7	0	0		
	Exhaust Gas Temperature Bank 2, Sensor 5	B,C	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT25: xxxx.x °C (xxxx.x °F)
	EGT25 shall display exhaust gas temperature for bank 2, sensor 1. EGT25 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 6	D,E	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT26: xxxx.x °C (xxxx.x °F)
	EGT26 shall display exhaust gas temperature for bank 2, sensor 6. EGT26 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 7	F,G	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT27: xxxx.x °C (xxxx.x °F)
	EGT27 shall display exhaust gas temperature for bank 2, sensor 7. EGT27 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 8	H,I	-40 °C	6513.5 °C	0.1 °C / bit with -40 °C offset	EGT28: xxxx.x °C (xxxx.x °F)
	EGT28 shall display exhaust gas temperature for bank 2, sensor 8. EGT28 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

TABLE B130 - PID $9C DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
9C	O2 Sensor (Wide Range)					
	Support of O2 Sensor Data	A (bit)	Byte 1 of 17			
	O2 Sensor Concentration Bank 1 Sensor 3 supported	A, bit 0	0	1	1 = O2 Sensor Concentration Bank 1 Sensor 3 supported	
	O2 Sensor Concentration Bank 1 Sensor 4 supported	A, bit 1	0	1	1 = O2 Sensor Concentration Bank 1 Sensor 3 supported	
	O2 Sensor Concentration Bank 2 Sensor 3 supported	A, bit 2	0	1	1 = O2 Sensor Concentration Bank 2 Sensor 3 supported	
	O2 Sensor Concentration Bank 2 Sensor 4 supported	A, bit 3			1 = O2 Sensor Concentration Bank 2 Sensor 4 supported	
	O2 Sensor Lambda Bank 1 Sensor 3 supported	A, bit 4			1 = O2 Sensor Lambda Bank 1 Sensor 3 supported	
	O2 Sensor Lambda Bank 1 Sensor 4 supported	A, bit 5			1 = O2 Sensor Lambda Bank 1 Sensor 4 supported	
	O2 Sensor Lambda Bank 2 Sensor 3 supported	A, bit 6			1 = O2 Sensor Lambda Bank 2 Sensor 3 supported	
	O2 Sensor Lambda Bank 2 Sensor 4 supported	A, bit 7	0	1	1 = O2 Sensor Lambda Bank 2 Sensor 4 supported	
	O2 Sensor Concentration Bank 1 Sensor 3	B,C	0%	100%	0.001526 %/bit	O2S13_PCT xxx.xxxxxx %
	O2S13 shall display O2 concentration for Bank 1 Sensor 1.					
	O2 Sensor Concentration Bank 1 Sensor 4	D,E	0%	100%	0.001526 %/bit	O2S14_PCT xxx.xxxxxx %
	O2S14 shall display O2 concentration for Bank 1 Sensor 2.					
	O2 Sensor Concentration Bank 2 Sensor 3	F,G	0%	100%	0.001526 %/bit	O2S23_PCT xxx.xxxxxx %
	O2S23 shall display O2 concentration for Bank 2 Sensor 1.					
	O2 Sensor Concentration Bank 2 Sensor 4	H,I	0%	100%	0.001526 %/bit	O2S24_PCT xxx.xxxxxx %
	O2S24 shall display O2 concentration for Bank 2 Sensor 2.					
	O2 Sensor Lambda Bank 1 Sensor 3	J,K	0	7.99	0.000122 lambda//bit	LAMBDA13: x.xxx
	O2S13 shall display O2 Lambda for Bank 1 Sensor 1.					
	O2 Sensor Lambda Bank 1 Sensor 4	L,M	0	7.99	0.000122 lambda//bit	LAMBDA14: x.xxx
	O2S14 shall display O2 Lambda for Bank 1 Sensor 2.					
	O2 Sensor Lambda Bank 2 Sensor 3	N,O	0	7.99	0.000122 lambda//bit	LAMBDA23: x.xxx
	O2S23 shall display O2 Lambda for Bank 2 Sensor 1.					
	O2 Sensor Lambda Bank 2 Sensor 4	P,Q	0	7.99	0.000122 lambda//bit	LAMBDA24: x.xxx
	O2S24 shall display O2 Lambda for Bank 2 Sensor 2.					
	PIDs $9C 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 B131 - PID $8E - $FF DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
95, 96, 97, 9A, 9B, 9D – 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) (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) General EWMA calculation: 0.1 * (current misfire counts) + 0.9 * (previous misfire counts average) Initial value for (previous misfire counts average) = 0 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. $\text{High_Precision_EWMA_Misfire_Counts}_{current}$ = Rounded [(0.1) * $\text{High\_Precision\_Misfire\_Counts}_{current}$ + (0.9) * $\text{High\_Precision\_EWMA\_Misfire\_Counts}_{previous}$] Where: Rounded means rounded to the nearest integer. The high-precision values are never reported, they are only used for internal calculations. 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) 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.

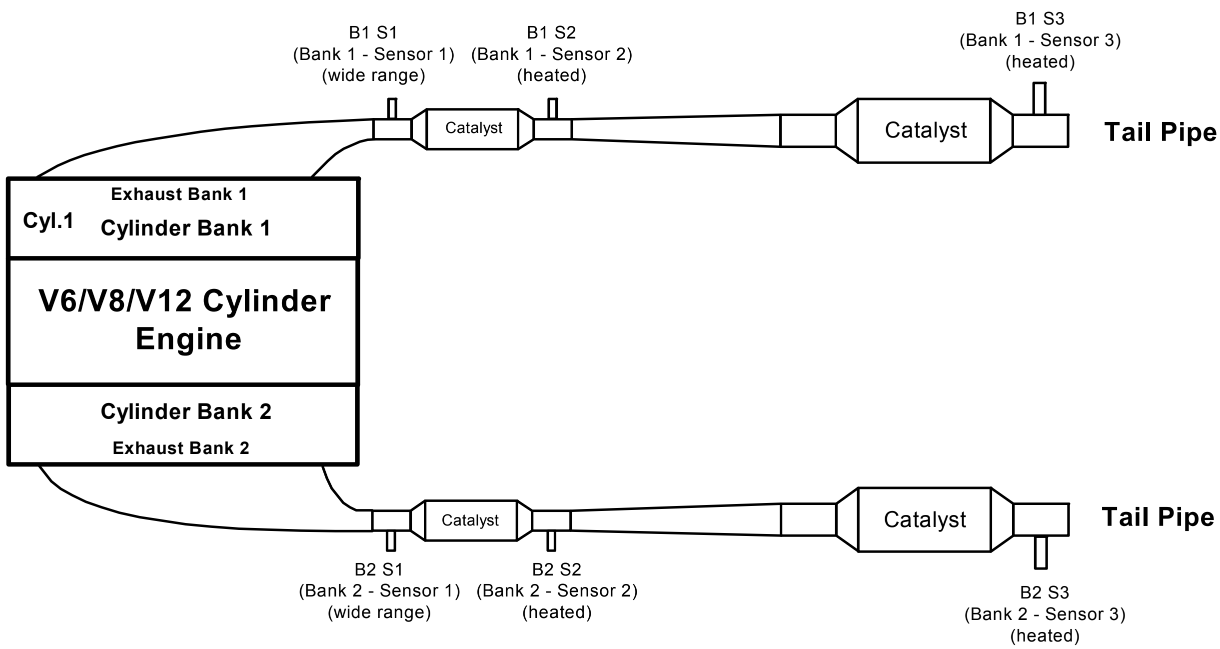


FIGURE D1 - V6/V8/V12 CYLINDER ENGINE WITH 2 EXHAUST BANKS AND 4 CATALYSTS EXAMPLE

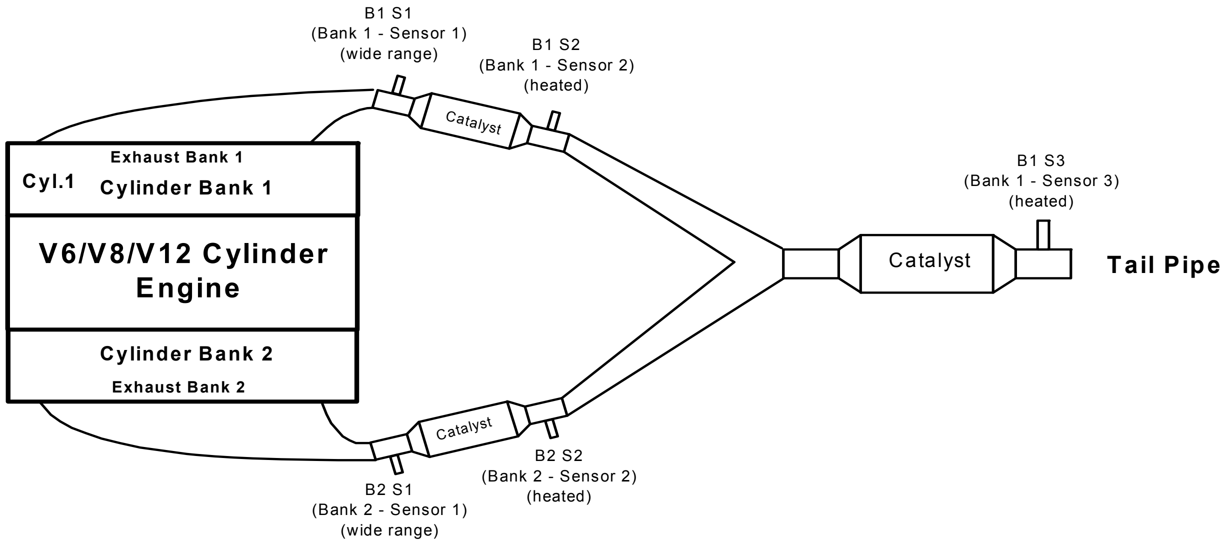


FIGURE D2 - V6V8/V12 CYLINDER ENGINE WITH 2 EXHAUST BANKS AND 3 CATALYSTS EXAMPLE

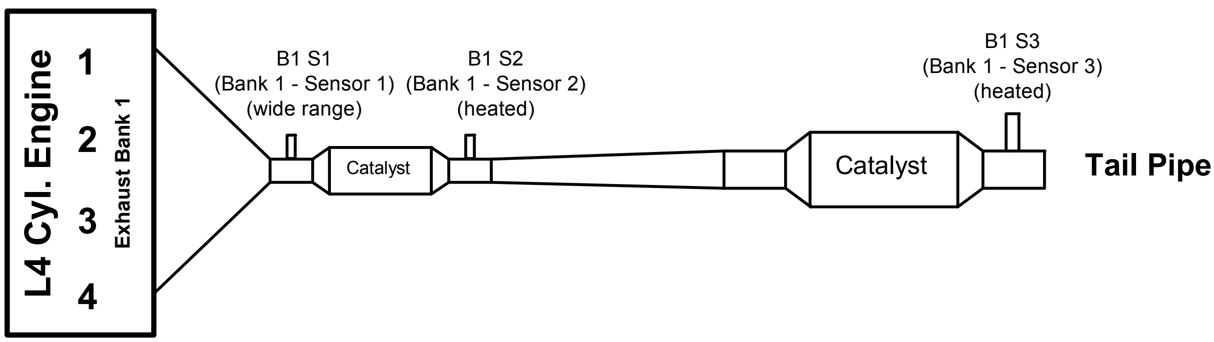


FIGURE D3 - L4 CYLINDER ENGINE WITH 1 EXHAUST BANK AND 2 CATALYSTS EXAMPLE

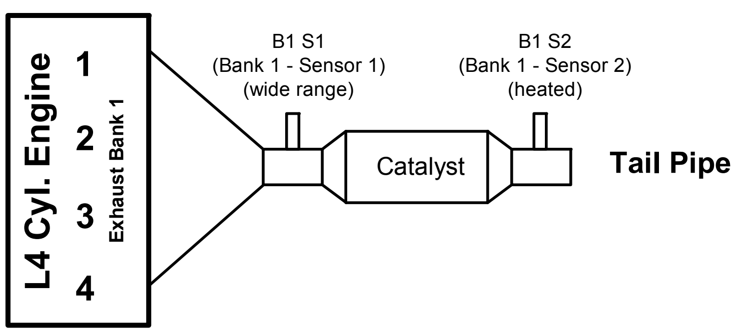


FIGURE D4 - L4 CYLINDER ENGINE WITH 1 EXHAUST BANK AND 1 CATALYST EXAMPLE

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 hex to decimal unsigned	0000	0	FFFF	65535	xxxxx
			Data Range examples:				Display examples:
			$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 hex to decimal unsigned	0000	0	FFFF	6553.5	xxxx.x
			Data Range examples:				Display examples:
			$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 hex to decimal unsigned	0000	0	FFFF	655.35	xxx.xx
			Data Range examples:				Display examples:
			$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 hex to decimal unsigned	0000	0	FFFF	65.535	xx.xxx
			Data Range examples:				Display examples:
			$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: 1 km/h = 0.62137 mph		$0000		0 km/h		0.00 km/h (0.00 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: 1 km/h = 0.62137 mph		$0000		0 km/h		0 km/h (0 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
			Data Range examples:				Display examples:
	Conversion mA -> A: 1000 mA = 1 A		$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)
			Data Range examples:				Display examples:
	Conversion s -> min -> h: 60 s = 1 min 60 min = 1 h		$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)
			Data Range examples:				Display examples:
	Conversion s -> min -> h: 60 s = 1 min 60 min = 1 h		$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)
			Data Range examples:				Display examples:
	Conversion s -> min -> h: 60 s = 1 min 60 min = 1 h		$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)	Min. Value (dec.)	Max. Value (hex)	Max. Value (dec.)	External Test Equipment SI (Metric) Display
14	Resistance	1 Ohm per bit	0000	0 Ohm	FFFF	65535 Ohm	xx.xxx kOhm
		unsigned	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)	Min. Value (dec.)	Max. Value (hex)	Max. Value (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)	Min. Value (dec.)	Max. Value (hex)	Max. Value (dec.)	External Test Equipment SI (Metric) Display	
16	Temperature	(0.1 °C per bit) - 40 °C	0000	– 40 °C	FFFF	+ 6513.5 °C	xxxx.x °C (xxxxx.x °F)	
		unsigned	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)	Min. Value (dec.)	Max. Value (hex)	Max. Value (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:			Data Range examples:				Display examples:	
1 kPa (10 HPa) = 0.1450377 PSI			$0000		0 kPa		0.00 kPa	(0.0 PSI)
Additional Conversions:			$0001		+ 0.01 kPa		0.01 kPa	(0.0 PSI)
1 kPa = 4.0146309 inH2O			$FFFF		+ 655.35 kPa		655.35 kPa	(95.1 PSI)
1 kPa = 101.9716213 mmH2O (millimeter of water)								
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:			Data Range examples:				Display examples:
1 kPa (10 HPa) = 0.1450377 PSI			$0000		0 kPa		0.0000 kPa (0.0 PSI)
Additional Conversions:			$0001		+ 0.0117 kPa		0.0117 kPa (0.0 PSI)
1 kPa = 4.0146309 inH2O			$FFFF		+ 766.7595 kPa		766.7595 kPa (111.2 PSI)
1 kPa = 101.9716213 mmH2O (millimeter of water)							
1 kPa = 7.5006151 mmHg (millimeter of mercury)							
1 kPa = 0.010 bar							

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:			Data Range examples:				Display examples:
1 kPa (10 HPa) = 0.1450377 PSI			$0000		0 kPa		0.000 kPa (0.0 PSI)
Additional Conversions:			$0001		+ 0.079 kPa		0.079 kPa (0.0 PSI)
1 kPa = 4.0146309 inH2O			$FFFF		+ 5177.265 kPa		5177.265 kPa (750.9 PSI)
1 kPa = 101.9716213 mmH2O (millimeter of water)							
1 kPa = 7.5006151 mmHg (millimeter of mercury)							
1 kPa = 0.010 bar							

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:			Data Range examples:				Display examples:
1 kPa (10 HPa) = 0.1450377 PSI			$0000		0 kPa		0 kPa (0.0 PSI)
Additional Conversions:			$0001		+ 1 kPa		1 kPa (0.1 PSI)
1 kPa = 4.0146309 inH2O			$FFFF		+ 65535 kPa		65535 kPa (9505.0 PSI)
1 kPa = 101.9716213 mmH2O (millimeter of water)							
1 kPa = 7.5006151 mmHg (millimeter of mercury)							
1 kPa = 0.010 bar							

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			Data Range examples:				Display examples:
1 kPa (10 HPa) = 0.1450377 PSI			$0000		0 kPa		0 kPa (0.0 PSI)
Additional Conversions:			$0001		+ 10 kPa		10 kPa (1.5 PSI)
1 kPa = 4.0146309 inH2O			$FFFF		+ 655350 kPa		655350 kPa (95050.5 PSI)
1 kPa = 101.9716213 mmH2O (millimeter of water)							
1 kPa = 7.5006151 mmHg (millimeter of mercury)							
1 kPa = 0.010 bar							

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:
			$0000	0			0.0000000 lambda
	measured Air/Fuel ratio divided by the stoichiometric Air/Fuel ratio (14.64 for gasoline)		$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 (hex)	Min. Value (dec.)	Max. Value (hex)	Max. Value (dec.)	External Test Equipment SI (Metric) Display
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 $8000 $FFFF		0 mHz 32768 mHz 65535 mHz		0.000 Hz 32.768 Hz 65.535 Hz

TABLE E34 - UNIT AND SCALING ID $22 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
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 $8000 $FFFF		0 Hz 32768 Hz 65535 Hz		0 Hz 32768 Hz 65535 Hz

TABLE E35 - UNIT AND SCALING ID $23 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
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 $8000 $FFFF		0 KHz 32768 KHz 65535 KHz		0.000 MHz 32.768 MHz 65.535 MHz

TABLE E36 - UNIT AND SCALING ID $24 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
24	Counts	1 count per bit unsigned	0000	0 counts	FFFF	65535	xxxxx counts
			Data Range examples:				Display examples:
			$0000 $FFFF		0 counts 65535 counts		0 counts 65535 counts

TABLE E37 - UNIT AND SCALING ID $25 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
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 $FFFF		0 km 65535 km		0 km (0 miles) 65535 km (40721 miles)

TABLE E38 - UNIT AND SCALING ID $26 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
26	Voltage per time	0.1 mV/ms per bit unsigned	0000	0 V/ms	FFFF	6.5535 V/ms	x.xxxx V/ms
	Conversion mV/ms -> V/ms:		Data Range examples:				Display examples:
	1000 mV/ms = 1 V/ms		$0000		0 mV/ms		0.0000 V/ms
			$0001		0.1 mV/ms		0.0001 V/ms
			$FFFF		+ 6553.5 mV/ms		6.5535 V/ms

TABLE E39 - UNIT AND SCALING ID $27 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display	
			(hex)	(dec.)	(hex)	(dec.)		
27	Mass per time	0.01 g/s per bit unsigned	0000	0 g/s	FFFF	655.35 g/s	xxx.xx g/s (x.xxx lb/s)	
			Data Range examples:				Display examples:	
	Conversion g/s -> lb/s:		$0000		0 g/s		0.00 g/s	(0.000 lb/s)
	1 g/s = 0.0022046 lb/s		$0001		+ 0.01 g/s		0.01 g/s	(0.000 lb/s)
			$FFFF		+ 655.35 g/s		655.35 g/s	(1.445 lb/s)

TABLE E40 - UNIT AND SCALING ID $28 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display	
			(hex)	(dec.)	(hex)	(dec.)		
28	Mass per time	1 g/s per bit unsigned	0000	0 g/s	FFFF	65535 g/s	xxxxx g/s (xxx.xx lb/s)	
			Data Range examples:				Display examples:	
	Conversion g/s -> lb/s:		$0000		0 g/s		0 g/s	(0.00 lb/s)
	1 g/s = 0.0022046 lb/s		$0001		+ 1 g/s		1 g/s	(0.00 lb/s)
			$FFFF		+ 65535 g/s		65535 g/s	(144.48 lb/s)

TABLE E41 - UNIT AND SCALING ID $29 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display	
			(hex)	(dec.)	(hex)	(dec.)		
29	Pressure per time	0.25 Pa/s per bit unsigned	0000	0 kPa/s	FFFF	16.384 kPa/s	xx.xxxx kPa/s (xx.xxx inH2O/s)	
Conversion: inH2O/s -> kPa/s			Data Range examples:				Display examples:	
1 inH2O/s = 0.2490889 kPa/s			$0000	0 Pa/s	0 inH2O/s		0.0000 kPa/s	(0.000 inH2O/s)
(inch of water) 1 inH2O = 249.0889 Pa			$0004	+ 1 Pa/s	+ 4.015 inH2O/s		0.0010 kPa/s	(4.015 inH2O/s)
(millimeter of water) 1 mmH2O = 9.80665 Pa			$FFFF	+ 16384 Pa/s	+ 65,5348 inH2O/s		16.3838 kPa/s	(65.775 inH2O/s)
(millimeter of mercury) 1 mmHg = 133.3224 Pa								

TABLE E42 - UNIT AND SCALING ID $2A DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
2A	Mass per time	0.001 kg/h per bit unsigned	0000	0 kg/h	FFFF	65.535 kg/h	xx.xxx kg/h
	Conversion lbs/s -> kg/h:		Data Range examples:				Display examples:
	1 lbs/s = 0.4535924 kg/h		$0000		0 kg/h		0.000 kg/h
			$0001		+ 0.001 kg/h		0.001 kg/h
			$FFFF		+ 65.535 kg/h		65.535 kg/h

TABLE E43 - UNIT AND SCALING ID $2B 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
2B	Switches	hex to decimal unsigned	0000	0	FFFF	65535	xxxxx switches
			Data Range examples:				Display examples:
			$0000 $0001 $FFFF	0 switches + 1 switches + 65535 switches			0 switches 1 switches 65535 switches

TABLE E44 - UNIT AND SCALING ID $2C 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
2C	mass per cylinder	0.01 g/cyl per bit unsigned	0000	0 g/cyl	FFFF	655.35 g/cyl	xxx.xx g/cyl
			Data Range examples:				Display examples:
			$0000 $0001 $FFFF	0 g/cyl + 0.01 g/cyl + 655.35 g/cyl			0.00 g/cyl 0.01 g/cyl 655.35 g/cyl

TABLE E45 - UNIT AND SCALING ID $2D 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
2D	Mass per stroke	0.01 mg/stroke unsigned	0000	0 mg/stroke	FFFF	655.35 mg/stroke	xxx.xx mg/stroke
			Data Range examples:				Display examples:
			$0000 $0001 $FFFF	0 mg/stroke + 0.01 mg/stroke + 655.35 mg/stroke			0.00 mg/stroke 0.01 mg/stroke 655.35 mg/stroke

TABLE E46 - UNIT AND SCALING ID $2E 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
2E	True/False	state encoded unsigned	0000	false	0001	True	
			Data Range examples:				Display examples:
			$0000 $0001	False True			false true

TABLE E47 - UNIT AND SCALING ID $2F 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
2F	Percent	0.01 % per bit unsigned	0000	0 %	FFFF	655.35 %	xxx.xx %
			Data Range examples:				Display examples:
			$0000 $0001 $2710 $FFFF	0 % + 0.01 % + 100 % + 655.35 %			0.00 % 0.01 % 100.00 % 655.35 %

TABLE E48 - UNIT AND SCALING ID $30 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
30	Percent	0.001526 % per bit, unsigned	0000	0 %	FFFF	100.00 %	xxx.xxxxxx %
			Data Range examples:				Display examples:
			$0000	0 %			0.000000 %
			$0001	+ 0.001526 %			0.001526 %
			$FFFF	+ 100.00641 %			100.006410 %

TABLE E49 - UNIT AND SCALING ID $31 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
31	volume	0.001 L per bit, unsigned	0000	0 L	FFFF	65.535 L	xx.xxx L
			Data Range examples:				Display examples:
			$0000	0 L			0.000 L
			$0001	+ 0.001 L			0.001 L
			$FFFF	+ 65.535 L			65.535 L

TABLE E50 - UNIT AND SCALING ID $32 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
32	length	0.0000305 inch per bit, unsigned	0000	0 inch	FFFF	1.999 inch	xx.xxxxxxx mm (x.xxx inch)
			Data Range examples:				Display examples:
	1 inch = 25.4 mm		$0000	0 inch			0.0000000 mm (0.000 inch)
			:	:			:
			$0010	+ 0.0004883 inch			0.0124023 mm (0.000 inch)
			$0011	+ 0.0005188 inch			0.0131775 mm (0.001 inch)
			$FFFF	+ 1.9999695 inch			50.7992249 mm (1.999 inch)

TABLE E51 - UNIT AND SCALING ID $33 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
33	Equivalence ratio (lambda)	0.00024414 per bit, unsigned	0000	0	FFFF	15.99976	xx.xxxxxxxx lambda
			Data Range examples:				Display examples:
	measured Air/Fuel ratio divided by the stoichiometric Air/Fuel ratio (14.64 for gasoline)		$0000	0			0.00000000 lambda
			$0001	0.00			0.00024414 lambda
			$1000	1.00			1.00000000 lambda
			$E5BE	14.36			14.3588867 lambda
			$FFFF	16.00			15.99975586 lambda

TABLE E52 - UNIT AND SCALING ID $34 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
34	Time	1 minute per bit unsigned	0000	0	FFFF	65535	xx days, xx h, xx min
			Data Range examples:				Display examples:
	Conversion s -> min -> h: 60 min = 1 h 24 h = 1 day		$0000	0 min			0 days, 0 h, 0 min
			$003C	+ 60 min			0 days, 1 h, 0 min
			$0E10	+ 3,600 min			2 days, 12 h, 0 min
			$FFFF	+ 65,535 min			45 days, 12 h, 15 min

TABLE E53 - UNIT AND SCALING ID $35 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
35	Time	10 ms per bit unsigned	0000	0	FFFF	655,350	xxx.xx s (x min, xx s)
			Data Range examples:				Display examples:
	Conversion s -> min -> h: 60 s = 1 min 60 min = 1 h		$0000 $8000 $EA60 $FFFF		0 ms + 327,680 ms + 600,000 ms + 655,350 ms		0.00 s (0 min, 0 s) 327.68 s (5 min, 28 s) 600.00 s (10 min, 0 s) 655.35 s (10 min, 55 s)

TABLE E54 - UNIT AND SCALING ID $36 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
36	Weight	0.01 g per bit unsigned	0000	0	FFFF	655.35	xxx.xx g (x.xxx lbs)
			Data Range examples:				Display examples:
	Conversion g -> lbs: 1 lbs = 453 g		$0000 $0052 $0E21 $FFFF		0 g + 0.82 g + 36.17 g + 655.35 g		0.00 g (0.000 lbs) 0.82 g (0.002 lbs) 36.17 g (0.079 lbs) 655.35 g (1.447 lbs)

TABLE E55 - UNIT AND SCALING ID $37 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
37	Weight	0.1 g per bit unsigned	0000	0	FFFF	6553.5	xxxx.x g (xx.xxx lbs)
			Data Range examples:				Display examples:
	Conversion g -> lbs: 1 lbs = 453 g		$0000 $0052 $0E21 $FFFF		0 g + 8.20 g + 361.7 g + 6553.5 g		0.0 g (0.000 lbs) 8.2 g (0.018 lbs) 361.7 g (0.798 lbs) 6553.5 g (14.467 lbs)

TABLE E56 - UNIT AND SCALING ID $38 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
38	Weight	1 g per bit unsigned	0000	0	FFFF	65535	xxxxx g (xxx.xx lbs)
			Data Range examples:				Display examples:
	Conversion g -> lbs: 1 lbs = 453 g		$0000 $0052 $0E21 $FFFF		0 g + 82 g + 3617 g + 65535 g		0 g (0.00 lbs) 82 g (0.18 lbs) 3617 g (7.98 lbs) 65535 g (144.67 lbs)

TABLE E57 - UNIT AND SCALING ID $39 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
39	Percent	0.01% per bit unsigned	0000	– 327.68 %	FFFF	+ 327.67 %	xxx.xx %
			Data Range examples:				Display examples:
	Conversion H = E*100 – 32768		$0000 $58F0 $7FFF $8000 $8001 $A710 $FFFF		– 327.68 % – 100.00% – 0.01 % 0 % + 0.01 % + 100 % + 327.67 %		– 327.68 % – 100.00 % – 0.01 % 0.00 % + 0.01 % + 100.00 % + 327.67 %

TABLE E58 - UNIT AND SCALING ID $3A 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
3A	Weight	0.001 g per bit unsigned	0000	0	FFFF	65.535	xx.xxx g (x.xxxx lbs)
			Data Range examples:				Display examples:
	Conversion g -> lbs: 1 lbs = 453 g		$0000		0 g		0.000 g (0.0000 lbs)
			$0052		+ 0.082 g		0.082 g (0.0002 lbs)
			$0E21		+ 3.617 g		3.617 g (0.0079 lbs)
			$FFFF		+ 65.535 g		65.535 g (0.1447 lbs)

TABLE E59 - UNIT AND SCALING ID $3B 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
3B	Weight	0.0001 g per bit unsigned	0000	0	FFFF	6.5535	x.xxxx g (x.xxxxx lbs)
			Data Range examples:				Display examples:
	Conversion g -> lbs: 1 lbs = 453 g		$0000		0 g		0.0000 g (0.00000 lbs)
			$0052		+ 0.0082 g		0.0082 g (0.00002 lbs)
			$0E21		+ 0.3617 g		0.3617 g (0.00079 lbs)
			$FFFF		+ 6.5535 g		6.5535 g (0.01447 lbs)

TABLE E60 - UNIT AND SCALING ID $3C 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
3C	Time	0.1 µs per bit unsigned	0000	0 µs	FFFF	6553.5 µs	xxxx.x µs
			Data Range examples:				Display examples:
	Conversion s -> min: 60 s = 1 min		$0000		0 µs		0.0 µs
			$8000		+ 3276.8 µs		3276.8 µs
			$EA60		+ 6000.0 µs		6000.0 µs
			$FFFF		+ 6553.5 µs		6553.5 µs

TABLE E61 - UNIT AND SCALING ID $3D 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
3D	Current	0.01 mA per bit unsigned	0000	0 mA	FFFF	655.35 mA	xxx.xx mA
			Data Range examples:				Display examples:
	Conversion mA -> A: 1000 mA = 1 A		$0000		0 mA		0.00 mA
			$0001		+0.01 mA		0.01 mA
			$FFFF		+ 655.35 mA		655.35 mA

TABLE E62 - UNIT AND SCALING ID $3E 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
3E	Area	0.00006103516 mm2 per bit unsigned	0000	0 mm2	FFFF	3.999939 mm2	x.xx mm2
			Data Range examples:				Display examples:
			$0000		0 mm2		0.00 mm2
			$8000		1.99999488 mm2		2.00 mm2
			$FFFF		3.999939 mm2		4.00 mm2

TABLE E63 - UNIT AND SCALING ID $3F 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
3F	volume	0.01 L per bit, unsigned	0000	0 L	FFFF	655.35 L	xxx.xx L
			Data Range examples:				Display examples:
			$0000	0 L			0.00 L
			$0001	+ 0.01 L			0.01 L
			$FFFF	+ 655.35 L			655.35 L

TABLE E64 - UNIT AND SCALING ID $40 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
40	part per million	1 ppm per bit unsigned	0000	0 ppm	FFFF	65535 ppm	xxxxx ppm
			Data Range examples:				Display examples:
			$0000	0 ppm			0 ppm
			$FFFF	65535 ppm			65535 ppm

TABLE E65 - UNIT AND SCALING ID $41 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
41	Current	0.01 microA per bit unsigned	0000	0 µA	FFFF	655.35 µA	xxx.xx µA
			Data Range examples:				Display examples:
	Conversion microA -> A: 1000000 microA = 1 A		$0000	0 µA			0.00 µA
			$0001	+0.01 µA			0.01 µA
			$FFFF	+ 655.35 µA			655.35 µA

Unit And Scaling Identifiers in the unsigned range of $01 through $7F, which are not specified, are ISO/SAE reserved. Additional Scaling Identifiers shall be submitted to the SAE Vehicle E/E System Diagnostic Standards Committee or ISO/TC22/SC3/WG1 to consider for implementation in this document.

E.2 SIGNED UNIT AND SCALING IDENTIFIERS DEFINITION

TABLE E66 - UNIT AND SCALING ID $81 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
81	Raw Value	1 per bit hex to decimal signed	8000	– 32768	7FFF	+ 32767	xxxxx
			Data Range examples:				Display examples:
			$8000	– 32768			– 32768
			$FFFF	– 1			– 1
			$0000	0			0
			$0001	+ 1			1
			$7FFF	+ 32767			32767

TABLE E67 - UNIT AND SCALING ID $82 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
82	Raw Value	0.1 per bit hex to decimal signed	8000	– 3276.8	7FFF	+ 3276.7	xxxx.x
			Data Range examples:				Display examples:
			$8000	– 3276.8			– 3276.8
			$FFFF	– 0.1			– 0.1
			$0000	0			0.0
			$0001	+ 0.1			0.1
			$7FFF	+ 3276.7			3276.7

TABLE E68 - UNIT AND SCALING ID $83 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
83	Raw Value	0.01 per bit hex to decimal signed	8000	– 327.68	7FFF	+ 327.67	xxx.xx
			Data Range examples:				Display examples:
			$8000	– 327.68			– 327.68
			$FFFF	– 0.01			– 0.01
			$0000	0			0.00
			$0001	+ 0.01			0.01
			$7FFF	+ 327.67			327.67

TABLE E69 - UNIT AND SCALING ID $84 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
84	Raw Value	0.001 per bit hex to decimal signed	8000	-32.768	7FFF	+ 32.767	xx.xxx
			Data Range examples:				Display examples:
			$8000	– 32.768			– 32.768
			$FFFF	– 0.001			– 0.001
			$0000	0			0.000
			$0001	+ 0.001			0.001
			$7FFF	+ 32.767			32.767

TABLE E70 - UNIT AND SCALING ID $85 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
85	Raw Value	0.0000305 per bit hex to decimal signed	8000	-0.999	7FFF	0.999	x.xxxxxxx
			Data Range examples:				Display examples:
				$8000		– 0.9999995	– 0.9999995
				$FFFF		– 0.0000305	-0.0000305
				$0000		0	0.0000000
				$0001		+ 0.0000305	0.0000305
				$7FFF		+ 0.9999690	0.9999690

TABLE E71 - UNIT AND SCALING ID $86 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
86	Raw Value	0.000305 per bit hex to decimal signed	8000	– 9.994	7FFF	9.994	x.xxxxxx
			Data Range examples:				Display examples:
				$8000		– 9.999995	– 10.000000
				$FFFF		– 0.000305	-0.000305
				$0000		0	0.000000
				$0001		+ 0.000305	0.000305
				$7FFF		+ 9.99969	9.999969

TABLE E72 - UNIT AND SCALING ID $87 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
87	part per million	1 ppm per bit hex to decimal signed	8000	– 32768 ppm	7FFF	+ 32767 ppm	xxxxx ppm
			Data Range examples:				Display examples:
				$8000		– 32768 ppm	– 32768 ppm
				$FFFF		– 1 ppm	– 1 ppm
				$0000		0 ppm	0 ppm
				$0001		+ 1 ppm	1 ppm
				$7FFF		+ 32767 ppm	32767 ppm

TABLE E73 - UNIT AND SCALING ID $8A DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
8A	Voltage	0.122 mV per bit signed	8000	– 3.9977 V	7FFF	3.9976 V	x.xxxxxx V
			Data Range examples:				Display examples:
	Conversion mV -> V: 1000 mV = 1 V			$8000		– 3999.998 mV	– 3.999998 V
				$FFFF		– 0.122 mV	– 0.000122 V
				$0000		0 mV	0.000000 V
				$0001		0.122 mV	0.000122 V
				$7FFF		+ 3999.876 mV	3.999876 V

TABLE E74 - UNIT AND SCALING ID $8B DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
8B	Voltage	0.001 V per bit, signed	8000	– 32.768 V	7FFF	32.767 V	xx.xxx V
			Data Range examples:				Display examples:
	Conversion mV -> V: 1000 mV = 1 V		$8000	– 32768 mV			– 32.768 V
			$FFFF	– 1 mV			– 0.001 V
			$0000	0 mV			0.000 V
			$0001	1 mV			0.001 V
			$7FFF	+ 32767 mV			32.767 V

TABLE E75 - UNIT AND SCALING ID $8C DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
8C	Voltage	0.01 V per bit, signed	8000	– 327.68 V	7FFF	327.67 V	xxx.xx V
			Data Range examples:				Display examples:
	Conversion mV -> V: 1000 mV = 1 V		$8000	– 327680 mV			– 327.68 V
			$FFFF	– 10 mV			– 0.01 V
			$0000	0 mV			0.00 V
			$0001	+ 10 mV			0.01 V
			$7FFF	+ 327670 mV			327.67 V

TABLE E76 - UNIT AND SCALING ID $8D DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
8D	Current	0.00390625 mA per bit, signed	8000	– 128.0 mA	7FFF	127.996 mA	xxx.xxxxxxxx mA
			Data Range examples:				Display examples:
			$8000	– 128 mA			– 128.00000000 mA
			$FFFF	– 0.00390625 mA			– 0.00390625 mA
			$0000	+ 0 mA			0.00000000 mA
			$0001	0.00390625 mA			0.00390625 mA
			$7FFF	+ 127.996 mA			127.99609375 mA

TABLE E77 - UNIT AND SCALING ID $8E DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value		Max. Value		External Test Equipment SI (Metric) Display
			(hex)	(dec.)	(hex)	(dec.)	
8E	Current	0.001 A per bit, signed	8000	– 32.768 A	7FFF	32.767 A	xx.xxx A
			Data Range examples:				Display examples:
	Conversion mA -> A: 1000 mA = 1 A		$8000	– 32768 mA			– 32.768 A
			$FFFF	– 1 mA			– 0.001 A
			$0000	0 mA			0.000 A
			$0001	+ 1 mA			0.001 A
			$7FFF	+ 32767 mA			32.767 A

TABLE E78 - UNIT AND SCALING ID $90 DEFINITION

Unit and Scaling ID (hex)	Description	Scaling/Bit	Min. Value (hex)	Min. Value (dec.)	Max. Value (hex)	Max. Value (dec.)	External Test Equipmen SI (Metric) Display
90	Time	1 ms per bit, signed	8000	– 32.768 s	7FFF	+ 32.767 s	xx.xxx s
			Data Range examples:				Display examples:
			$8000		– 32768 ms		– 32.768 s
			$0001		+ 1 ms		+ 0.001 s
			$7FFF		+ 32767 ms		+ 32.767 s

TABLE E79 - UNIT AND SCALING ID $96 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	
96	Temperature	0.1 °C per bit, signed	8000	– 3276.8 °C	7FFF	+ 3276.7 °C	xxxx.x °C (xxxx.x °F)	
			Data Range examples:				Display examples:	
	Conversion °C -> °F: °F = °C * 1.8 + 32 °C		$8000		– 3276.8 °C		– 3276.8 °C	(– 5886.2 °F)
			$FE70		– 40 °C		– 40.0 °C	(– 40.0 °F)
			$FFFF		– 0.1 °C		-0.1 °C	(31.8 °F)
			$0000		0 °C		0.0 °C	(32.0 °F)
			$0001		+ 0.1 °C		0.1 °C	(32.2 °F)
			$4E20		+ 2000 °C		2000.0 °C	(3632.0 °F)
			$7FFF		+ 3276.7 °C		3276.7 °C	(5930.1 °F)

TABLE E80 - UNIT AND SCALING ID $99 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	
99	Pressure	0.1 kPa per bit signed	8000	– 3276.8 kPa	7FFF	3276.7 kPa	xxxx.x kPa (xxx.xx PSI)	
Conversion kPa -> PSI: 1 kPa (10 HPa) = 0.1450377 PSI			Data Range examples:				Display examples:	
			$8000		– 3276.8 kPa		– 3276.8 kPa	(-475.26 PSI)
			$FFFF		– 0.1 kPa		– 0.1 kPa	(-0.15 PSI)
			$0000		0 kPa		0.0 kPa	(0.00 PSI)
Additional Conversions:			$0001		+ 0.1 kPa		0.1 kPa	(0.15 PSI)
1 kPa = 4.0146309 inH2O			$7FFF		+ 3276.7 kPa		+ 3276.7 kPa	(475.25 PSI)
1 kPa = 101.9716213 mmH2O (millimeter of water)								
1 kPa = 7.5006151 mmHg (millimeter of mercury)								
1 kPa = 0.010 bar								

TABLE E81 - UNIT AND SCALING ID $9C 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
9C	Angle	0.01° per bit, signed	8000	– 327.68 °	7FFF	327.67 °	xxx.xx °
			Data Range examples:				Display examples:
			$8000		– 327.68 °		– 327.68 °
			$F060		– 40 °		– 40.00 °
			$FFFF		– 0.01 °		– 0.01 °
			$0000		0 °		0.00 °
			$0FA0		+ 40 °		+ 40.00 °
			$7FFF		+ 327.67 °		+ 327.67 °

TABLE E82 - UNIT AND SCALING ID $9D 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
9D	Angle	0.5° per bit, signed	8000	-16384 °	7FFF	16383.5 °	xxxxx.x °
			Data Range examples:				Display examples:
			$8000	– 16384 °			– 16384.0 °
			$FF60	– 80 °			– 80.0 °
			$FFFF	– 0.5 °			– 0.5 °
			$0000	0 °			0.0 °
			$0001	+ 0.5 °			0.5 °
			$00A0	+ 80 °			80.0 °
			$7FFF	+ 16383.5 °			16383.5 °

TABLE E83 - UNIT AND SCALING ID $A8 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
A8	Mass per time	1 g/s per bit, signed	8000	– 32768 g/s	7FFF	+ 32767 g/s	xxxxx g/s (xx.xx lb/s)
			Data Range examples:				Display examples:
	Conversion g/s -> lb/s: 1 g/s = 0.0022046 lb/s		$8000	– 32768 g/s			– 32768 g/s (– 72.24 lb/s)
			$FFFF	– 1 g/s			– 1 g/s (– 0.00 lb/s)
			$0000	0 g/s			0 g/s (0.00 lb/s)
			$0001	+ 1 g/s			1 g/s (0.00 lb/s)
			$7FFF	+ 32767 g/s			32767 g/s (72.24 lb/s)

TABLE E84 - UNIT AND SCALING ID $A9 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
A9	Pressure per time	0.25 Pa/s per bit signed	8000	– 8192 Pa/s	7FFF	8191.75 Pa/s	xxxx.xx Pa/s (xx.xxx inH2O/s)
	Conversion Pa -> inH2O 1 Pa = 0.0040146309 inH2O		Data Range examples:				Display examples:
			$8000	– 8192 Pa/s			– 8192.00 Pa/s (– 32.888 inH2O/s)
			$FFFC	– 1 Pa/s			– 1.00 Pa/s (– 0.004 inH2O/s)
			$0000	0 Pa/s			0.00 Pa/s (0.000 inH2O/s)
			$0004	+ 1 Pa/s			1.00 Pa/s (0.004 inH2O/s)
			$7FFF	+ 8191.75 Pa/s			8191.75 Pa/s (32.887 inH2O/s)

TABLE E85 - UNIT AND SCALING ID $AD 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
AD	Mass per stroke	0.01 mg/stroke signed	8000	-327.68 mg/stroke	7FFF	327.67 mg/stroke	xxx.xx mg/stroke
			Data Range examples:				Display examples:
			$8000	-327.68			-327.68 mg/stroke
			$FFFF	- 0.01 mg/stroke			- 0.01 mg/stroke
			$0000	0 mg/stroke			0.00 mg/stroke
			$0001	+ 0.01 mg/stroke			0.01 mg/stroke
			$7FFF	+ 327.67 mg/stroke			327.67 mg/stroke

TABLE E86 - UNIT AND SCALING ID $AE 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
AE	Mass per stroke	0.1 mg/stroke signed	8000	-3276.8 mg/stroke	7FFF	3276.7 mg/stroke	xxxx.x mg/stroke
			Data Range examples:				Display examples:
			$8000	-3276.8 mg/stroke			-3276.8 mg/stroke
			$FFFF	- 0.1 mg/stroke			- 0.1 mg/stroke
			$0000	0 mg/stroke			0.00 mg/stroke
			$0001	+ 0.1 mg/stroke			0.1 mg/stroke
			$7FFF	+ 3276.7 mg/stroke			3276.7 mg/stroke

TABLE E87 - UNIT AND SCALING ID $AF 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
AF	Percent	0.01 % per bit, signed	8000	– 327.68 %	7FFF	+ 327.67 %	xxx.xx %
			Data Range examples:				Display examples:
			$8000	– 327.68 %			– 327.68 %
			$D8F0	– 100 %			– 100.00 %
			$FFFF	– 0.01 %			– 0.10 %
			$0000	0 %			0.00 %
			$0001	+ 0.01 %			0.10 %
			$2710	+ 100 %			100.00 %
			$7FFF	+ 327.67 %			+ 327.67 %

TABLE E88 - UNIT AND SCALING ID $B0 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
B0	Percent	0.003052 % per bit, signed	8000	– 100.01 %	7FFF	+ 100.00 %	xxx.xxxxxx %
			Data Range examples:				Display examples:
			$8000	– 100.007936 %			– 100.007936 %
			$FFFF	– 0.003052 %			0.000000 %
			$0000	0 %			0.000000 %
			$0001	+ 0.003052 %			0.003052 %
			$7FFF	+ 100.004884 %			+ 100.004884 %

TABLE E89 - UNIT AND SCALING ID $B1 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
B1	Voltage per time	2 mV/s per bit signed	8000	– 65536 mV/s	7FFF	65534 mV/s	xxxxx mV/s
			Data Range examples:				Display examples:
			$8000	– 65536 mV/s			– 65536 mV/s
			$FFFF	– 2 mV/s			– 2 mV/s
			$0000	0 mV/s			0 mV/s
			$0001	+ 2 mV/s			+ 2 mV/s
			$7FFF	+ 65534 mV			+ 65534 mV

TABLE E90 - UNIT AND SCALING ID $FC 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
FC	Pressure	0.01 kPa per bit, signed	8000	– 327.68 kPa	7FFF	+ 327.67 kPa	xxx.xx kPa
			Data Range examples:				Display examples:
			$8000		– 327.68 kPa		– 327.68 kPa
			$0001		+ 0.01 kPa		+ 0.01 kPa
			$7FFF		+ 327.67 kPa		+ 327.67 kPa

TABLE E91 - UNIT AND SCALING ID $FD 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
FD	Pressure	0.001 kPa per bit, signed	8000	– 32.768 kPa	7FFF	+ 32.767 kPa	xx.xxx kPa
			Data Range examples:				Display examples:
			$8000		– 32.768 kPa		– 32.768 kPa
			$0001		+ 0.001 kPa		+ 0.001 kPa
			$7FFF		+ 32.767 kPa		+ 32.767 kPa

TABLE E92 - UNIT AND SCALING ID $FE 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
FE	Pressure	0.25 Pa per bit signed	8000	– 8192 Pa	7FFF	8191.75 Pa	xxxx.xx Pa (xx.xxx inH2O)
	Conversion Pa -> inH2O		Data Range examples:				Display examples:
	1 Pa = 0.0040146309 inH2O		$8000		– 8192 Pa		– 8192.00 Pa (– 32.888 inH2O)
			$FFFC		– 1 Pa		– 1.00 Pa (– 0.004 inH2O)
			$0000		0 Pa		0.00 Pa (0.000 inH2O)
			$0004		+ 1 Pa		1.00 Pa (0.004 inH2O)
			$7FFF		+ 8191.75 Pa		8191.75 Pa (32.887 inH2O)

Unit And Scaling Identifiers in the signed range of $80 through $FE, which are not specified, are ISO/SAE reserved. Additional Scaling identifiers shall be submitted to the SAE Vehicle E/E System Diagnostic Standards Committee or ISO/TC22/SC3/WG1 to consider for implementation in this document.

APPENDIX F - (NORMATIVE)
TIDS (TEST ID) FOR SERVICE $08 SCALING AND DEFINITION

TABLE F1 - TEST ID DESCRIPTION

Test ID #	Description
$01	**Evaporative system leak test** For ISO 9141-2, ISO 14230-4 and SAE J1850, DATA_A - DATA_E should be set to $00 for a request and response message. If the conditions are not proper to run the test, the vehicle may either not respond to the request, or may respond with a manufacturer-specified value as DATA_A which corresponds to the reason the test cannot be run. For ISO 15765-4 protocol, DATA_A - DATA_E shall not be included in the request and response message. If the conditions are not proper to run the test, the vehicle shall respond with a negative response message with a response code $22 – conditionsNotCorrect. This service enables the conditions required to conduct an evaporative system leak test, but does not actually run the test. An example is to close a purge solenoid, preventing leakage if the system is pressurized. The vehicle manufacturer is responsible to determine the criteria to automatically stop the test (open the solenoid in the example) such as engine running, vehicle speed greater than zero, or exceeding a specified time period.
$02	**Diesel Particulate Filter Regeneration** For ISO 9141-2, ISO 14230-4 and SAE J1850, DATA_A - DATA_E should be set to $00 for a request and response message. If the conditions are not proper to run the test, the vehicle may either not respond to the request, or may respond with a manufacturer-specified value as DATA_A which corresponds to the reason the test cannot be run. For ISO 15765-4 protocol, DATA_A - DATA_E shall not be included in the request and response message. If the conditions are not proper to run the test, the vehicle shall respond with a negative response message with a response code $22 – conditionsNotCorrect. This service requests the vehicle to initiate a DPF regeneration. The vehicle manufacturer is responsible to determine the criteria to enable, start and stop the test, such as engine running, vehicle speed, or engine rpm.
$03 – $FF	ISO/SAE reserved

APPENDIX G - (NORMATIVE)
INFOTYPES FOR SERVICE $09 SCALING AND DEFINITION

TABLE G1 - MESSAGECOUNT VIN DATA BYTE DESCRIPTION

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
01	**MessageCount VIN** Number of messages to report Vehicle Identification Number (VIN) — For ISO 9141-2, ISO 14230-4 and SAE J1850, the message count in the response shall always be $05, and shall be reported for consistency in the use of this service. For ISO 15765-4, support for this parameter is not recommended/required for the ECU and the external test equipment. The response message format is not specified.	1 byte unsigned numeric	MC_VIN

TABLE G2 - VEHICLE IDENTIFICATION NUMBER DATA BYTE DESCRIPTION

InfoType (Hex)	Description	Scaling	External Test Equipment SI (Metric) / English Display
02	**Vehicle Identification Number**	17 ASCII characters	VIN: XXXXXXXXXXXXXXXXX
	For vehicles that provide electronic access to the VIN, it is recommended to report it using this format for ease of use by the external test equipment intended either for vehicle diagnostics or Inspection/Maintenance programs. Each of the 17 characters in each VIN shall be one of the letters in the set: [ABCDEFGHJKLMNPRSTUVWXYZ] ($41 - $48, $4A - $4E, $50, $52 - $5A), or a numeral in the set: [0123456789] ($30 - $39). For ISO 9141-2, ISO 14230-4 and SAE J1850, the response consists of the following messages: – Message #1 shall contain three (3) filling bytes of $00, followed by VIN character #1; – Message #2 shall contain VIN characters #2 to #5 inclusive; – Message #3 shall contain VIN characters #6 to #9 inclusive; – Message #4 shall contain VIN characters #10 to #13 inclusive; – Message #5 shall contain VIN characters #14 to #17 inclusive. For ISO 15765-4, there is only one response message, which contains all VIN characters without any filling bytes.		

TABLE G3 - MESSAGECOUNT CALID DATA BYTE DESCRIPTION

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
03	**MessageCount CALID** Number of messages to report calibration identifications — For ISO 9141-2, ISO 14230-4 and SAE J1850, the message count in the response shall always be a multiple of four (4) because four (4) messages are used to report each calibration identification. For ISO 15765-4, support for this parameter is not recommended/required for the ECU and the external test equipment because the message count is always one.	1 byte unsigned numeric	MC_CALID

TABLE G4 - CALIBRATION IDENTIFICATIONS DATA BYTE DESCRIPTION

InfoType (Hex)	Description	Scaling	External Test Equipment SI (Metric) / English Display
04	**Calibration Identifications**	16 ASCII characters	CALID: XXXXXXXXXXXXXXXX
	Multiple calibration identifications may be reported for a controller, depending on the software architecture. Calibration identifications can include a maximum of sixteen (16) characters. Each calibration identification can contain only printable ASCII characters ($20 through $7E), and will be reported as ASCII values. Any unused data bytes shall be reported as $00 and filled at the end of the calibration identification. Calibration identifications shall uniquely identify the software installed in the ECU. If regulations require calibration identifications for emission-related software, those shall be reported in a standardized format. Calibrations developed by any entity other than the vehicle manufacturer shall also contain unique calibration identification to indicate that a calibration is installed in the vehicle that is different from that developed by the vehicle manufacturer. Vehicle controllers that contain calibration identifications shall store and report sixteen (16) ASCII-character calibration identifications, even though they may not use all sixteen (16) characters. This will allow modified calibration IDs to be reported that include additional characters.		

TABLE G5 - MESSAGECOUNT CVN DATA BYTE DESCRIPTION

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
05	**MessageCount CVN** Number of messages to report Calibration Verification Numbers — For ISO 9141-2, ISO 14230-4 and SAE J1850, the message count in the response shall be the number of CVNs to report, because one message is required to report each CVN. For ISO 15765-4, support for this parameter is not recommended/required for the ECU and the external test equipment because the message count is always one.	1 byte unsigned numeric	MC_CVN

TABLE G6 - CALIBRATION VERIFICATION NUMBERS DATA BYTE DESCRIPTION

<table>
<tr><th>InfoType (Hex)</th><th>Description</th><th>Scaling</th><th>External Test Equipment SI (Metric) / English Display</th></tr>
<tr><td rowspan="2">06</td><td>Calibration Verification Numbers</td><td>4 byte hex (most significant byte reported as Data A)</td><td>CVN: XXXXXXXX</td></tr>
<tr><td colspan="3">A Calibration Verification Number (CVN) is used to verify the integrity of the vehicle software. The vehicle manufacturer is responsible for determining how many CVNs are required and how the CVNs are calculated, e.g. checksum, and the areas of memory to be included in each calculation. If regulations require calibration verification numbers for emission-related software, those shall be reported in a standardized format. Each calibration, as identified by a calibration ID number (InfoType $04), shall also have at least one unique calibration verification number (CVN) unless the entire ECU is not programmable. The CVN (or group of CVNs) assigned to a CALID shall be reported in the same order as the CALIDs are reported to the external test equipment.

Two (2) response methods to report the CVN(s) to external test equipment are allowed. The method to be implemented in the vehicle is specified by the applicable regulations.
– Method #1: The CVN(s) shall not be computed on demand, but instead shall be computed at least once per trip. A trip shall be of reasonable length (e.g. 5 to 10 min). The computed CVN(s) shall be stored in NVM (Non Volatile Memory) for immediate access by the external test equipment. Once the computation is completed for the first time after a reprogramming event of the ECU(s) or a battery disconnect, the results shall be made available to the external test equipment, even if the engine is running. If the CVN(s) are requested before they have been computed, a negative response message with response code $78 – RequestCorrectlyReceived-ResponsePending shall be sent by the ECU(s) until the positive response message is available for the ISO 14230-4 and ISO 15765-4 protocols. For ISO 9141-2 and SAE J1850 protocols, the external test equipment and ECU(s) shall behave as specified in 5.2.4.3.2 and Figure 11.
– Method #2: If method #1 does not apply, the on-board software of the ECU(s) shall compute the CVN(s) on an external test equipment request message. If the ECU(s) are not able to send an immediate positive response message, a negative response message with response code $78 – RequestCorrectlyReceived-ResponsePending shall be sent by the ECU(s) until the positive response message is available for the ISO 14230-4 and ISO 15765-4 protocols. For ISO 9141-2 and SAE J1850 protocols, the external test equipment and ECU(s) shall behave as specified in 5.2.4.3.2 and Figure 11.

Calibrations developed by any entity other than the vehicle manufacturer will generally have a calibration verification number that is different from that calculated based on the calibration developed by the vehicle manufacturer.

If the calculation technique does not use all four (4) bytes, the CVN shall be right justified and filled with $00.</td></tr>
</table>

TABLE G7 - MESSAGECOUNT IPT DATA BYTE DESCRIPTION
FOR SPARK AND COMPRESSION IGNITION VEHICLES

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
07	**MessageCount IPT** Number of messages to report In-use Performance Tracking using InfoType $08 for spark ignition vehicles and InfoType $0B for compression ignition vehicles. — For ISO 9141-2, ISO 14230-4 and SAE J1850, the message count in the response shall be $08 if sixteen (16) values are required to be reported, $09 if eighteen (18) values are required to be reported, and $0A if twenty (20) values are required to be reported (one message is required to report two values). For ISO 15765-4, support for this parameter is not recommended/required for the ECU and the external test equipment because the message count is always one.	1 byte unsigned numeric	MC_IPT

TABLE G8 - IN-USE PERFORMANCE TRACKING DATA BYTE DESCRIPTION
FOR SPARK IGNITION VEHICLES

InfoType (Hex)	Description	# of Data Bytes	External Test Equipment SI (Metric) / English Display
08	**In-use Performance Tracking:** 16 or 20 counters	32 or 40	IPT:
	Scaling: unsigned numeric (most significant byte reported as Data A). This data is used to support possible regulatory requirements for In-use Performance Tracking for spark ignition vehicles and compression ignition vehicles prior to 2010 MY. Manufacturers are required to implement software algorithms that track in-use performance for each of the following components: catalyst bank 1, catalyst bank 2, primary oxygen sensor bank 1, primary oxygen sensor bank 2, evaporative 0.020" leak detection system, EGR system, and secondary air system, and secondary oxygen sensor bank 1 and secondary oxygen sensor bank 2 for 2010 MY and beyond. The numerator for each component or system shall track the number of times that all conditions necessary for a specific monitor to detect a malfunction have been encountered. The denominator for each component or system shall track the number of times that the vehicle has been operated in the specified conditions. These conditions are specified for each monitored component or system. The ignition counter shall track the number of times that the engine has been started. All data items of the In-use Performance Tracking record shall be reported in the order as listed in this table. Data values, which are not implemented (e.g. bank 2 of the catalyst monitor of a 1-bank system) shall be reported as $0000. If a vehicle utilizes Variable Valve Timing (VVT) in place of EGR, the VVT in-use data shall be reported in place of the EGR in-use data. If a vehicle utilizes both an EGR system and a VVT system, the ECU shall track the in-use performance data for both monitors, but shall report only the data for the system with the lowest numerical ratio. If a vehicle utilizes an evaporative system monitor that is certified to 0.040“ requirements instead of 0.020” requirements, the ECU shall report the 0.040“ monitor in-use performance data in place of the 0.020” in-use performance data.		
	OBD Monitoring Conditions Encountered Counts	2 bytes	OBDCOND: xxxxx cnts
	OBD Monitoring Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified OBD monitoring conditions (general denominator).		
	Ignition Cycle Counter	2 bytes	IGNCNTR: xxxxx cnts
	Ignition Cycle Counter displays the count of the number of times that the engine has been started.		
	Catalyst Monitor Completion Counts Bank 1	2 bytes	CATCOMP1: xxxxx cnts
	Catalyst Monitor Completion Counts Bank 1 displays the number of times that all conditions necessary to detect a catalyst system bank 1 malfunction have been encountered (numerator).		
	Catalyst Monitor Conditions Encountered Counts Bank 1	2 bytes	CATCOND1: xxxxx cnts
	Catalyst Monitor Conditions Encountered Counts Bank 1 displays the number of times that the vehicle has been operated in the specified catalyst monitoring conditions (denominator).		
	Catalyst Monitor Completion Counts Bank 2	2 bytes	CATCOMP2: xxxxx cnts
	Catalyst Monitor Completion Counts Bank 2 displays the number of times that all conditions necessary to detect a catalyst system bank 2 malfunction have been encountered (numerator).		
	Catalyst Monitor Conditions Encountered Counts Bank 2	2 bytes	CATCOND2: xxxxx cnts
	Catalyst Monitor Conditions Encountered Counts Bank 2 displays the number of times that the vehicle has been operated in the specified catalyst monitoring conditions (denominator).		
	O2 Sensor Monitor Completion Counts Bank 1	2 bytes	O2SCOMP1: xxxxx cnts
	O2 Sensor Monitor Completion Counts Bank 1 displays the number of times that all conditions necessary to detect an oxygen sensor bank 1 malfunction have been encountered (numerator).		

TABLE G8 - IN-USE PERFORMANCE TRACKING DATA BYTE DESCRIPTION
FOR SPARK IGNITION VEHICLES (CONTINUED)

InfoType (Hex)	Description	# of Data Bytes	External Test Equipment SI (Metric) / English Display
08	**O2 Sensor Monitor Conditions Encountered Counts Bank 1**	2 bytes	O2SCOND1: xxxxx cnts
	O2 Sensor Monitor Conditions Encountered Counts Bank 1 displays the number of times that the vehicle has been operated in the specified oxygen sensor monitoring conditions (denominator).		
	O2 Sensor Monitor Completion Counts Bank 2	2 bytes	O2SCOMP2: xxxxx cnts
	O2 Sensor Monitor Completion Counts Bank 2 displays the number of times that all conditions necessary to detect an oxygen sensor bank 2 malfunction have been encountered (numerator).		
	O2 Sensor Monitor Conditions Encountered Counts Bank 2	2 bytes	O2SCOND2: xxxxx cnts
	O2 Sensor Monitor Conditions Encountered Counts Bank 2 displays the number of times that the vehicle has been operated in the specified oxygen sensor monitoring conditions (denominator).		
	EGR and/or VVT Monitor Completion Condition Counts	2 bytes	EGRCOMP: xxxxx cnts
	EGR and/or VVT Monitor Completion Condition Counts displays the number of times that all conditions necessary to detect an EGR/VVT system malfunction have been encountered (numerator).		
	EGR and/or VVT Monitor Conditions Encountered Counts	2 bytes	EGRCOND: xxxxx cnts
	EGR and/or VVT Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified EGR/VVT system monitoring conditions (denominator).		
	AIR Monitor Completion Condition Counts (Secondary Air)	2 bytes	AIRCOMP: xxxxx cnts
	AIR Monitor Completion Condition Counts (Secondary Air) displays the number of times that all conditions necessary to detect an AIR system malfunction have been encountered (numerator).		
	AIR Monitor Conditions Encountered Counts (Secondary Air)	2 bytes	AIRCOND: xxxxx cnts
	AIR Monitor Conditions Encountered Counts (Secondary Air) displays the number of times that the vehicle has been operated in the specified AIR system monitoring conditions (denominator).		
	EVAP Monitor Completion Condition Counts	2 bytes	EVAPCOMP: xxxxx cnts
	EVAP Monitor Completion Condition Counts displays the number of times that all conditions necessary to detect a 0.020“ (or 0.040”) EVAP system leak malfunction have been encountered (numerator).		
	EVAP Monitor Conditions Encountered Counts	2 bytes	EVAPCOND: xxxxx cnts
	EVAP Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified EVAP system leak malfunction monitoring conditions (denominator).		
	Secondary O2 Sensor Monitor Completion Counts Bank 1	2 bytes	SO2SCOMP1: xxxxx cnts
	Secondary O2 Sensor Monitor Completion Counts Bank 1 displays the number of times that all conditions necessary to detect a secondary oxygen sensor bank 1 malfunction have been encountered (numerator).		
	Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 1	2 bytes	SO2SCOND1: xxxxx cnts
	Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 1 displays the number of times that the vehicle has been operated in the specified secondary oxygen sensor monitoring conditions (denominator).		
	Secondary O2 Sensor Monitor Completion Counts Bank 2	2 bytes	SO2SCOMP2: xxxxx cnts
	Secondary O2 Sensor Monitor Completion Counts Bank 2 displays the number of times that all conditions necessary to detect a secondary oxygen sensor bank 2 malfunctions have been encountered (numerator).		

TABLE G8 - IN-USE PERFORMANCE TRACKING DATA BYTE DESCRIPTION
FOR SPARK IGNITION VEHICLES (CONTINUED)

InfoType (Hex)	Description	# of Data Bytes	External Test Equipment SI (Metric) / English Display
08	**Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 2**	2 bytes	SO2SCOND2: xxxxx cnts
	Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 2 displays the number of times that the vehicle has been operated in the specified secondary oxygen sensor monitoring conditions (denominator).		

TABLE G9 - MESSAGECOUNT ECU NAME DATA BYTE DESCRIPTION

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
09	**MessageCount ECUNAME** Number of messages to report the ECU's/module's acronym and text name — For ISO 9141-2, ISO 14230-4 and SAE J1850, the message count in the response shall always be five (5). For ISO 15765-4, support for this parameter is not recommended/required for the ECU and the external test equipment because the message count is always one.	1 byte unsigned Numeric	MC_ECUNM

TABLE G10 - ECU NAME DATA BYTE DESCRIPTION

InfoType (Hex)	Description	Scaling	External Test Equipment SI (Metric) / English Display
0A	**ECUNAME**	20 ASCII characters	ECU: XXXX ECUNAME: YYYYYYYYYYYYYYY
	This data is used to support the reporting of the ECU's/module's acronym and text name to enable the external test equipment to display the acronym and text name of the ECU/module with the data retrieved from that device. A maximum of printable 20 ASCII characters shall be used to report the acronym and text name of the ECU/module. The format shall be a defined field of four characters for acronym, one character for delimiter, and 15 characters for text name. One character for ECU number can be added to the end of each string (acronym and text name) if the vehicle is equipped with more than one ECU of that type. If there is only one ECU, no ECU number shall be used. If there is more than one ECU, ECUs shall be numbered sequentially in ascending order starting with the number 1. Defined field assignment: – Data bytes 1-4, "XXXX", contains ECU acronym and ECU number if the vehicle is equipped with more than one ECU of that type; – Data byte 5, "-", ($2D) contains delimiter; – Data bytes 6-20, "YYYYYYYYYYYYYYY", contains text name (no blanks between words) and ECU number if the vehicle is equipped with more than one ECU of that type. All bytes in each field are available for use, but any unused bytes shall be filled with $00. The use of any filler bytes shall extend to the end of each field for ECU acronym and name. Each ECU name shall contain only printable ASCII characters, and these characters shall spell acronyms and names in the English language. All non-zero hex bytes (displaying valid text based information) are left justified within each field. EXAMPLE #1: $45 43 4D 00 2D 45 6E 67 69 6E 65 43 6F 6E 74 72 6F 6C 00 00 translates to "ECM-EngineControl" EXAMPLE #2: $41 42 53 31 2D 41 6E 74 69 4C 6F 63 6B 42 72 61 6B 65 31 00 translates to "ABS1-AntiLockBrake1" This will benefit the technician to better understand which ECU/module provides the requested data.		

TABLE G10 - ECU NAME DATA BYTE DESCRIPTION (CONTINUED)

InfoType (Hex)	**Description**	**Scaling**	**External Test Equipment SI (Metric) / English Display**
0A	The ECUs (control modules), if emissions-related, shall report the external test equipment acronym and name as listed below. This table is not complete and emissions-related ECUs not listed in the table shall be reported to ISO/SAE for definition.		

	External test equipment reported acronym (max 1 – 4 chars)	**Full name of Control Module/ECU**	**External test equipment reported name and ECU number (max 14 chars + 1 optional digit)**
	ABS, ABS1, ABS2	Anti-Lock Brake System (ABS) Control Module	**AntiLockBrake**
	AFCM, AFC1, AFC2	Alternative Fuel Control Module	**AltFuelCtrl**
	AHCM, AHC1, AHC2	Auxiliary Heater Control Module	**AuxHeatCtrl**
	APCM, APC1, APC2	Air Pump Control Module	**AirPumpCtrl**
	AWDC, AWD1, AWD2	All Wheel Drive Control Module	**AllWhlDrvCtrl**
	BCCM, BCC1, BCC2	Battery Charger Control Module	**B+ChargerCtrl**
	BECM, BEC1, BEC2	Battery Energy Control Module	**B+EnergyCtrl**
	BSCM,BSC1, BSC2	Brake System Control Module	**BrakeSystem**
	CHCM, CHC1, CHC2	Chassis Control Module	**ChassisCtrl**
	CRCM, CRC1, CRC2	Cruise Control Module	**CruiseControl**
	CTCM, CTC1, CTC2	Coolant Temperature Control Module	**CoolTempCtrl**
	DCDC, DCD1, DCD2	DC/DC Converter Control Module	**DCDCConvCtrl**
	DMCM, DMC1, DMC2	Drive Motor Control Module	**DriveMotorCtrl**
	EACC, EAC1, EAC2	Electric A/C Compressor Control Module	**ElecACCompCtrl**
	ECCI, ECC1, ECC2	Emissions Critical Control Information	**EmisCritInfo**
	ECM, ECM1, ECM2	Engine Control Module	**EngineControl**
	FACM. FAC1, FAC2	Fuel Additive Control Module	**FuelAddCtrl**
	FICM, FIC1, FIC2	Fuel Injector Control Module	**FuelInjCtrl**
	FPCM, FPC1, FPC2	Fuel Pump Control Module	**FuelPumpCtrl**
	4WDC, 4WD1, 4WD2	Four-Wheel Drive Clutch Control Module	**4WhlDrvClCtrl**
	GPCM, GPC1, GPC2	Glow Plug Control Module	**GlowPlugCtrl**
	GSM, GSM1, GSM2	Gear Shift Control Module	**GearShiftCtrl**
	HVAC, HVA1, HVA2	HVAC Control Module	**HVACCtrl**
	HPCM, HPC1, HPC2	Hybrid Powertrain Control Module	**HybridPtCtrl**
	IPC, IPC1, IPC2	Instrument Panel Cluster (IPC) Control Module	**InstPanelClust**
	PCM, PCM1, PCM2	Powertrain Control Module	**PowertrainCtrl**
	RDCM, RDC1, RDC2	Reductant Control Module	**ReductantCtrl**
	SGCM, SGC1, SGC2	Starter / Generator Control Module	**Start/GenCtrl**
	TACM, TAC1, TAC2	Throttle Actuator Control Module	**ThrotActCtrl**
	TCCM, TCC1, TCC2	Transfer Case Control Module	**TransfCaseCtrl**
	TCM, TCM1, TCM2	Transmission Control Module	**TransmisCtrl**

TABLE G11 - IN-USE PERFORMANCE TRACKING DATA BYTE DESCRIPTION
FOR COMPRESSION IGNITION VEHICLES

InfoType (Hex)	Description	# of Data Bytes	External Test Equipment SI (Metric) / English Display
0B	**In-use Performance Tracking**: 16 or 18 counters	32 or 36	IPT:
	Scaling: unsigned numeric (most significant byte reported as Data A). This data is used to support regulatory requirements for In-use Performance Tracking for compression ignition vehicles for 2010 MY and beyond. Manufacturers are required to implement software algorithms that track in-use performance for each of the following components: NMHC catalyst, NOx catalyst monitor, NOx adsorber monitor, PM filter monitor, exhaust gas sensor monitor, EGR/ VVT monitor, boost pressure monitor and fuel system monitor for 2013 MY and beyond. The numerator for each component or system shall track the number of times that all conditions necessary for a specific monitor to detect a malfunction have been encountered. The denominator for each component or system shall track the number of times that the vehicle has been operated in the specified conditions. These conditions are specified for each monitored component or system. The ignition counter shall track the number of times that the engine has been started. All data items of the In-use Performance Tracking record shall be reported in the order as listed in this table. Data values, which are not implemented (e.g. bank 2 of the catalyst monitor of a 1-bank system) shall be reported as $0000. If a vehicle utilizes Variable Valve Timing (VVT) in place of EGR, the VVT in-use data shall be reported in place of the EGR in-use data. If a vehicle utilizes both an EGR system and a VVT system, the ECU shall track the in-use performance data for both monitors, but shall report only the data for the system with the lowest numerical ratio.		
	OBD Monitoring Conditions Encountered Counts	2 bytes	OBDCOND: xxxxx cnts
	OBD Monitoring Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified OBD monitoring conditions (general denominator).		
	Ignition Cycle Counter	2 bytes	IGNCNTR: xxxxx cnts
	Ignition Cycle Counter displays the count of the number of times that the engine has been started.		
	NMHC Catalyst Monitor Completion Condition Counts	2 bytes	HCCATCOMP: xxxxx cnts
	NMHC Catalyst Monitor Completion Condition Counts displays the number of times that all conditions necessary to detect an NMHC catalyst system malfunction have been encountered (numerator).		
	NMHC Catalyst Monitor Conditions Encountered Counts	2 bytes	HCCATCOND: xxxxx cnts
	NMHC Catalyst Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified NMHC catalyst monitoring conditions (denominator).		
	NOx/SCR Catalyst Monitor Completion Condition Counts	2 bytes	NCATCOMP: xxxxx cnts
	NOx Catalyst Monitor Completion Condition Counts displays the number of times that all conditions necessary to detect a NOx catalyst system malfunction have been encountered (numerator).		
	NOx/SCR Catalyst Monitor Conditions Encountered Counts	2 bytes	NCATCOND: xxxxx cnts
	NOx Catalyst Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified NOx catalyst monitoring conditions (denominator).		
	NOx Adsorber Monitor Completion Condition Counts	2 bytes	NADSCOMP: xxxxx cnts
	NOx Adsorber Monitor Completion Counts displays the number of times that all conditions necessary to detect a NOx adsorber system malfunction have been encountered (numerator).		
	NOx Adsorber Monitor Conditions Encountered Counts	2 bytes	NADSCOND: xxxxx cnts
	NOx Adsorber Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified NOx adsorber monitoring conditions denominator).		

TABLE G11 - IN-USE PERFORMANCE TRACKING DATA BYTE DESCRIPTION
FOR COMPRESSION IGNITION VEHICLES (CONTINUED)

InfoType (Hex)	Description	# of Data Bytes	External Test Equipment SI (Metric) / English Display
0B	**PM Filter Monitor Completion Condition Counts**	2 bytes	PMCOMP: xxxxx cnts
	PM Filter Monitor Completion Counts displays the number of times that all conditions necessary to detect a PM filter system malfunction have been encountered (numerator).		
	PM Filter Monitor Conditions Encountered Counts	2 bytes	PMCOND: xxxxx cnts
	PM Filter Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified PM filter monitoring conditions denominator).		
	Exhaust Gas Sensor Monitor Completion Condition Counts	2 bytes	EGSCOMP: xxxxx cnts
	Exhaust Gas Sensor Monitor Completion Counts displays the number of times that all conditions necessary to detect an exhaust gas sensor malfunction have been encountered (numerator)		
	Exhaust Gas Sensor Monitor Conditions Encountered Counts	2 bytes	EGSCOND: xxxxx cnts
	Exhaust Gas Sensor Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified exhaust gas sensor monitoring conditions (denominator).		
	EGR and/or VVT Monitor Completion Condition Counts	2 bytes	EGRCOMP: xxxxx cnts
	EGR and/or VVT Monitor Completion Condition Counts displays the number of times that all conditions necessary to detect an EGR/VVT system malfunction have been encountered (numerator).		
	EGR and/or VVT Monitor Conditions Encountered Counts	2 bytes	EGRCOND: xxxxx cnts
	EGR and/or VVT Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified EGR/VVT system monitoring conditions (denominator).		
	Boost Pressure Monitor Completion Condition Counts	2 bytes	BPCOMP: xxxxx cnts
	Boost Pressure Monitor Completion Condition Counts displays the number of times that all conditions necessary to detect a boost pressure system malfunction have been encountered (numerator).		
	Boost Pressure Monitor Conditions Encountered Counts	2 bytes	BPCOND: xxxxx cnts
	Boost Pressure Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified boost pressure system monitoring conditions (denominator).		
	Fuel Monitor Completion Condition Counts	2 bytes	FUELCOMP: xxxxx cnts
	Fuel System Monitor Completion Condition Counts displays the number of times that all conditions necessary to detect a fuel system malfunction have been encountered (numerator).		
	Fuel Monitor Conditions Encountered Counts	2 bytes	FUELCOND: xxxxx cnts
	Fuel System Monitor Conditions Encountered Counts displays the number of times that the vehicle has been operated in the specified fuel system monitoring conditions (denominator).		

TABLE G12 - MESSAGECOUNT ESN DATA BYTE DESCRIPTION

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
0C	**MessageCount ESN** Number of messages to report Engine Serial Number (ESN) — For ISO 9141-2, ISO 14230-4 and SAE J1850, the message count in the response shall always be $05, and shall be reported for consistency in the use of this service. For ISO 15765-4, support for this parameter is not recommended/required for the ECU and the external test equipment because the message count is always one.	1 byte unsigned numeric	MC_ESN

TABLE G13 - ENGINE SERIAL NUMBER DATA BYTE DESCRIPTION

InfoType (Hex)	Description	Scaling	External Test Equipment SI (Metric) / English Display
0D	**Engine Serial Number**	17 ASCII characters	ESN: XXXXXXXXXXXXXXXXX
	For vehicles that provide electronic access to the ESN, it is recommended to report it using this format for ease of use by the external test equipment intended either for vehicle diagnostics or Inspection/Maintenance programs. The length and format of the ESN are not specified, however, ESN shall be reported by always using up to 17 printable ASCII characters, preceded by any fill bytes of $00, followed by the ESN characters. Manufacturers should use the same format for ESN as for VIN. Each of the ESN characters should be one of the letters in the set: [ABCDEFGHJKLMNPRSTUVWXYZ] ($41 - $48, $4A - $4E, $50, $52 - $5A), or a numeral in the set: [0123456789] ($30 - $39). For ISO 9141-2, ISO 14230-4 and SAE J1850, the response consists of the following messages: – Message #1 shall contain up to four filling bytes of $00 or ESN characters; – Message #2 shall contain up to four filling bytes of $00 or ESN characters; – Message #3 shall contain up to four filling bytes of $00 or ESN characters; – Message #4 shall contain up to four filling bytes of $00 or ESN characters; – Message #5 shall contain up to three filling bytes of $00, followed by any ESN characters; For ISO 15765-4, there is only one response message, which contains 17 characters starting with any fill bytes of $00, followed by the ASCII ESN characters.		

TABLE G14 - MESSAGECOUNT EROTAN DATA BYTE DESCRIPTION

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
0E	**MessageCount EROTAN** Number of messages to report Exhaust Regulation Or Type Approval Number (EROTAN) — For ISO 9141-2, ISO 14230-4 and SAE J1850, the message count in the response shall always be $05, and shall be reported for consistency in the use of this service. For ISO 15765-4, support for this parameter is not recommended/required for the ECU and the external test equipment because the message count is always one.	1 byte unsigned numeric	MC_EROTAN

TABLE G15 - EXHAUST REGULATION OR TYPE APPROVAL NUMBER

InfoType (Hex)	Description	Scaling	External Test Equipment SI (Metric) / English Display
0F	**Exhaust Regulation Or Type Approval Number**	17 ASCII characters	EROTAN: XXXXXXXXXXXXXXXXX
	The Exhaust Regulation Or Type Approval Number (EROTAN) is defined by the vehicle manufacturer in accordance with the Type Approval registration office. It takes into account vehicle type, engine displacement, number of cylinders, engine power and emission standards. For vehicles that provide electronic access to the EROTAN, it is recommended to report it using this format for ease of use by the external test equipment intended either for Type Approval, Conformity of Production testing or Inspection/Maintenance. The length and format of the EROTAN are not specified, however, EROTAN shall be reported by always using up to 17 printable ASCII characters, preceded by any fill bytes of $00, followed by the EROTAN characters. Each of the EROTAN characters should be one of the letters in the set: [ABCDEFGHJKLMNPRSTUVWXYZ] ($41 - $48, $4A - $4E, $50, $52 - $5A), a numeral in the set: [0123456789] ($30 - $39) or a special character in the set [space, asterisk, hyphen, period, slash] ($20, $2A, $2D, $2E, $2F). For ISO 9141-2, ISO 14230-4 and SAE J1850, the response consists of the following messages: – Message #1 shall contain up to four filling bytes of $00 or EROTAN characters; – Message #2 shall contain up to four filling bytes of $00 or EROTAN characters; – Message #3 shall contain up to four filling bytes of $00 or EROTAN characters; – Message #4 shall contain up to four filling bytes of $00 or EROTAN characters; – Message #5 shall contain up to three filling bytes of $00, followed by any EROTAN characters; For ISO 15765-4, there is only one response message, which contains 17 characters starting with any fill bytes of $00, followed by the ASCII EROTAN characters. Only one EROTAN value shall be reported for an ECU.		

TABLE G16 – PROTOCOL IDENTIFICATION

InfoType (Hex)	Description	Scaling	Mnemonic
10	**Protocol Identification** This piece of information is used to identify the type of protocol supported by the ECU. It is required for the initialization sequence specified in ISO 15765-4 0x00 reserved 0x01 ISO 27145-4 0x02 - 0xFF reserved	1 byte unsigned numeric	

TABLE G17 – WWH-OBD GTR NUMBER

InfoType (Hex)	Description	Scaling	External Test Equipment SI (Metric) / English Display
11	**WWH-OBD GTR Number**	11 ASCII characters	GTR_XXX.XXX
	This data is used to identify the GTR revision the WWH-OBD vehicle is compliant with. XXX is the 3 character main GTR version and xxx is the 3 character minor GTR version. All 11 ASCII characters shall always be reported. (Zeros are ASCII $30) Example of the ASCII string used to report: GTR_005.000 is: $47,$54, $52, $5F, $35, $30, $30, $2E, $30, $30, $30 For ISO 15765-4, there is only one response message, which contains 11 characters. Only one GTR value shall be reported for an ECU.		

TABLE G18 - ISO/SAE RESERVED

InfoType (Hex)	Vehicle Information Data Byte Description	Scaling	Mnemonic
10 – FF	ISO/SAE reserved.	—	—

APPENDIX H - REVISION REQUEST FORM FOR SAE J1979-DA

To ensure that your request is accepted for voting and incorporation into SAE J1979-DA please download the revision request form from the SAE Web Site and supply the following information consistent with the naming procedure as defined in this document.

Perform the following steps to download the revision request form:

a. Go to the J1979 Task Force area on the SAE Web Site:

   http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS14 ,

b. Enter "SAE J1979-DA" in search field,

c. Press "Enter" button,

d. Select "SAE_J1979-DA_Revision_Request_Form.doc" document and download to your computer,

e. Fill out the revision request form with your request;

Please send e-mail with completed revision request form as attachment to:

SAE Headquarters
755 West Big Beaver Road
Suite 1600
Troy, MI 48084-4093, USA
Fax: +1 (248) 273-2494
Email: **saej1979@sae.org**