OBD-II PIDs

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OBD-II PIDs (On-board diagnostics **Parameter IDs**) are codes used to request data from a vehicle, used as a diagnostic tool.

SAE standard J/1939 defines many PIDs, but manufacturers also define many more PIDs specific to their vehicles. All light duty vehicles (i.e. less than 8,500 pounds) sold in North America since 1996, as well as medium duty vehicles (i.e. 8,500-14,000 pounds) beginning in 2005, and heavy duty vehicles (i.e. greater than 14,000 pounds) beginning in 2010,[1] are required to support OBD-II diagnostics, using a standardized data link connector, and a subset of the SAE J/1979 defined PIDs (or SAE J/1939 as applicable for medium/heavy duty vehicles), primarily for state mandated emissions inspections.

Typically, an automotive technician will use PIDs with a scan tool connected to the vehicle's OBD-II connector.

- The technician enters the PID
- The scan tool sends it to the vehicle's controller–area network (CAN)-bus, VPW, PWM, ISO, KWP. (After 2008, CAN only)
- A device on the bus recognizes the PID as one it is responsible for, and reports the value for that PID to the bus
- The scan tool reads the response, and displays it to the technician

Contents

Modes

There are 10 modes of operation described in the latest OBD-II standard SAE J1979. They are as follows:

Mode (hex)	Description
01	Show current data
02	Show freeze frame data
03	Show stored Diagnostic Trouble Codes
04	Clear Diagnostic Trouble Codes and stored values
05	Test results, oxygen sensor monitoring (non CAN only)
06	Test results, other component/system monitoring (Test results, oxygen sensor monitoring for CAN only)
07	Show pending Diagnostic Trouble Codes (detected during current or last driving cycle)
08	Control operation of on-board component/system
09	Request vehicle information
0A	Permanent Diagnostic Trouble Codes (DTCs) (Cleared DTCs)

Vehicle manufacturers are not required to support all modes. Each manufacturer may define additional modes above #9 (e.g.: mode 22 as defined by SAE J2190 for Ford/GM, mode 21 for Toyota) for other information e.g. the voltage of the traction battery in a hybrid electric vehicle (HEV).[2]

Standard PIDs

The table below shows the standard OBD-II PIDs as defined by SAE J1979. The expected response for each PID is given, along with information on how to translate the response into meaningful data. Again, not all vehicles will support all PIDs and there can be manufacturer-defined custom PIDs that are not defined in the OBD-II standard.

Note that modes 1 and 2 are basically identical, except that Mode 1 provides current information, whereas Mode 2 provides a snapshot of the same data taken at the point when the last diagnostic trouble code was set. The exceptions are PID 01, which is only available in Mode 1, and PID 02, which is only available in Mode 2. If Mode 2 PID 02 returns zero, then there is no snapshot and all other Mode 2 data is meaningless.

When using Bit-Encoded-Notation, quantities like C4 means bit 4 from data byte C. Each bit is numerated from 0 to 7, so 7 is the most significant bit and 0 is the least significant bit.

A								B								C								D							
A7	A6	A5	A4	A3	A2	A1	A0	B7	B6	B5	B4	B3	B2	B1	B0	C7	C6	C5	C4	C3	C2	C1	C0	D7	D6	D5	D4	D3	D2	D1	D0

Mode `01`

PID (hex)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]
00	4	PIDs supported [01 - 20]				Bit encoded [A7..D0] == [PID $01..PID $20] See below
01	4	Monitor status since DTCs cleared. (Includes malfunction indicator lamp (MIL) status and number of DTCs.)				Bit encoded. See below
02	2	Freeze DTC				
03	2	Fuel system status				Bit encoded. See below
04	1	Calculated engine load	0	100	%	$\frac{100}{255}A$ (or $\frac{A}{2.55}$)
05	1	Engine coolant temperature	-40	215	°C	$A-40$
06	1	Short term fuel trim—Bank 1	-100 (Reduce Fuel: Too Rich)	99.2 (Add Fuel: Too Lean)	%	$\frac{100}{128}A-100$ (or $\frac{A}{1.28}-100$)
07	1	Long term fuel trim—Bank 1				
08	1	Short term fuel trim—Bank 2				
09	1	Long term fuel trim—Bank 2				
0A	1	Fuel pressure (gauge pressure)	0	765	kPa	$3A$
0B	1	Intake manifold absolute pressure	0	255	kPa	A
0C	2	Engine RPM	0	16,383.75	rpm	$\frac{256A+B}{4}$
0D	1	Vehicle speed	0	255	km/h	A
0E	1	Timing advance	-64	63.5	° before TDC	$\frac{A}{2}-64$
0F	1	Intake air temperature	-40	215	°C	$A-40$
10	2	MAF air flow rate	0	655.35	grams/sec	$\frac{256A+B}{100}$
11	1	Throttle position	0	100	%	$\frac{100}{255}A$
12	1	Commanded secondary air status				Bit encoded. See below
13	1	Oxygen sensors present (in 2 banks)				[A0..A3] == Bank 1, Sensors 1-4. [A4..A7] == Bank 2...
14	2	Oxygen Sensor 1 A: Voltage B: Short term fuel trim	0 -100	1.275 99.2	Volts %	$\frac{A}{200}$ $\frac{100}{128}B-100$ (if B==$FF, sensor is not used in trim calculation)
15	2	Oxygen Sensor 2 A: Voltage B: Short term fuel trim				
16	2	Oxygen Sensor 3 A: Voltage B: Short term fuel trim				
17	2	Oxygen Sensor 4 A: Voltage B: Short term fuel trim				
18	2	Oxygen Sensor 5 A: Voltage B: Short term fuel trim				
19	2	Oxygen Sensor 6 A: Voltage B: Short term fuel trim				
1A	2	Oxygen Sensor 7 A: Voltage B: Short term fuel trim				
1B	2	Oxygen Sensor 8 A: Voltage B: Short term fuel trim				
1C	1	OBD standards this vehicle conforms to				Bit encoded. See below
1D	1	Oxygen sensors present (in 4 banks)				Similar to PID 13, but [A0..A7] == [B1S1, B1S2, B2S1, B2S2, B3S1, B3S2, B4S1, B4S2]
1E	1	Auxiliary input status				A0 == Power Take Off (PTO) status (1 == active) [A1..A7] not used
1F	2	Run time since engine start	0	65,535	seconds	$256A+B$
20	4	PIDs supported [21 - 40]				Bit encoded [A7..D0] == [PID $21..PID $40] See below
21	2	Distance traveled with malfunction indicator lamp (MIL) on	0	65,535	km	$256A+B$
22	2	Fuel Rail Pressure (relative to manifold vacuum)	0	5177.265	kPa	$0.079(256A+B)$

23	2	Fuel Rail Gauge Pressure (diesel, or gasoline direct injection)	0	655,350	kPa	$10(256A+B)$
24	4	Oxygen Sensor 1 AB: Fuel–Air Equivalence Ratio CD: Voltage	0 0	< 2 < 8	ratio V	$\frac{2}{65536}(256A+B)$ $\frac{8}{65536}(256C+D)$
25	4	Oxygen Sensor 2 AB: Fuel–Air Equivalence Ratio CD: Voltage				
26	4	Oxygen Sensor 3 AB: Fuel–Air Equivalence Ratio CD: Voltage				
27	4	Oxygen Sensor 4 AB: Fuel–Air Equivalence Ratio CD: Voltage				
28	4	Oxygen Sensor 5 AB: Fuel–Air Equivalence Ratio CD: Voltage				
29	4	Oxygen Sensor 6 AB: Fuel–Air Equivalence Ratio CD: Voltage				
2A	4	Oxygen Sensor 7 AB: Fuel–Air Equivalence Ratio CD: Voltage				
2B	4	Oxygen Sensor 8 AB: Fuel–Air Equivalence Ratio CD: Voltage				
2C	1	Commanded EGR	0	100	%	$\frac{100}{255}A$
2D	1	EGR Error	-100	99.2	%	$\frac{100}{128}A-100$
2E	1	Commanded evaporative purge	0	100	%	$\frac{100}{255}A$
2F	1	Fuel Tank Level Input	0	100	%	$\frac{100}{255}A$
30	1	Warm-ups since codes cleared	0	255	count	A
31	2	Distance traveled since codes cleared	0	65,535	km	$256A+B$
32	2	Evap. System Vapor Pressure	-8,192	8191.75	Pa	$\frac{256A+B}{4}$ (AB is two's complement signed)[3]
33	1	Absolute Barometric Pressure	0	255	kPa	A
34	4	Oxygen Sensor 1 AB: Fuel–Air Equivalence Ratio CD: Current	0 -128	< 2 <128	ratio mA	$\frac{2}{65536}(256A+B)$ $\frac{256C+D}{256}-128$ or $C+\frac{D}{256}-128$
35	4	Oxygen Sensor 2 AB: Fuel–Air Equivalence Ratio CD: Current				
36	4	Oxygen Sensor 3 AB: Fuel–Air Equivalence Ratio CD: Current				
37	4	Oxygen Sensor 4 AB: Fuel–Air Equivalence Ratio CD: Current				
38	4	Oxygen Sensor 5 AB: Fuel–Air Equivalence Ratio CD: Current				
39	4	Oxygen Sensor 6 AB: Fuel–Air Equivalence Ratio CD: Current				
3A	4	Oxygen Sensor 7 AB: Fuel–Air Equivalence Ratio CD: Current				
3B	4	Oxygen Sensor 8 AB: Fuel–Air Equivalence Ratio CD: Current				
3C	2	Catalyst Temperature: Bank 1, Sensor 1	-40	6,513.5	°C	$\frac{256A+B}{10}-40$
3D	2	Catalyst Temperature: Bank 2, Sensor 1				
3E	2	Catalyst Temperature: Bank 1, Sensor 2				
3F	2	Catalyst Temperature: Bank 2, Sensor 2				
40	4	PIDs supported [41 - 60]				Bit encoded [A7..D0] == [PID $41..PID $60] See below
41	4	Monitor status this drive cycle				Bit encoded. See below

42	2	Control module voltage	0	65.535	V	$\frac{256A+B}{1000}$
43	2	Absolute load value	0	25,700	%	$\frac{100}{255}(256A+B)$
44	2	Fuel–Air commanded equivalence ratio	0	< 2	ratio	$\frac{2}{65536}(256A+B)$
45	1	Relative throttle position	0	100	%	$\frac{100}{255}A$
46	1	Ambient air temperature	-40	215	°C	$A-40$
47	1	Absolute throttle position B	0	100	%	$\frac{100}{255}A$
48	1	Absolute throttle position C				
49	1	Accelerator pedal position D				
4A	1	Accelerator pedal position E				
4B	1	Accelerator pedal position F				
4C	1	Commanded throttle actuator				
4D	2	Time run with MIL on	0	65,535	minutes	$256A+B$
4E	2	Time since trouble codes cleared				
4F	4	Maximum value for Fuel–Air equivalence ratio, oxygen sensor voltage, oxygen sensor current, and intake manifold absolute pressure	0, 0, 0, 0	255, 255, 255, 2550	ratio, V, mA, kPa	A, B, C, D*10
50	4	Maximum value for air flow rate from mass air flow sensor	0	2550	g/s	A*10, B, C, and D are reserved for future use
51	1	Fuel Type				From fuel type table see below
52	1	Ethanol fuel %	0	100	%	$\frac{100}{255}A$
53	2	Absolute Evap system Vapor Pressure	0	327.675	kPa	$\frac{256A+B}{200}$
54	2	Evap system vapor pressure	-32,767	32,768	Pa	((A*256)+B)-32767
55	2	Short term secondary oxygen sensor trim, A: bank 1, B: bank 3	-100	99.2	%	$\frac{100}{128}A-100$ $\frac{100}{128}B-100$
56	2	Long term secondary oxygen sensor trim, A: bank 1, B: bank 3				
57	2	Short term secondary oxygen sensor trim, A: bank 2, B: bank 4				
58	2	Long term secondary oxygen sensor trim, A: bank 2, B: bank 4				
59	2	Fuel rail absolute pressure	0	655,350	kPa	$10(256A+B)$
5A	1	Relative accelerator pedal position	0	100	%	$\frac{100}{255}A$
5B	1	Hybrid battery pack remaining life	0	100	%	$\frac{100}{255}A$
5C	1	Engine oil temperature	-40	210	°C	$A-40$
5D	2	Fuel injection timing	-210.00	301.992	°	$\frac{256A+B}{128}-210$
5E	2	Engine fuel rate	0	3212.75	L/h	$\frac{256A+B}{20}$
5F	1	Emission requirements to which vehicle is designed				Bit Encoded
60	4	PIDs supported [61 - 80]				Bit encoded [A7..D0] == [PID $61..PID $80] See below
61	1	Driver's demand engine - percent torque	-125	125	%	A-125
62	1	Actual engine - percent torque	-125	125	%	A-125
63	2	Engine reference torque	0	65,535	Nm	$256A+B$
64	5	Engine percent torque data	-125	125	%	A-125 Idle B-125 Engine point 1 C-125 Engine point 2 D-125 Engine point 3 E-125 Engine point 4
65	2	Auxiliary input / output supported				Bit Encoded
66	5	Mass air flow sensor				
67	3	Engine coolant temperature				
68	7	Intake air temperature sensor				
69	7	Commanded EGR and EGR Error				
6A	5	Commanded Diesel intake air flow control and relative intake air flow position				
6B	5	Exhaust gas recirculation temperature				
6C	5	Commanded throttle actuator control and relative throttle position				
6D	6	Fuel pressure control system				
6E	5	Injection pressure control system				

6F	3	Turbocharger compressor inlet pressure				
70	9	Boost pressure control				
71	5	Variable Geometry turbo (VGT) control				
72	5	Wastegate control				
73	5	Exhaust pressure				
74	5	Turbocharger RPM				
75	7	Turbocharger temperature				
76	7	Turbocharger temperature				
77	5	Charge air cooler temperature (CACT)				
78	9	Exhaust Gas temperature (EGT) Bank 1				Special PID. See below
79	9	Exhaust Gas temperature (EGT) Bank 2				Special PID. See below
7A	7	Diesel particulate filter (DPF)				
7B	7	Diesel particulate filter (DPF)				
7C	9	Diesel Particulate filter (DPF) temperature				
7D	1	NOx NTE control area status				
7E	1	PM NTE control area status				
7F	13	Engine run time				
80	4	PIDs supported [81 - A0]				Bit encoded [A7..D0] == [PID $81..PID $A0] See below
81	21	Engine run time for Auxiliary Emissions Control Device(AECD)				
82	21	Engine run time for Auxiliary Emissions Control Device(AECD)				
83	5	NOx sensor				
84		Manifold surface temperature				
85		NOx reagent system				
86		Particulate matter (PM) sensor				
87		Intake manifold absolute pressure				
A0	4	PIDs supported [A1 - C0]				Bit encoded [A7..D0] == [PID $A1..PID $C0] See below
C0	4	PIDs supported [C1 - E0]				Bit encoded [A7..D0] == [PID $C1..PID $E0] See below
C3	?	?	?	?	?	Returns numerous data, including Drive Condition ID and Engine Speed*
C4	?	?	?	?	?	B5 is Engine Idle Request B6 is Engine Stop Request*
PID (hex)	**Data bytes returned**	**Description**	**Min value**	**Max value**	**Units**	**Formula[a]**

Mode 02

Mode 02 accepts the same PIDs as mode 01, with the same meaning, but information given is from when the freeze frame was created.

You have to send the frame number in the data section of the message.

PID (hex)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]
02	2	DTC that caused freeze frame to be stored.				BCD encoded. Decoded as in mode 3

Mode 03

PID (hex)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]
N/A	n*6	Request trouble codes				3 codes per message frame. See below

Mode 04

PID (hex)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]
N/A	0	Clear trouble codes / Malfunction indicator lamp (MIL) / Check engine light				Clears all stored trouble codes and turns the MIL off.

Mode 05

PID (hex)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]
0100		OBD Monitor IDs supported ($01 – $20)				
0101		O2 Sensor Monitor Bank 1 Sensor 1	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0102		O2 Sensor Monitor Bank 1 Sensor 2	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0103		O2 Sensor Monitor Bank 1 Sensor 3	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0104		O2 Sensor Monitor Bank 1 Sensor 4	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0105		O2 Sensor Monitor Bank 2 Sensor 1	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0106		O2 Sensor Monitor Bank 2 Sensor 2	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0107		O2 Sensor Monitor Bank 2 Sensor 3	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0108		O2 Sensor Monitor Bank 2 Sensor 4	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0109		O2 Sensor Monitor Bank 3 Sensor 1	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
010A		O2 Sensor Monitor Bank 3 Sensor 2	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
010B		O2 Sensor Monitor Bank 3 Sensor 3	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
010C		O2 Sensor Monitor Bank 3 Sensor 4	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
010D		O2 Sensor Monitor Bank 4 Sensor 1	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
010E		O2 Sensor Monitor Bank 4 Sensor 2	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
010F		O2 Sensor Monitor Bank 4 Sensor 3	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0110		O2 Sensor Monitor Bank 4 Sensor 4	0.00	1.275	Volts	0.005 Rich to lean sensor threshold voltage
0201		O2 Sensor Monitor Bank 1 Sensor 1	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0202		O2 Sensor Monitor Bank 1 Sensor 2	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0203		O2 Sensor Monitor Bank 1 Sensor 3	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0204		O2 Sensor Monitor Bank 1 Sensor 4	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0205		O2 Sensor Monitor Bank 2 Sensor 1	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0206		O2 Sensor Monitor Bank 2 Sensor 2	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0207		O2 Sensor Monitor Bank 2 Sensor 3	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0208		O2 Sensor Monitor Bank 2 Sensor 4	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0209		O2 Sensor Monitor Bank 3 Sensor 1	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
020A		O2 Sensor Monitor Bank 3 Sensor 2	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
020B		O2 Sensor Monitor Bank 3 Sensor 3	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
020C		O2 Sensor Monitor Bank 3 Sensor 4	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
020D		O2 Sensor Monitor Bank 4 Sensor 1	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
020E		O2 Sensor Monitor Bank 4 Sensor 2	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
020F		O2 Sensor Monitor Bank 4 Sensor 3	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
0210		O2 Sensor Monitor Bank 4 Sensor 4	0.00	1.275	Volts	0.005 Lean to Rich sensor threshold voltage
PID (hex)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]

Mode 09

PID (hex)	Data bytes returned	Description	Min value	Max value	Units	Formula[a]
00	4	Mode 9 supported PIDs (01 to 20)				Bit encoded. [A7..D0] = [PID $01..PID $20] See below
01	1	VIN Message Count in PID 02. Only for ISO 9141-2, ISO 14230-4 and SAE J1850.				Usually value will be 5.
02	17-20	Vehicle Identification Number (VIN)				17-char VIN, ASCII-encoded and left-padded with null chars (0x00) if needed to.
03	1	Calibration ID message count for PID 04. Only for ISO 9141-2, ISO 14230-4 and SAE J1850.				It will be a multiple of 4 (4 messages are needed for each ID).
04	16	Calibration ID				Up to 16 ASCII chars. Data bytes not used will be reported as null bytes (0x00).
05	1	Calibration verification numbers (CVN) message count for PID 06. Only for ISO 9141-2, ISO 14230-4 and SAE J1850.				
06	4	Calibration Verification Numbers (CVN)				Raw data left-padded with null characters (0x00). Usually displayed as hex string.
07	1	In-use performance tracking message count for PID 08 and 0B. Only for ISO 9141-2, ISO 14230-4 and SAE J1850.	8	10		8 if sixteen (16) values are required to be reported, 9 if eighteen (18) values are required to be reported, and 10 if twenty (20) values are required to be reported (one message reports two values, each one consisting in two bytes).
08	4	In-use performance tracking for spark ignition vehicles				4 or 5 messages, each one containing 4 bytes (two values). See below
09	1	ECU name message count for PID 0A				
0A	20	ECU name				ASCII-coded. Right-padded with null chars (0x00).
0B	4	In-use performance tracking for compression ignition vehicles				5 messages, each one containing 4 bytes (two values). See below
PID (hex)	**Data bytes returned**	**Description**	**Min value**	**Max value**	**Units**	**Formula[a]**

a. In the formula column, letters A, B, C, etc. represent the decimal equivalent of the first, second, third, etc. bytes of data. Where a (?) appears, contradictory or incomplete information was available.

Bitwise encoded PIDs

Some of the PIDs in the above table cannot be explained with a simple formula. A more elaborate explanation of these data is provided here:

Mode 1 PID 00

A request for this PID returns 4 bytes of data. Each bit, from MSB to LSB, represents one of the next 32 PIDs and is giving information about if it is supported.

For example, if the car response is BE1FA813, it can be decoded like this:

Hexadecimal	B				E				1				F				A				8				1				3			
Binary	1	0	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	1
Supported?	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No	No	No	No	Yes	No	No	Yes	Yes
PID number	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20

So, supported PIDs are: 01, 03, 04, 05, 06, 07, 0C, 0D, 0E, 0F, 10, 11, 13, 15, 1C, 1F and 20

Mode 1 PID 01

A request for this PID returns 4 bytes of data, labeled A B C and D.

The first byte(A) contains two pieces of information. Bit A7 (MSB of byte A, the first byte) indicates whether or not the MIL (check engine light) is illuminated. Bits A6 through A0 represent the number of diagnostic trouble codes currently flagged in the ECU.

The second, third, and fourth bytes(B, C and D) give information about the availability and completeness of certain on-board tests. Note that test **availability** is indicated by set (1) bit and **completeness** is indicated by reset (0) bit.

Bit	Name	Definition
A7	MIL	Off or On, indicates if the CEL/MIL is on (or should be on)
A6-A0	DTC_CNT	Number of confirmed emissions-related DTCs available for display.
B7	RESERVED	Reserved (should be 0)
B3	*NO NAME*	0 = Spark ignition monitors supported 1 = Compression ignition monitors supported

Here are the common bit B definitions, they are test based.

	Test available	Test incomplete
Misfire	B0	B4
Fuel System	B1	B5
Components	B2	B6

The third and fourth bytes are to be interpreted differently depending on if the engine is spark ignition or compression ignition. In the second (B) byte, bit 3 indicates how to interpret the C and D bytes, with `0` being spark and `1` (set) being compression.

The bytes C and D for spark ignition monitors:

	Test available	Test incomplete
Catalyst	C0	D0
Heated Catalyst	C1	D1
Evaporative System	C2	D2
Secondary Air System	C3	D3
A/C Refrigerant	C4	D4
Oxygen Sensor	C5	D5
Oxygen Sensor Heater	C6	D6
EGR System	C7	D7

And the bytes C and D for compression ignition monitors:

	Test available	Test incomplete
NMHC Catalyst[a]	C0	D0
NOx/SCR Monitor	C1	D1
Boost Pressure	C3	D3
Exhaust Gas Sensor	C5	D5
PM filter monitoring	C6	D6
EGR and/or VVT System	C7	D7

a. NMHC *may* stand for Non-Methane HydroCarbons, but J1979 does not enlighten us. The translation would be the ammonia sensor in the SCR catalyst.

Mode 1 PID `41`

A request for this PID returns 4 bytes of data. The first byte is always zero. The second, third, and fourth bytes give information about the availability and completeness of certain on-board tests. Note that test **availability** is represented by a set (`1`) bit and **completeness** is represented by a reset (`0`) bit:

	Test enabled	Test incomplete
Reserved	B3	B7
Components	B2	B6
Fuel System	B1	B5
Misfire	B0	B4
EGR System	C7	D7
Oxygen Sensor Heater	C6	D6
Oxygen Sensor	C5	D5
A/C Refrigerant	C4	D4
Secondary Air System	C3	D3
Evaporative System	C2	D2
Heated Catalyst	C1	D1
Catalyst	C0	D0

Mode 1 PID 78

A request for this PID will return 9 bytes of data. The first byte is a bit encoded field indicating which EGT sensors are supported:

Byte	Description
A	Supported EGT sensors
B-C	Temperature read by EGT11
D-E	Temperature read by EGT12
F-G	Temperature read by EGT13
H-I	Temperature read by EGT14

The first byte is bit-encoded as follows:

Bit	Description
A7-A4	Reserved
A3	EGT bank 1, sensor 4 Supported?
A2	EGT bank 1, sensor 3 Supported?
A1	EGT bank 1, sensor 2 Supported?
A0	EGT bank 1, sensor 1 Supported?

The remaining bytes are 16 bit integers indicating the temperature in degrees Celsius in the range -40 to 6513.5 (scale 0.1), using the usual $(A \times 256 + B)/10 - 40$ formula (MSB is A, LSB is B). Only values for which the corresponding sensor is supported are meaningful.

The same structure applies to PID 79, but values are for sensors of bank 2.

Mode 3 (no PID required)

A request for this mode returns a list of the DTCs that have been set. The list is encapsulated using the ISO 15765-2 protocol.

If there are two or fewer DTCs (4 bytes) they are returned in an ISO-TP Single Frame (SF). Three or more DTCs in the list are reported in multiple frames, with the exact count of frames dependent on the communication type and addressing details.

Each trouble code requires 2 bytes to describe. The text description of a trouble code may be decoded as follows. The first character in the trouble code is determined by the first two bits in the first byte:

A7-A6	First DTC character
00	P - Powertrain
01	C - Chassis
10	B - Body
11	U - Network

The two following digits are encoded as 2 bits. The second character in the DTC is a number defined by the following table:

A5-A4	Second DTC character
00	0
01	1
10	2
11	3

The third character in the DTC is a number defined by

A3-A0	Third DTC character
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

The fourth and fifth characters are defined in the same way as the third, but using bits B7-B4 and B3-B0. The resulting five-character code should look something like "U0158" and can be looked up in a table of OBD-II DTCs. Hexadecimal characters (0-9, A-F), while relatively rare, are allowed in the last 3 positions of the code itself.

Mode 9 PID 08

It provides information about track in-use performance for catalyst banks, oxygen sensor banks, evaporative leak detection systems, EGR systems and secondary air system.

The numerator for each component or system tracks 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 tracks the number of times that the vehicle has been operated in the specified conditions.

The count of data items should be reported at the beginning (the first byte).

All data items of the In-use Performance Tracking record consist of two (2) bytes and are reported in this order (each message contains two items, hence the message length is 4).

Mnemonic	Description
OBDCOND	OBD Monitoring Conditions Encountered Counts
IGNCNTR	Ignition Counter
CATCOMP1	Catalyst Monitor Completion Counts Bank 1
CATCOND1	Catalyst Monitor Conditions Encountered Counts Bank 1
CATCOMP2	Catalyst Monitor Completion Counts Bank 2
CATCOND2	Catalyst Monitor Conditions Encountered Counts Bank 2
O2SCOMP1	O2 Sensor Monitor Completion Counts Bank 1
O2SCOND1	O2 Sensor Monitor Conditions Encountered Counts Bank 1
O2SCOMP2	O2 Sensor Monitor Completion Counts Bank 2
O2SCOND2	O2 Sensor Monitor Conditions Encountered Counts Bank 2
EGRCOMP	EGR Monitor Completion Condition Counts
EGRCOND	EGR Monitor Conditions Encountered Counts
AIRCOMP	AIR Monitor Completion Condition Counts (Secondary Air)
AIRCOND	AIR Monitor Conditions Encountered Counts (Secondary Air)
EVAPCOMP	EVAP Monitor Completion Condition Counts
EVAPCOND	EVAP Monitor Conditions Encountered Counts
SO2SCOMP1	Secondary O2 Sensor Monitor Completion Counts Bank 1
SO2SCOND1	Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 1
SO2SCOMP2	Secondary O2 Sensor Monitor Completion Counts Bank 2
SO2SCOND2	Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 2

Mode 9 PID 0B

It provides information about track in-use performance for 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.

All data items consist of two (2) bytes and are reported in this order (each message contains two items, hence message length is 4):

Mnemonic	Description
OBDCOND	OBD Monitoring Conditions Encountered Counts
IGNCNTR	Ignition Counter
HCCATCOMP	NMHC Catalyst Monitor Completion Condition Counts
HCCATCOND	NMHC Catalyst Monitor Conditions Encountered Counts
NCATCOMP	NOx/SCR Catalyst Monitor Completion Condition Counts
NCATCOND	NOx/SCR Catalyst Monitor Conditions Encountered Counts
NADSCOMP	NOx Adsorber Monitor Completion Condition Counts
NADSCOND	NOx Adsorber Monitor Conditions Encountered Counts
PMCOMP	PM Filter Monitor Completion Condition Counts
PMCOND	PM Filter Monitor Conditions Encountered Counts
EGSCOMP	Exhaust Gas Sensor Monitor Completion Condition Counts
EGSCOND	Exhaust Gas Sensor Monitor Conditions Encountered Counts
EGRCOMP	EGR and/or VVT Monitor Completion Condition Counts
EGRCOND	EGR and/or VVT Monitor Conditions Encountered Counts
BPCOMP	Boost Pressure Monitor Completion Condition Counts
BPCOND	Boost Pressure Monitor Conditions Encountered Counts
FUELCOMP	Fuel Monitor Completion Condition Counts
FUELCOND	Fuel Monitor Conditions Encountered Counts

Enumerated PIDs

Some PIDs are to be interpreted specially, and aren't necessarily exactly bitwise encoded, or in any scale. The values for these PIDs are enumerated.

Mode 1 PID `03`

A request for this PID returns 2 bytes of data. The first byte describes fuel system #1.

Value	Description
1	Open loop due to insufficient engine temperature
2	Closed loop, using oxygen sensor feedback to determine fuel mix
4	Open loop due to engine load OR fuel cut due to deceleration
8	Open loop due to system failure
16	Closed loop, using at least one oxygen sensor but there is a fault in the feedback system

Any other value is an invalid response. There can only be one bit set at most.

The second byte describes fuel system #2 (if it exists) and is encoded identically to the first byte.

Mode 1 PID 12

A request for this PID returns a single byte of data which describes the secondary air status.

Value	Description
1	Upstream
2	Downstream of catalytic converter
4	From the outside atmosphere or off
8	Pump commanded on for diagnostics

Any other value is an invalid response. There can only be one bit set at most.

Mode 1 PID 1C

A request for this PID returns a single byte of data which describes which OBD standards this ECU was designed to comply with. The different values the data byte can hold are shown below, next to what they mean:

Value	Description
1	OBD-II as defined by the CARB
2	OBD as defined by the EPA
3	OBD and OBD-II
4	OBD-I
5	Not OBD compliant
6	EOBD (Europe)
7	EOBD and OBD-II
8	EOBD and OBD
9	EOBD, OBD and OBD II
10	JOBD (Japan)
11	JOBD and OBD II
12	JOBD and EOBD
13	JOBD, EOBD, and OBD II
14	Reserved
15	Reserved
16	Reserved
17	Engine Manufacturer Diagnostics (EMD)
18	Engine Manufacturer Diagnostics Enhanced (EMD+)
19	Heavy Duty On-Board Diagnostics (Child/Partial) (HD OBD-C)
20	Heavy Duty On-Board Diagnostics (HD OBD)
21	World Wide Harmonized OBD (WWH OBD)
22	Reserved
23	Heavy Duty Euro OBD Stage I without NOx control (HD EOBD-I)
24	Heavy Duty Euro OBD Stage I with NOx control (HD EOBD-I N)
25	Heavy Duty Euro OBD Stage II without NOx control (HD EOBD-II)
26	Heavy Duty Euro OBD Stage II with NOx control (HD EOBD-II N)
27	Reserved
28	Brazil OBD Phase 1 (OBDBr-1)
29	Brazil OBD Phase 2 (OBDBr-2)
30	Korean OBD (KOBD)
31	India OBD I (IOBD I)
32	India OBD II (IOBD II)
33	Heavy Duty Euro OBD Stage VI (HD EOBD-IV)
34-250	Reserved
251-255	Not available for assignment (SAE J1939 special meaning)

Fuel Type Coding

Mode 1 PID 51 returns a value from an enumerated list giving the fuel type of the vehicle. The fuel type is returned as a single byte, and the value is given by the following table:

Value	Description
0	Not available
1	Gasoline
2	Methanol
3	Ethanol
4	Diesel
5	LPG
6	CNG
7	Propane
8	Electric
9	Bifuel running Gasoline
10	Bifuel running Methanol
11	Bifuel running Ethanol
12	Bifuel running LPG
13	Bifuel running CNG
14	Bifuel running Propane
15	Bifuel running Electricity
16	Bifuel running electric and combustion engine
17	Hybrid gasoline
18	Hybrid Ethanol
19	Hybrid Diesel
20	Hybrid Electric
21	Hybrid running electric and combustion engine
22	Hybrid Regenerative
23	Bifuel running diesel

Any other value is reserved by ISO/SAE. There are currently no definitions for flexible-fuel vehicle.

Non-standard PIDs

The majority of all OBD-II PIDs in use are non-standard. For most modern vehicles, there are many more functions supported on the OBD-II interface than are covered by the standard PIDs, and there is relatively minor overlap between vehicle manufacturers for these non-standard PIDs.

There is very limited information available in the public domain for non-standard PIDs. The primary source of information on non-standard PIDs across different manufacturers is maintained by the US-based Equipment and Tool Institute and only available to members. The price of ETI membership for access to scan codes varies based on company size defined by annual sales of automotive tools and equipment in North America:

Annual Sales in North America	Annual Dues
Under $10,000,000	$5,000
$10,000,000 - $50,000,000	$7,500
Greater than $50,000,000	$10,000

However, even ETI membership will not provide full documentation for non-standard PIDs. ETI state:[4][5]

> Some OEMs refuse to use ETI as a one-stop source of scan tool information. They prefer to do business with each tool company separately. These companies also require that you enter into a contract with them. The charges vary but here is a snapshot as of April 13th, 2015 of the per year charges:

GM	$50,000
Honda	$5,000
Suzuki	$1,000
BMW	$25,500 plus $2,000 per update. Updates occur annually.

CAN (11-bit) bus format

The PID query and response occurs on the vehicle's CAN bus. Standard OBD requests and responses use functional addresses. The diagnostic reader initiates a query using CAN ID $7DF, which acts as a broadcast address, and accepts responses from any ID in the range $7E8 to $7EF. ECUs that can respond to OBD queries listen both to the functional broadcast ID of $7DF and one assigned ID in the range $7E0 to $7E7. Their response has an ID of their assigned ID plus 8 e.g. $7E8 through $7EF.

This approach allows up to eight ECUs, each independently responding to OBD queries. The diagnostic reader can use the ID in the ECU response frame to continue communication with a specific ECU. In particular, multi-frame communication requires a response to the specific ECU ID rather than to ID $7DF.

CAN bus may also be used for communication beyond the standard OBD messages. Physical addressing uses particular CAN IDs for specific modules (e.g., 720 for the instrument cluster in Fords) with proprietary frame payloads.

Query

The functional PID query is sent to the vehicle on the CAN bus at ID 7DFh, using 8 data bytes. The bytes are:

	Byte							
PID Type	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SAE Standard	Number of additional data bytes: 2	Mode 01 = show current data; 02 = freeze frame; etc.	PID code (e.g.: 05 = Engine coolant temperature)	not used (may be 55h)				
Vehicle specific	Number of additional data bytes: 3	Custom mode: (e.g.: 22 = enhanced data)	PID code (e.g.: 4980h)		not used (may be 00h or 55h)			

Response

The vehicle responds to the PID query on the CAN bus with message IDs that depend on which module responded. Typically the engine or main ECU responds at ID 7E8h. Other modules, like the hybrid controller or battery controller in a Prius, respond at 07E9h, 07EAh, 07EBh, etc. These are 8h higher than the physical address the module responds to. Even though the number of bytes in the returned value is variable, the message uses 8 data bytes regardless (CAN bus protocol form Frameformat with 8 data bytes). The bytes are:

	Byte							
PID Type	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
SAE Standard 7E8h, 7E9h, 7EAh, etc.	Number of additional data bytes: 3 to 6	Custom mode Same as query, except that 40h is added to the mode value. So: 41h = show current data; 42h = freeze frame; etc.	PID code (e.g.: 05 = Engine coolant temperature)	value of the specified parameter, byte 0	value, byte 1 (optional)	value, byte 2 (optional)	value, byte 3 (optional)	not used (may be 00h or 55h)
Vehicle specific 7E8h, or 8h + physical ID of module.	Number of additional data bytes: 4to 7	Custom mode: same as query, except that 40h is added to the mode value.(e.g.: 62h = response to mode 22h request)	PID code (e.g.: 4980h)		value of the specified parameter, byte 0	value, byte 1 (optional)	value, byte 2 (optional)	value, byte 3 (optional)
Vehicle specific 7E8h, or 8h + physical ID of module.	Number of additional data bytes: 3	7Fh this a general response usually indicating the module doesn't recognize the request.	Custom mode: (e.g.: 22h = enhanced diagnostic data by PID, 21h = enhanced data by offset)	31h	not used (may be 00h)			

See also

- On-board diagnostics
- Engine control unit
- ELM327 very common chip used in OBD-II interfaces
- OBDuino onboard computer using Arduino connected to OBD-II port

References

1. "Basic Information | On-Board Diagnostics (OBD)". US EPA. 16 March 2015. Retrieved 24 June 2015.
2. "Escape PHEV TechInfo - PIDs". *Electric Auto Association - Plug in Hybrid Electric Vehicle*. Retrieved 11 December 2013.
3. "Extended PID's - Signed Variables". *Torque-BHP*. Retrieved 17 March 2016.
4. "ETI Full Membership FAQ". The Equipment and Tool Institute. Retrieved 29 November 2013. showing cost of access to OBD-II PID documentation
5. "Special OEM License Requirements". The Equipment and Tool Institute. Retrieved 13 April 2015.

External links

- OBD-II Error Codes Definition (http://www.autocodes.com/), description and repair information for most makes of vehicles.
- OBD II Error Codes Definition and Lookup (http://www.obd-codes.com), including manufacturer-specific codes.
- Generic/Manufacturer OBD2 Codes and Their Meanings (http://www.totalcardiagnostics.com/support/index.php?_m=knowledgebase&_a=viewarticle&kbarticleid=23)
- Engine Trouble Codes Meanings (http://www.enginetroublecode.com/) , Engine trouble code look-up and meanings.
- Directive 98/69/EC of the European Parliament and of the Council of 13 October 1998 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1998L0069:19981228:EN:PDF).
- CAN Bus Vehicles (http://www.auterraweb.com/aboutcan.html) Partial list of 2003-2007 vehicles which support the OBD-II CAN bus standard.
- Fault Code Examples (http://kbmsystems.net/files/Engine%20ECU%20Fault%20Code%20Reading%20with%20OBDKey.pdf) Sample fault code data read using the OBDKey Bluetooth, OBDKey USB and OBDKey WLAN vehicle interface units.