

## Data Definitions

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### Serial Data Interpretation

#### OBD II Data Stream (CARB)

##### Parameter Definitions

#### **FUEL SYS (#1 AND #2)**

Air/fuel ratio feedback loop status displayed as either open or closed loop. Open indicates that ECM ignores feedback from the exhaust O2 sensor. Closed indicates final injection duration is corrected for O2 sensor feedback.

#### **CALC LOAD**

Engine load displayed as a percentage of maximum possible load. Value is calculated mathematically using the formula:  $\text{actual air volume} = \text{maximum possible air volume} \times 100\%$ .

#### **COOLANT TEMP**

Temperature of the engine coolant displayed in degrees Fahrenheit or Celsius. Value determined by comparing the THW voltage signal to corresponding temperatures in a look-up table.

#### **SHORT FT (#1 and #2)**

A/F Ratio feedback correction value (for cylinder banks #1 and #2 respectively.) Displayed as the percentage of rich or lean correction being applied to corrected injection duration. Short fuel trim is based on rapidly switching exhaust O2 sensor values.

A positive value indicates fuel delivery is being increased to correct for a lean A/F Ratio. A negative value indicates fuel delivery is being decreased to correct for a rich A/F Ratio. Maximum possible short correction is  $\pm 20\%$  of basic injection duration.

### **LONG FT (#1 AND #2)**

Learned value (adaptive memory) correction to A/F Ratio feedback control system. Displayed as a percentage of rich or lean correction applied to basic injection duration calculation. For example:

Case #1 LONG FT = 0%

MAF = 5.0 grams/sec

ENGINE SPD = 1500 rpm

INJECTOR = 4.0 ms

Case #2 LONG FT = 10%

MAF = 5.0 grams/sec

ENGINE SPD = 1500 rpm

INJECTOR = 4.4 ms

A positive value indicates a rich correction due to an extended period of lean exhaust indication. A negative value indicates a lean correction due to an extended period of rich exhaust indication.

Long fuel trim compensates for changes in engine operating conditions like fuel pressure, air leaks, injection spray pattern, changes in fuel properties, and etc. Maximum long fuel correction is 20% to 30% plus or minus basic injection duration. Changes in long fuel trim occur very slowly only after short fuel trim corrections fail to bring air/fuel ratio back to neutral value.

### **ENGINE SPD**

Engine revolutions per minute calculated by comparing the NE signal with the ECM internal clock.

### **VEHICLE SPD**

Vehicle road speed displayed in miles or kilometers per hour. Calculated by comparing the pulsed vehicle speed sensor signal with the ECM internal clock.

**IGN ADVANCE**

Ignition spark advance angle referenced to #1 cylinder Top Dead Center. Calculated by comparing the relationship between the crankshaft position sensor (NE) and camshaft position sensor (G) signals. The two missing teeth on the (NE) timing rotor (36 minus 2 tooth configuration) identify #1 cylinder TDC. The (G) signal identifies the approach of #1 cylinder compression stroke, occurring at 90° BTDC.

**INTAKE AIR**

Temperature of air entering the intake manifold, displayed in degrees Fahrenheit or Celsius. Value determined by comparing the THA voltage signal to corresponding temperatures in a look-up table.

**MAF**

Total mass of air entering the intake manifold, represented in grams per second. This signal is determined by comparing the analog voltage signal from the VG terminal of the MAF sensor to a corresponding value in a lookup table.

**THROTTLE POS**

Position of the throttle valve displayed as a percentage of fully open. Value is determined by comparing VTA voltage to corresponding value in a look-up table. Normal throttle opening ranges from about 8% at normal curb idle to 80% at wide open throttle. Each .5V = 10% throttle opening.

**O2S (B1, S1 and B1, S2)**

Signal voltage (in millivolts) for the main and sub O2 sensors respectively, located in Bank 1. High concentration of oxygen in exhaust (lean condition) causes signal voltage to go low (less than 400 mv), low concentration of oxygen in exhaust causes signal voltage to go high (greater than 600 mv).

**O2FT (B1, S1 and B2, S1)**

The short term fuel trim correction taking place based upon the value of the main O2 sensor located in cylinder banks 1 and 2 respectively. This value is expressed as the percentage of correction to basic injection duration. It should closely follow SHORT FT.

Positive percentage means injection is increased to correct for a lean A/F Ratio. Negative percentage indicates injection is decreased to correct for a rich A/F Ratio.

**MISFIRE RPM**

Freeze frame data stored when misfire is detected by OBD II software. This parameter represents the engine rpm at the moment that misfire code was set.

**OBD II Data MISFIRE LOAD**

Stream

(Enhanced)

Parameter

Definitions

Load at which misfire code was set, measured in grams per revolution.

**INJECTOR**

Calculated time in milliseconds that fuel injector is open, delivering fuel.

**IAC DUTY RATIO**

Duty ratio signal applied to the Rotary Solenoid Idle Air Control Valve displayed as the percentage of time that voltage is high on the RSO (open) coil. The longer the duty ratio (higher percent open time), the greater the air by-pass volume, the higher the idle speed.

**STARTER SIG**

ON/OFF status of the STA signal at the ECM. Signal will be ON whenever the ignition switch is in the START position (voltage high at ECM).

**CTP SW**

ON/OFF status of IDL contact. Signal will be ON whenever the throttle is fully closed and the IDL switch contact is closed (voltage low at ECM).

**A/C SIG**

ON/OFF status of the A/C magnetic clutch input to the ECM. Signal will be ON anytime the air conditioning compressor clutch is energized (voltage low at ECM). Signal will cycle OFF whenever compressor cycles off due to low evaporator temperature.

**PNP SW**

(A/T only) ON/OFF status of the neutral safety switch input to the ECM. Signal will be ON whenever the automatic transmission is in the neutral or park gear positions (voltage low at ECM).

**ELECTRICAL LOAD SIG**

ON/OFF status of the ELS input signal to the ECM. Signal will be ON whenever the tail light or rear window defogger relays are energized (voltage high at ECM).

**STOP LIGHT SW**

ON/OFF status of the STP signal input to the ECM. Signal will be ON whenever the brake pedal is depressed (stop light switch closed, high voltage at ECM).

**FC IDL**

ON/OFF status of the IDL fuel cut program in the ECM. Signal will be ON whenever deceleration fuel cut is commanded as a result of closed IDL contact with engine rpm above fuel cut speed.

**FC TAU**

ON/OFF status of the deceleration enleanment program in the ECM. Signal will be ON whenever deceleration enleanment is commanded as a result of rapid deceleration taking place with the IDL switch contact open.

**(MISFIRE) CYL #1 - 8**

Percentage of time each individual cylinder is detected misfiring during a specified ignition event detection cycle (see IGNITION). For example, cylinder #2 is detected misfiring 1500 times during a 3000 event detection cycle. MISFIRE CYL#2 will read 50%.

Maximum possible misfire per cylinder is 100%.

## **IGNITION**

Ignition event counter, which is used to determine the percentage of ignition, misfire occurring. This counter resets every 3000 ignition cycles on a 6 cylinder engine, every 2000 ignition cycles on a 4 cylinder engine, and every 4000 ignition cycles on an 8 cylinder engine.

## **EGRT GAS**

Temperature of exhaust gas (in degrees Fahrenheit or Celsius) passing into the intake manifold through the EGR valve (measured on the intake side of the valve.) Value is determined by comparing the THG voltage signal to corresponding temperatures in a look-up table.

## **INTAKE CTRL VSV**

ON/OFF status of the ACIS VSV, which controls the vacuum supply to the ACIS, vacuum actuator. Signal will be ON whenever the VSV is energized (voltage low at ECM) and vacuum is being passed to the ACIS actuator.

## **EGR SYSTEM**

ON/OFF status of the EGR system. Signal will indicate ON whenever EGR system is operating and will indicate OFF whenever VSV is energized preventing/bleeding vacuum flow to EGR valve and modulator. When VSV is energized, EGR system is off and when VSV is de-energized, EGR system is on.

## **FUEL PRES UP VSV**

ON/OFF status of the FPU VSV which controls the vacuum bleed in the manifold vacuum line to the fuel pressure regulator. Signal will be ON whenever the VSV is energized, bleeding atmosphere into the fuel pressure regulator vacuum chamber.

## **A/C CUT SIG**

ON/OFF status of A/C cutoff (ACT) signal from ECM to A/C amplifier. Signal is ON (low voltage at ECM) whenever A/C compressor cut is requested as a result of wide open throttle operation.

**A/C IDLE UP VSV**

ON/OFF status of A/C idle up VSV which controls the A/C idle up air bypass. Signal is ON whenever (low voltage at ECM) whenever the A/C magnetic clutch is energized.

**TOTAL FT (B1 and B2)**

Total fuel trim correction to injectors feeding cylinder banks 1 and 2 respectively. Nominal value is 1.00. Values less than 1.00 indicate reduction in fuel injection duration to correct for overall rich condition. Values greater than 1.00 indicate increase in fuel injection duration to correct for overall lean condition. This number remains fairly stable.

**O2 L→R (B1, S1 and B2, S1)**

O2 sensor switch time from lean to rich, displayed in milliseconds. Affected by the age and condition of the O2 sensor.

**O2 R→L (B1, S1 and B2, S1)**

O2 sensor switch time from rich to lean, displayed in milliseconds. Affected by the age and condition of the O2 sensor.

Certain types of O2S contamination or degradation effect the switching time more significantly from rich to lean (or vise versa).

**OBD Data INJECTOR  
Stream**

**Parameter** Calculated injection time in milliseconds. Time that fuel injector is open,  
**Definitions** delivering fuel.

**IGNITION**

Ignition spark advance angle in addition to base timing (determined by distributor position) referenced to #1 cylinder Top Dead Center. Calculated by comparing the relationship between the NE and G signals.

**ISC STEP #**

Commanded position of the idle air control pintle valve. Value represents valve position relative to the fully closed position. 125 steps indicate valve is fully retracted (maximum by-pass air). Zero steps indicate fully closed or seated valve position.

ECM will command step position changes until actual engine speed is within 50 rpm of target idle speed. Therefore, if the valve is mechanically incapable of moving, commanded valve position will continue to change until zero or 125 steps is reached.

**ENGINE SPD**

Engine revolutions per minute calculated by comparing the NE signal with the ECM internal clock.

**AIRFLOW (Karman)**

Volume of air entering the intake manifold (measured with the Karman vortex air flow meter). The Karman sensor generates a variable frequency signal, which increases as intake air volume increases. Signal value is expressed in milliseconds; the time between these frequency pulses. As signal frequency increases, the time between signals decreases. Signal time is calculated by comparing the pulse train generated by the sensor to the clock in the ECM.

**AIRFLOW (VAF[VS])**

Volume of air entering the intake manifold (measured with the Volume Air Flow meter). Airflow meter voltage signal is converted from analog to digital for use by the ECM then changed back to an analog voltage for display on the serial data stream. On OBD equipped vehicles, signal voltage decreases as intake air volume increases.

**INTAKE MAN**

Manifold Absolute Pressure, displayed as pressure in mmHg (millimeters of mercury), in. Hg, or Kilopascals. Signal value is determined by comparing the PIM voltage signal to corresponding pressures in a look-up table. As load is applied to the engine, manifold pressure increases (approaching atmospheric pressure.)



**COOLANT**

Temperature of the engine coolant displayed in degrees Fahrenheit or Celsius. Value determined by comparing the THW voltage signal to corresponding temperatures in a look-up table.

**THROTTLE**

Position of the throttle valve displayed in degrees of throttle angle opening. Some OBD applications display this value in steps, skipping several degrees between each position update. Value is determined by comparing VTA voltage to corresponding value in a look-up table. Typical signal range is between 0° at closed throttle, 70° to 80° at wide open throttle.

**VEHICLE SPD**

Vehicle road speed displayed in miles or kilometers per hour. Calculated by comparing the pulsed vehicle speed sensor signal with the ECM internal clock.

**TARGET A/F (L AND R)**

Learned value (adaptive memory) correction to A/F Ratio feedback control system (based on left and right main O2 sensors respectively). Displayed as a zero to five volt signal, which changes in 1.25 volt steps. Neutral value (no feedback correction) is displayed as 2.50V. Voltage lower than neutral indicates fuel delivery is being decreased to correct for a rich A/F Ratio. Voltage higher than neutral indicates fuel delivery is being increased to correct for a lean A/F Ratio.

Learned value correction is similar to OBD II LONG FT, maximum possible correction is  $\pm 20\%$  of basic injection duration. For example:

Case #1 TARGET A/F = 2.50V

VAF = 2.7V

ENGINE SPD = 800 rpm

INJECTOR = 4.0 ms

Case #2 TARGET A/F = 5.0V

VAF = 2.7V

ENGINE SPD = 800 rpm

INJECTOR = 4.8 ms

**A/F FB (L AND R)**

The same as OBD II FUEL SYS. A/F Ratio feedback loop status (for left and right cylinder banks respectively), displayed as either OFF (open loop) or ON (closed loop.) Open loop indicates that the ECM ignores feedback from the exhaust O2 sensor and relies on other major sensors to determine final injection pulse width (i.e. intake air volume or mass, engine rpm, and coolant temperature.) When in closed loop, Ox SIGNAL values should be constantly variable.

**KNOCK RETARD**

ON/OFF status of knock retard system operation. Indicates ON whenever detonation is sensed and knock retard is being commanded.

**STA SIGNAL**

Same as OBD II STARTER SIG. ON/OFF status of the STA signal at the ECM. Signal will be ON whenever the ignition switch is in the START position (voltage high at ECM).

**IDL SIGNAL**

Same as OBD II CTP SW. ON/OFF status of IDL contact. Signal will be ON whenever the throttle is fully closed and the IDL switch contact is closed (voltage low at ECM).

**A/C SIGNAL**

Same as OBD II A/C SIG. ON/OFF status of the A/C magnetic clutch input to the ECM. Signal will be ON anytime the air conditioning compressor clutch is energized (voltage low at ECM). Signal will cycle OFF whenever compressor cycles off due to low evaporator temperature.

**NSW SIGNAL**

Same as OBD II NEUTRAL SAFETY (PNP) SW. (A/T only) ON/OFF status of the neutral safety switch input to the ECM. Signal will be ON whenever the automatic transmission is in the neutral or park gear positions (voltage low at ECM).

**O<sub>x</sub> (L AND R) SIGNAL**

Similar to OBD II 02S Exhaust O<sub>2</sub> sensor signal displayed as either RICH or LEAN. High concentration of oxygen in exhaust (lean condition) causes signal display to go LEAN (less than 400 my sensor signal voltage). Low concentration of oxygen in exhaust causes signal to go RICH (greater than 600 my sensor voltage).

V-BoB **NE**  
Data Stream  
Preselected  
Parameter  
Definitions

Engine revolutions per minute calculated by comparing the NE signal with a fixed clock pulse.

**Ks**

Volume of air entering the intake manifold (measured with the Karman vortex air flow meter). The Karman sensor generates a variable frequency signal which increases as intake air volume increases. Signal value is expressed in milliseconds; the time between these frequency pulses. As signal frequency increases, the time between signals decreases. Signal time is calculated by comparing the pulse train generated by the sensor to the clock in the ECM.

**#10**

Calculated injection time in milliseconds. Time that fuel injector is open, delivering fuel.

**Vs**

Volume of air entering the intake manifold (measured with the Volume Air Flow meter). Air flow meter analog voltage signal is tapped directly from the Vs signal wire at the ECM.

**OX(L/R)**

Main exhaust O<sub>2</sub> sensor signal, displayed as either RICH or LEAN. High concentration of oxygen in exhaust (lean condition) causes signal display to go LEAN (less than 400 mv sensor signal voltage). Low concentration of oxygen in exhaust causes signal to go RICH (greater than 600 mv sensor voltage).

**OXS**

Sub-O<sub>2</sub> sensor signal, displayed as either RICH or LEAN. High concentration of oxygen in exhaust (lean condition) causes signal display to go LEAN (less than 400 mv sensor signal voltage). Low concentration of oxygen in exhaust causes signal to go RICH (greater than 600 mv sensor voltage).

**THW**

Temperature of the engine coolant displayed in degrees fahrenheit or celsius. Value determined by comparing the THW voltage signal to corresponding temperatures in a **look-up table**.

**THA**

Temperature of the intake air displayed in degrees fahrenheit or celsius. Value determined by comparing the THA voltage signal to corresponding temperatures in a **look-up table**.

**VTA**

Position of the throttle valve displayed in degrees of throttle angle opening. Value is determined by comparing VTA voltage to corresponding value in a look-up table. Typical signal range is between 0° at closed throttle, 70° to 80° at wide-open throttle.

**IDL**

ON/OFF status of IDL contact. Signal will be ON whenever the throttle is fully closed and the IDL switch contact is closed (voltage low at ECM).

**IGF**

Ignition fail signal displayed in revolutions per minute. Calculated by comparing IGF voltage pulses to fixed clock pulse.

**SPI**

Vehicle road speed displayed in miles or kilometers per hour. Calculated by comparing the pulsed vehicle speed sensor signal a fixed clock pulse.

**NSW**

(A/T only) ON/OFF status of the neutral safety switch input to the ECM. Signal will be ON whenever the automatic transmission is in the neutral or park gear positions (voltage low at ECM).

**A/C**

On applications with ACMG, this is the request signal from the A/C control assembly, which informs the ECM that magnetic clutch, should be energized.

On applications where A/C magnetic clutch is controlled by the A/C amplifier, this signal informs the ECM that the magnetic clutch is energized.

### **ACMG**

ON/OFF status of the A/C magnetic clutch control by the ECM. Signal will be ON anytime the air conditioning compressor clutch is energized (voltage low at ECM). Signal will cycle OFF whenever the ECM cycles the compressor off.

### **FPU**

ON/OFF status of the Fuel Pressure Up VSV. Signal is on when the VSV is energized (voltage low at ECM). When energized the FPU VSV bleeds atmosphere into the fuel pressure regulator vacuum chamber for hot engine restarts.

### **STA**

ON/OFF status of the STA signal at the ECM. Signal will be ON whenever the ignition switch is in the START position (voltage high at ECM).

### **STJ**

ON/OFF status of the STJ cold start injector driver circuit in the ECM. Signal will be ON during cranking whenever engine coolant temperature is below a specified threshold.

### **B**

Battery voltage sensed at +B and +B1 terminals of the ECM. Battery voltage will be present anytime the EFI main relay power contacts are closed (when ignition switch is on).

### **VC**

Voltage constant 5V sensor circuit reference voltage. Will be approximately 5V whenever the ignition is on.

### **E01**

Ground circuit for fuel injectors. Should be less than 100 millivolts with the engine running.

### **E2**

Ground circuit for ECS system sensors. Should be less than 100 millivolts with the engine running.