CORE ECU

PARAMETER GUIDE

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REVISION HISTORY

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ABOUT THIS BOOK

This guide provides descriptions for the hundreds of tunable parameters (characteristics) and viewable outputs (measurements) provided by the CORE series of ECUs.

ORGANIZATION

For ease of understanding, parameters are grouped by the software modules that employ them. Although the modules themselves are not visible in VCM Live, this organization allows closely related parameters to be grouped together.

Other than this overview, each item in the book's Table of Contents represents a software module. Headings in the TOC group the modules together by function. For example, there are two Airflow modules.

Within the documentation for each module, parameters are further divided into Tunable Parameters (Characteristics) and Measurements. Many modules also have a detailed overview to explain their operation.

ACCELERATOR PEDAL

Parameters that pertain to the accelerator pedal and the accelerator pedal position sensor.

PEDAL POSITION SENSOR 1

Parameters for accelerator pedal position sensor 1.

TUNABLE PARAMETERS (CHARACTERISTICS)

ACCELERATION PEDAL 1 (ACCEL PEDAL 1) FILTER FREQUENCY

The frequency (in Hz) of the filter applied to the signal from accelerator pedal position sensor 1.

The filter is used to smooth the signal so that momentary spikes in pedal position do not create too much fluctuation in engine output. In the simplest terms, any signal spike that occurs faster than the frequency specified here will be flattened.

NOTE: 0 = no filter.

ACCELERATION PEDAL 1 (ACCEL PEDAL 1) POSITION SCALED ENDPOINTS

This table is used to translate the voltage output by the sensor to the pedal position represented by that voltage.

The values on the table's axis represent the highest and lowest voltages output by the sensor. Enter the corresponding pedal position (%) in the cells below.

Range: 0 to 100%

ACCELERATION PEDAL 1 (ACCEL PEDAL 1) SENSOR INPUT

Specifies the pin on the ECU connector that acceleration pedal position sensor 1 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is acceleration pedal position sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ACCELERATION PEDAL POSITION 1 (ACCEL PEDAL 1) SENSOR DTC MAXIMUM

This parameter specifies the maximum acceptable value (%) received from the acceleration pedal position sensor 1.

Adjust this parameter if you wish to set a boundary beyond which the ECU will recognize a significant deviation and generate a DTC.

ACCELERATION PEDAL POSITION 1 (ACCEL PEDAL 1) SENSOR DTC MAXIMUM VOLTAGE

This parameter specifies the maximum acceptable voltage for the signal received from Acceleration Pedal Position sensor 1 (open circuit threshold). Voltages above this threshold will set a DTC.

You may want to adjust this value to an appropriate maximum for the specific sensor you are using. This prevents false error codes when the sensor voltage range significantly differs from the default range expected by the ECU.

ACCELERATION PEDAL POSITION 1 (ACCEL PEDAL 1) SENSOR DTC MINIMUM

This parameter specifies the minimum acceptable value (%) received from the Acceleration Pedal Position sensor 1. Values above this threshold will trigger a DTC.

Adjust this parameter if you wish to set a boundary beyond which the ECU will recognize a significant deviation.

ACCELERATION PEDAL POSITION 1 (ACCEL PEDAL 1) SENSOR DTC MINIMUM VOLTAGE

This parameter establishes the minimum acceptable voltage for the signal received from Acceleration Pedal Position sensor 1 (short to ground threshold). Voltages below this threshold will set a DTC.

You may want to adjust this value to an appropriate minimum for the specific sensor you are using. This prevents false error codes when the sensor voltage range significantly differs from the default range expected by the ECU.

MEASUREMENTS

ACCELERATION PEDAL 1 (ACCEL PEDAL 1) POSITION

The accelerator pedal position reported by position sensor 1 (after filtering is applied).

Range: 0 to 100%

ACCELERATION PEDAL 1 (ACCEL PEDAL 1) POSITION RAW

The raw value reported by accelerator pedal position sensor 1, before filtering is applied.

ACCELERATION PEDAL 1 (ACCEL PEDAL 1) SENSOR VOLTAGE

The voltage produced by accelerator pedal position sensor 1.

ACCELERATION PEDAL POSITION 1 (ACCEL PEDAL 1) DTC ACTIVE

If YES, a DTC has been set for acceleration pedal position sensor 1.

PEDAL POSITION SENSOR 2

Parameters for accelerator pedal position sensor 2.

TUNABLE PARAMETERS (CHARACTERISTICS)

ACCELERATION PEDAL 2 (ACCEL PEDAL 2) FILTER FREQUENCY

The frequency (in Hz) of the filter applied to the signal from accelerator pedal position sensor 2.

The filter is used to smooth the signal so that momentary spikes in pedal position do not create too much fluctuation in engine output. In the simplest terms, any signal spike that occurs faster than the frequency specified here will be flattened.

NOTE: 0 = no filter.

ACCELERATION PEDAL 2 (ACCEL PEDAL 2) POSITION SCALED ENDPOINTS

This table is used to translate the voltage output by the sensor to the pedal position represented by that voltage.

The values on the table's axis represent the highest and lowest voltages output by the sensor. Enter the corresponding pedal position (%) in the cells below.

Range: 0 to 100%

ACCELERATION PEDAL 2 (ACCEL PEDAL 2) SENSOR INPUT

Specifies the pin on the ECU connector that acceleration pedal position sensor 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is acceleration pedal position sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ACCELERATION PEDAL POSITION 2 (ACCEL PEDAL 2) SENSOR DTC MAXIMUM

This parameter specifies the maximum acceptable value (%) received from acceleration pedal position sensor 2.

Adjust this parameter if you wish to set a boundary beyond which the ECU will recognize a significant deviation and generate a DTC.

ACCELERATION PEDAL POSITION 2 SENSOR DTC MAXIMUM VOLTAGE

This parameter specifies the maximum acceptable voltage for the signal received from Acceleration Pedal Position sensor 2 (open circuit threshold). Voltages above this threshold will set a DTC.

You may want to adjust this value to an appropriate maximum for the specific sensor you are using. This prevents false error codes when the sensor voltage range significantly differs from the default range expected by the ECU.

ACCELERATION PEDAL POSITION 2 (ACCEL PEDAL 2) SENSOR DTC MINIMUM

This parameter specifies the minimum acceptable value (%) received from acceleration pedal position sensor 2.

Adjust this parameter if you wish to set a boundary beyond which the ECU will recognize a significant deviation and generate a DTC.

ACCELERATION PEDAL POSITION 2 (ACCEL PEDAL 2) SENSOR DTC MINIMUM VOLTAGE

This parameter establishes the minimum acceptable voltage for the signal received from acceleration pedal position sensor 2 (short to ground threshold). Voltages below this threshold will set a DTC.

You may want to adjust this value to an appropriate minimum for the specific sensor you are using. This prevents false error codes when the sensor voltage range significantly differs from the default range expected by the ECU.

MEASUREMENTS

ACCELERATION PEDAL 2 (ACCEL PEDAL 2) POSITION

The accelerator pedal position reported by position sensor 2 (after filtering is applied).

Range: 0 to 100%

ACCELERATION PEDAL 2 (ACCEL PEDAL 2) POSITION RAW

The raw value reported by accelerator pedal position sensor 2, before filtering is applied.

ACCELERATION PEDAL 2 (ACCEL PEDAL 2) SENSOR VOLTAGE

The voltage produced by accelerator pedal position sensor 2.

ACCELERATION PEDAL POSITION 2 (ACCEL PEDAL 2) DTC ACTIVE

If YES, a DTC has been set for acceleration pedal position sensor 2.

PEDAL SECURITY

Parameters for responding to accelerator pedal failure.

TUNABLE PARAMETERS (CHARACTERISTICS)

ACCELERATION PEDAL (ACCEL PEDAL) SECURITY THRESHOLD

Accelerator pedal position must exceed this threshold (%) to enable stuck pedal security detection.

Also, accelerator pedal position will be limited to this percentage when limp home mode is triggered by accelerator pedal failure.

ACCELERATION PEDAL (ACCEL PEDAL) SECURITY TIME

The amount of time (in seconds) that both of the following must be true in order to enable stuck pedal security:

- Brakes are active
- Accelerator pedal position is above the Acceleration Pedal (Accel Pedal) Security Threshold

MEASUREMENTS

ACCELERATION PEDAL (ACCEL PEDAL) LIMP CONTROL REQUESTED

If TRUE, the ECU has requested limp home mode due to accelerator pedal position.

ACCELERATION PEDAL (ACCEL PEDAL) SECURITY ACTIVE

If TRUE, accelerator pedal security is active. Acceleration pedal position is limited to the amount specified in Acceleration Pedal (Accel Pedal) Security Threshold.

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FINAL PEDAL POSITION

MEASUREMENTS

ACCELERATION PEDAL (ACCEL PEDAL) POSITION

The final accelerator pedal position (in %) after all filtering and adjustments have been made by the ECU.

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AIRFLOW

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Airflow can be calculated using the following methods:

- **Speed Density.** See *Speed Density* (Page 29)
- **Mass Airflow.** See *Mass Airflow Sensor (MAF)* (Page 91)
- **Hybrid.** The engine will transition from mass airflow mode to speed density mode (and vice versa). Both options above must be configured. Also, the switching behavior for this option is configured in the Final Airflow module. See *Final Airflow* (Page 21)

The method used is specified with the Airflow Calculation Mode parameter in the Final Airflow module. See *Airflow Calculation Mode* (Page 21)

Additionally, Final Airflow contains a number of other parameters related to the calculation of the final airflow values to be used See *Final Airflow* (Page 21).

FINAL AIRFLOW

Final airflow parameters.

TUNABLE PARAMETERS (CHARACTERISTICS)

AIRFLOW CALCULATION MODE

The option selected here sets the airflow calculation mode:

- **Speed Density.** Mass airflow will be calculated using speed density methods. The calculation is based on engine speed and Manifold Absolute Pressure (MAP) gathered from the sensors as well as the values in the Volumetric Efficiency tables. Mass Airflow Estimated is the result of these calculations.
- **Mass Airflow.** Mass airflow will be measured by the Mass Airflow (MAF) sensor. Mass Airflow Calculated contains the sensor reading after processing.
- **Hybrid.** The engine will transition from mass airflow mode to speed density mode (and vice versa) based on current engine speed, mass airflow, manifold absolute pressure, and/or throttle position. The direction of switching is determined by the *Hybrid Switching Mode* (Page 23). The Hybrid Switching Mode and the various Hybrid Threshold values determine WHEN mode switching occurs. Hybrid Mass Airflow contains the combined value.

The result of the selected method will be used for Mass Airflow Filtered.

ENGINE SPEED HYBRID THRESHOLD

In hybrid mode, this is the engine speed (in rpm) that serves as a threshold between mass airflow mode and speed density mode.

- A switch to the "upper" of these two modes may be triggered when engine speed increases beyond this threshold.
- A switch back to the "lower" of these two modes may be triggered when engine speed falls below this value minus Engine Speed Hybrid Threshold Hysteresis.

Range: 0 -10,000 rpm

ENGINE SPEED HYBRID THRESHOLD HYSTERESIS

In hybrid mode, this is the engine speed (in rpm) that serves as a hysteresis (mode switching delay) between mass airflow mode and speed density mode.

A switch from the "upper" to the "lower" of these two modes may be triggered when engine speed falls below the Engine Speed Hybrid Threshold minus this value.

Higher values prevent frequent switching back and forth between modes when engine speed hovers near the threshold.

Range: 0 - 1000 rpm

HYBRID MASS AIRFLOW FILTER COEFFICIENT

When in hybrid mode, a filter can be applied to the blended airflow. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

0 and 1 themselves have special meanings:

- **1** - output unfiltered signal (the output signal is equal to input signal).
- **0** - output null signal (not recommended).

HYBRID MODE BLENDING STEP

In hybrid mode, this specifies the speed at which mass airflow calculation transitions from speed density to MAF (and vice versa). During the transition, values are blended.

Higher values increase the speed of the blended transition. Lower values decrease the speed.

Range: 0.001 - 1

HYBRID MODE SWITCHING BEHAVIOR

In hybrid mode, The option selected here specifies the behavior of the switching between MAF and speed density:

- **Lower All, Upper Single** - Switch from lower mode to upper mode if any single value exceeds its corresponding threshold. Switch from upper mode to lower mode if all values fall below their corresponding thresholds (minus the corresponding hysteresis).
- **Lower Single, Upper All** - Switch from lower mode to upper mode if all values exceed their corresponding thresholds. Switch from upper mode to lower mode if any single value falls below its corresponding threshold (minus the hysteresis).

> **NOTE:** The Hybrid Switching Mode parameter specifies which mode (MAF or speed density) is the "upper" mode and which is the "lower" mode.

HYBRID SWITCHING MODE

In hybrid mode, the option selected here specifies which method of determining mass airflow is the "upper" mode and which is the "lower" mode:

- **Mass Airflow To Speed Density** - MAF mode is used below the threshold(s) and SD above (SD is upper mode).
- **Speed Density To Mass Airflow** - SD mode is used below the threshold(s) and MAF mode above (MAF is upper mode).

MASS AIRFLOW TO SPEED DENSITY

This is the binary form of the Hybrid Switching Mode parameter. The binary value here indicates which of the two options is selected.

MANIFOLD ABSOLUTE PRESSURE HYBRID THRESHOLD

In hybrid mode, this is the manifold absolute pressure that serves as a threshold between mass airflow mode and speed density mode.

- A switch to the "upper" of these two modes may be triggered when manifold absolute pressure increases beyond this threshold.
- A switch back to the "lower" of these two modes may be triggered when manifold absolute pressure falls below this value minus Manifold Abs Pressure Hybrid Threshold Hysteresis.

Range: 0 - 300 kPa

> **NOTE:** The Hybrid Switch Mode parameter specifies which mode (MAF or speed density) is the "upper" mode and which is the "lower" mode.

> **NOTE:** Mode transition may require that other thresholds be reached as well. See description for Hybrid Mode Switching Behavior.

MANIFOLD ABSOLUTE PRESSURE HYBRID THRESHOLD HYSTERESIS

In hybrid mode, this is the manifold absolute pressure that serves as a hysteresis (mode switch delay) between mass airflow mode and speed density mode.

A switch from the "upper" to the "lower" of these two modes may be triggered when manifold absolute pressure falls below the Manifold Abs Pressure Hybrid Threshold minus this value.

Higher values prevent frequent switching back and forth between modes when manifold absolute pressure remains near the threshold.

Range: 0 - 100 kPa

> **NOTE:** The Hybrid Switch Mode parameter specifies which mode (MAF or speed density) is the "upper" mode and which is the "lower" mode.

> **NOTE:** Mode transition may require that other hysteresis values be reached as well. See description for Hybrid Mode Switching Behavior.

MASS AIRFLOW FILTER COEFFICIENT

This table specifies the mass airflow filter coefficient as a function of engine speed. When in MAF mode, a filter can be applied to the mass airflow signal. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

0 and 1 themselves have special meanings:

- **1** - do not filter the output signal (the output signal is equal to input signal).
- **0** - output null signal (not recommended).

MASS AIRFLOW HYBRID THRESHOLD

In hybrid mode, this is the mass airflow that serves as a threshold between mass airflow mode and speed density mode.

- A switch to the "upper" of these two modes may be triggered when mass airflow increases beyond this threshold.
- A switch back to the "lower" of these two modes may be triggered when mass airflow falls below this value minus Mass Airflow Hybrid Threshold Hysteresis.

Range: 0 - 2000 g/s

> **NOTE:** The Hybrid Switch Mode parameter specifies which mode (MAF or speed density) is the "upper" mode and which is the "lower" mode.

> **NOTE:** Mode transition may require that other thresholds be reached as well. See description for Hybrid Mode Switching Behavior.

MASS AIRFLOW HYBRID THRESHOLD HYSTERESIS

In hybrid mode, this is the mass airflow that serves as a hysteresis (mode switch delay) between mass airflow mode and speed density mode.

A switch from the "upper" to the "lower" of these two modes may be triggered when mass airflow falls below the Mass Airflow Hybrid Threshold minus this value.

Higher values prevent frequent switching back and forth between modes when mass airflow remains near the threshold.

Range: 0 - 100 g/s

> **NOTE:** The Hybrid Switch Mode parameter specifies which mode (MAF or speed density) is the "upper" mode and which is the "lower" mode.

> **NOTE:** Mode transition may require that other hysteresis values be reached as well. See description for Hybrid Mode Switching Behavior.

THROTTLE POSITION HYBRID THRESHOLD

In hybrid mode, this is the throttle position (%) that serves as a threshold between mass airflow mode and speed density mode.

- A switch to the "upper" of these two modes may be triggered when throttle position increases beyond this threshold.
- A switch back to the "lower" of these two modes may be triggered when throttle position falls below this value minus Throttle Position Hybrid Threshold Hysteresis.

Range: 0 - 100%

> **NOTE:** The Hybrid Switch Mode parameter specifies which mode (MAF or speed density) is the "upper" mode and which is the "lower" mode.

THROTTLE POSITION HYBRID THRESHOLD HYSTERESIS

In hybrid mode, this is the amount of throttle (%) that serves as a hysteresis (mode switch delay) between mass airflow mode and speed density mode.

A switch from the "upper" to the "lower" of these two modes may be triggered when throttle position falls below the Throttle Position Hybrid Threshold minus this value.

Higher values prevent frequent switching back and forth between modes when throttle position remains near the threshold.

Range: 0 - 100%

> **NOTE:** The Hybrid Switch Mode parameter specifies which mode (MAF or speed density) is the "upper" mode and which is the "lower" mode.

> **NOTE:** Mode transition may require that other hysteresis values be reached as well. See description for Hybrid Mode Switching Behavior.

MEASUREMENTS

VOLUMETRIC EFFICIENCY

The volumetric efficiency obtained by referencing the current engine speed and manifold absolute pressure in the Volumetric Efficiency tables.

HYBRID MASS AIRFLOW

When in hybrid mode, this indicates the estimated mass airflow derived from blending the speed density calculated airflow with the out put from the MAF sensor (in g/s or lb/min).

LOWER TO UPPER TRANSITION REQUESTED

(Hybrid Mode) If this flag is TRUE, the transition from "lower" to "upper" mode of airflow calculation has been requested.

CYLINDER AIRMASS

Indicates the calculated airmass for a single cylinder (in g).

CYLINDER AIRMASS DELTA

The rate at which the mass of air entering an engine cylinder changes during the intake phase, measured in grams per 20 cylinder cycles.

MASS AIRFLOW FILTERED

The mass airflow (in g/s or lb/min) after blending and other adjustments are applied. This is the MAF value used to calculate cylinder airmass.

SPEED DENSITY

Parameters for speed density.

TUNABLE PARAMETERS (CHARACTERISTICS)

CRANKING TO RUNNING SD CORRECTION STARTUP DELAY

The delay (in seconds) for the transition from cranking speed density correction to running speed density correction.

Range: 0 - 10 seconds

CRANKING VOLUMETRIC EFFICIENCY BAROMETRIC PRESSURE MULTIPLIER

This table defines the volumetric efficiency correction (%) during engine cranking as a function of barometric pressure.

Range: 0 - 31%

CRANKING VOLUMETRIC EFFICIENCY

This table defines the volumetric efficiency (%) while the engine is cranking as a function of manifold absolute pressure and engine speed.

Range: 0 - 100%

CYLINDER CHARGE TEMPERATURE BIAS

This table defines the cylinder charge temperature bias (%) as a function of the uncorrected mass airflow estimate. This percentage is applied to the uncorrected charge temperature in order to obtain the cylinder charge temperature that's fed into the Speed Density Charge Temperature Correction table.

Cell data range: 0 - 31%

SPEED DENSITY AIRFLOW FILTER COEFFICIENT

When in speed density mode, a filter can be applied to the calculated speed density signal. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

0 and 1 themselves have special meanings:

- **1** - do not filter output signal (output signal is equal to output signal).
- **0** - output null signal. Not recommended.

SPEED DENSITY CHARGE TEMPERATURE CORRECTION

This table defines speed density cylinder charge temperature correction based on cylinder charge temperature and manifold absolute pressure.

Cell data range: -100% to 100%

VOLUMETRIC EFFICIENCY BAROMETRIC PRESSURE MULTIPLIER

This table defines an adjustment to the engine's volumetric efficiency based on changes in barometric pressure. This multiplier is applied to the volumetric efficiency calculation to account for variations in atmospheric pressure.

When the barometric pressure is lower, indicating higher altitude or adverse weather conditions, the air is less dense. To compensate for this, the Volumetric Efficiency Barometric Pressure Multiplier is used to adjust the calculated volumetric efficiency.

Cell data range: 0 to 31%

VOLUMETRIC EFFICIENCY (MAP #1)

This is one of four maps that define volumetric efficiency (%) as a function of manifold absolute pressure and engine speed. This map will be used when Volumetric Efficiency Map Selected equals 1.

Cell data range: 0 - 200%

VOLUMETRIC EFFICIENCY MAP #2

This is one of four maps that define volumetric efficiency (%) as a function of manifold absolute pressure and engine speed. This map will be used when Volumetric Efficiency Map Selected equals 2.

Cell data range: 0 - 200%

VOLUMETRIC EFFICIENCY MAP #3

This is one of four maps that define volumetric efficiency (%) as a function of manifold absolute pressure and engine speed. This map will be used when Volumetric Efficiency Map Selected equals 3.

Cell data range: 0 - 200%

VOLUMETRIC EFFICIENCY MAP #4

This is one of four maps that define volumetric efficiency (%) as a function of manifold absolute pressure and engine speed. This map will be used when Volumetric Efficiency Map Selected equals 4.

Cell data range: 0 - 200%

VOLUMETRIC EFFICIENCY MAP SELECT

Use this parameter to specify the volumetric efficiency map to be used. (1, 2, 3 or 4)

MEASUREMENTS

CYLINDER CHARGE TEMPERATURE

Indicates the temperature of the air mass at the cylinder intake port.

> **NOTE:** This is calculated based on intake air temperature and engine coolant temperature rather than directly measured.

SPEED DENSITY CORRECTION

Indicates the amount (%) of correction applied to the Uncorrected Estimated Mass Airflow to get the Estimated Mass Airflow (the final output of speed density calculations).

This is obtained by plugging the current cylinder charge temperature and manifold absolute pressure into the Speed Density Charge Temperature Correction table.

SPEED DENSITY CORRECTION BIAS ACTIVE

If TRUE, then Speed Density Correction Bias is active.

MASS AIRFLOW ESTIMATED

The mass airflow value (in g/s or lb/min) that is produced by speed density calculations. This is produced by applying charge temperature corrections to the Uncorrected Estimated Mass Airflow.

> **NOTE:** The corrections applied are defined in the Cylinder Charge Temperature Bias table and the Speed Density Charge Temperature Correction table.

MASS AIRFLOW CALCULATED

The mass airflow reading from the mass airflow sensor (in g/s or lb/min).

- If Airflow Calculation Mode is set to **Mass Airflow**, the final Cylinder Airmass will be determined based on this value (as well as engine speed and cylinder count).
- If Airflow Calculation Mode is set to **Hybrid**, this value is combined with the Estimated Mass Airflow from speed density calculations.

UNCORRECTED ESTIMATED MASS AIRFLOW

The uncorrected estimated mass airflow. The mass airflow produced by looking up the appropriate value in the volumetric efficiency tables.

To get the Estimated Mass Airflow that will be the output of speed density calculations, the Speed Density Correction percentage must be applied to this value.

VOLUMETRIC EFFICIENCY

The volumetric efficiency (%). This is copied from the currently-selected volumetric efficiency map.

VOLUMETRIC EFFICIENCY MAP SELECTED

Indicates which volumetric efficiency map is currently selected.

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BOOST

BOOST CONTROL DEMAND

This module affects how much of the time the wastegate solenoid in the turbocharger is open (100% equals maximum boost). This value is called Wastegate Duty Cycle (WGDC).

Although the target value for WGDC is set by the Boost Control Regulation module, Boost Control Demand is responsible for applying corrections to WGDC based on factors such as barometric pressure, intake air temperature, and drive gear index.

TUNABLE PARAMETERS (CHARACTERISTICS)

NITROUS DEACTIVATION BOOST CONTROL DUTY CYCLE CUT DELAY

This parameter manages the interaction between the nitrous oxide system and the boost control system. Specifically, it specifies a delay in modifying the boost control duty cycle when deactivating the nitrous system. This delay may be implemented to ensure a smooth transition, prevent sudden changes in boost pressure, or address other considerations related to the engine's response during the deactivation of the nitrous system. This parameter also monitors the number of cylinder cycles that is required to observe the boost control duty cycle cut after nitrous deactivation.

Range: 0 to 600 seconds

WASTEGATE ACTUATOR #1 OUTPUT

Specifies the pin on the ECU connector that wastegate actuator 1 is wired to.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "Low Side Drivers." Selecting a low side driver tells the ECU which of these outputs is assigned to wastegate actuator 1 source.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

WASTEGATE ACTUATOR #1 OUTPUT FREQUENCY

Specifies the output frequency for wastegate actuator 1.

Range: 0 to 2000 Hz

WASTEGATE ACTUATOR #2 DUTY CYCLE CORRECTION

This table specifies a correction to boost control wastegate actuator 2 duty cycle based on manifold relative pressure and engine speed.

WASTEGATE ACTUATOR #2 OUTPUT

Specifies the pin on the ECU connector that wastegate actuator 2 is wired to.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "Low Side Drivers." Selecting a low side driver tells the ECU which of these outputs is assigned to wastegate actuator 2 source.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

WASTEGATE ACTUATOR #2 OUTPUT FREQUENCY

Specifies the output frequency for wastegate actuator 2.

Range: 0 to 2000 Hz

WASTEGATE DUTY CYCLE #1 BAROMETRIC PRESSURE CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #1. This is the correction due to barometric pressure.

WASTEGATE DUTY CYCLE #1 ENGINE COOLANT TEMPERATURE CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #2. This is the correction due to engine coolant temperature.

Cell data range: -100% to 200%

WASTEGATE DUTY CYCLE #1 GEAR CORRECTION

This table specifies an amount of correction that will be applied to the wastegate duty cycle for turbo charger #1 (i.e. left turbo). This correction is based on drive gear index.

Cell data range: -100% to 200%

WASTEGATE DUTY CYCLE #1 INTAKE AIR TEMPERATURE CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #1. This is the correction due to intake air temperature.

Cell data range: -100% to 200%

WASTEGATE DUTY CYCLE #2 BAROMETRIC PRESSURE CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #2. This is the correction due to barometric pressure.

WASTEGATE DUTY CYCLE #2 ENGINE COOLANT TEMPERATURE CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #2. This is the correction due to engine coolant temperature.

Range: -100% to 200%

WASTEGATE DUTY CYCLE #2 GEAR CORRECTION

This table specifies an amount of correction that will be applied to the wastegate duty cycle for turbo charger #2 (i.e. right turbo). This correction is based on drive gear index.

Range: -100 to 200

WASTEGATE DUTY CYCLE #2 INTAKE AIR TEMPERATURE CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #2. This is the correction due to intake air temperature.

Range: -100% to 200%

WASTEGATE DUTY CYCLE MAXIMUM

Specifies the maximum allowable value for wastegate (boost control) duty cycle.

Range: 0 to 100%

WASTEGATE DUTY CYCLE MINIMUM

Specifies the minimum allowable value for wastegate (boost control) duty cycle.

Range: 0 to 100%

WASTEGATE ACTUATOR OUTPUT INVERTED

Set this to YES if the wastegate actuator signal is inverted (when wastegate actuator increases, the voltage from the actuator decreases).

MEASUREMENTS

WASTEGATE ACTUATOR #1 DUTY CYCLE

Indicates the current duty cycle (%) of wastegate actuator #1.

WASTEGATE ACTUATOR #1 OUTPUT STATUS

The output status of wastegate actuator #1.

WASTEGATE ACTUATOR #2 DUTY CYCLE

Indicates the current duty cycle (%) of the wastegate actuator for turbo charger #2 (i.e. left turbo).

WASTEGATE ACTUATOR #2 OUTPUT STATUS

The output status of wastegate actuator #2.

WASTEGATE DUTY CYCLE #1 BAROMETRIC CORRECTION

Indicates the amount (%) of correction applied to the duty cycle for wastegate actuator #1, due to barometric pressure.

WASTEGATE DUTY CYCLE #1 ENGINE COOLANT TEMPERATURE CORRECTION

Indicates the amount (%) of correction applied to the duty cycle for wastegate actuator #1, due to engine coolant temperature.

WASTEGATE DUTY CYCLE #1 GEAR CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #2. This correction is based on the drive gear index.

WASTEGATE DUTY CYCLE #1 INTAKE AIR TEMPERATURE CORRECTION

Indicates the amount (%) of correction applied to the duty cycle for wastegate actuator #1, due to intake air temperature.

WASTEGATE DUTY CYCLE #2 BAROMETRIC CORRECTION

Indicates the amount of correction applied to the duty cycle for wastegate actuator #2, due to barometric pressure.

WASTEGATE DUTY CYCLE #2 ENGINE COOLANT TEMPERATURE CORRECTION

Indicates the amount (%) of correction applied to the duty cycle for wastegate actuator #2, due to engine coolant temperature.

WASTEGATE DUTY CYCLE #2 GEAR CORRECTION

This table specifies an amount of correction applied to the duty cycle for wastegate actuator #2. This correction is based on the drive gear index.

WASTEGATE DUTY CYCLE #2 INTAKE AIR TEMPERATURE CORRECTION

Indicates the amount (%) of correction applied to the duty cycle for wastegate actuator #2, due to intake air temperature.

BOOST CONTROL REGULATION

Boost control regulation parameters.

TUNABLE PARAMETERS (CHARACTERISTICS)

BOOST CONTROL CLOSED LOOP MAXIMUM

This parameter specifies the maximum limit or threshold set for the closed-loop control system that manages boost. This parameter determines the highest boost level that the closed-loop system is allowed to target and maintain.

Range: 0 to 100%

BOOST CONTROL CLOSED LOOP MINIMUM

This parameter specifies the minimum limit or threshold set for the closed-loop control system that manages boost. This parameter determines the lowest boost level that the closed-loop system is allowed to target and maintain.

Range: -100 to 0%

BOOST CONTROL INTEGRAL DEADBAND

If Boost Pressure Error is less than this value, it will be treated as zero error when updating the Boost Control Integral Term. (In other words, the Integral Term will not change this cycle because the error is effectively zero.)

This defines a range around the target boost pressure (Boost Pressure Setpoint) within which the integral term does not actively contribute to adjustments and has the effect of freezing the integral term when manifold relative pressure nears the target.

Range: 0 to 10 kPa.

BOOST CONTROL INTEGRAL GAIN

This table defines boost control integral gain as a function of Boost Pressure Error. The gain specified here influences how aggressively the integral term in the boost pressure control loop responds to accumulated boost pressure errors.

When calculating the integral term, this value is multiplied by the Boost Pressure Error, which is then multiplied by 0.01 seconds (the time period between each calculation of the integral term). The resulting value is added to the integral term from the previous cycle.

Cell data range:-1,000 to 1,000 %/kPa/s

BOOST CONTROL INTEGRAL RESET REQUEST

Setting this parameter to TRUE forces the Boost Control Integral Term to the value specified in Boost Control Integral Reset Value.

This may be useful during the tuning process if the integral term grows increasingly large in magnitude rather than converging on zero as intended.

BOOST CONTROL INTEGRAL RESET VALUE

If an integral term reset is triggered (by setting Boost Control Integral Term Reset Request to TRUE), the integral term will be reset to this value.

Range: -100 to 100 %

BOOST CONTROL INTEGRAL TERM MAXIMUM

Specifies the maximum allowable value for the Boost Control Integral Term. This value will be used as the Integral Term if the calculated Integral Term exceeds it.

Range 0 to 100%

BOOST CONTROL INTEGRAL TERM MINIMUM

Specifies the largest allowable NEGATIVE value for the Boost Control Integral Term. This value will be used as the integral term if the calculated value for the integral term is a larger negative number.

Range -100 to 0%

BOOST CONTROL MANIFOLD RELATIVE PRESSURE THRESHOLD

Specifies the relative manifold pressure. Values above this will activate boost control.

BOOST CONTROL MANIFOLD RELATIVE PRESSURE THRESHOLD HYSTERESIS

If boost control manifold relative pressure falls below Boost Control Manifold Relative Pressure Threshold minus this value, deactivate boost control.

BOOST CONTROL MODE

Specifies whether boost control operates as an open loop system or a closed loop system.

- In closed loop mode, the Boost Control module creates a feedback loop, utilizing the proportional and integral terms to help maintain the target boost level.
- In open loop mode, the Boost Control module simply outputs the amount of boost specified in the Open Loop Wastegate Duty Cycle maps.

BOOST CONTROL PROPORTIONAL GAIN

This table defines boost control proportional gain as a function of Boost Pressure Error. The gain specified here influences how aggressively the proportional term in the boost pressure control loop responds to boost pressure error.

To calculate the proportional term, the value from this table is multiplied by the Boost Pressure Error.

Cell data range:-100 to 100 %/kPa

BOOST CONTROL PROPORTIONAL TERM MAXIMUM

Specifies the maximum allowable value for the Boost Control Proportional Term. This value will be used as the Proportional Term if the calculated Proportional Term exceeds it.

Range 0 to 100%

BOOST CONTROL PROPORTIONAL TERM MINIMUM

Specifies the largest allowable NEGATIVE value for the Boost Control Proportional Term. This value will be used as the proportional term if the calculated value for the proportional term is a larger negative number.

Range -100 to 0%

OPEN LOOP WASTEGATE DUTY CYCLE (MAP #1)

This is 1 of 4 tables that determine the percentage of time the wastegate actuator is open as a function of engine speed and manifold absolute pressure. This table is used when Boost Control Map Selected equals 1.

> **NOTE:** Use the same table as wastegate (boost control) feed forward duty cycle when closed loop boost control is active.

Range: 0 to 100 %

OPEN LOOP WASTEGATE DUTY CYCLE MAP #2

This is 1 of 4 tables that determine the percentage of time the wastegate actuator is open as a function of engine speed and manifold absolute pressure. This table is used when Boost Control Map Selected equals 2.

> **NOTE:** Use the same table as wastegate (boost control) feed forward duty cycle when close loop boost control is active.

Range: 0 to 100 %

OPEN LOOP WASTEGATE DUTY CYCLE MAP #3

This is 1 of 4 tables that determine the percentage of time the wastegate actuator is open as a function of engine speed and manifold absolute pressure. This table is used when Boost Control Map Selected equals 3.

> **NOTE:** Use the same table as wastegate (boost control) feed forward duty cycle when close loop boost control is active.

Range: 0 to 100 %

OPEN LOOP WASTEGATE DUTY CYCLE MAP #4

This is 1 of 4 tables that determine the percentage of time the wastegate actuator is open as a function of engine speed and manifold absolute pressure. This table is used when Boost Control Map Selected equals 4.

> **NOTE:** Use the same table as wastegate (boost control) feed forward duty cycle when close loop boost control is active.

Range: 0 to 100 %

MEASUREMENTS

BOOST CONTROL ACTIVE

If TRUE, boost control is active. The ECU is actively adjusting the boost pressure.

BOOST CONTROL INTEGRAL TERM

One of two component values that are used to calculate the correction that will be applied to reduce Boost Pressure Error.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term.

The integral term is based on of the Boost Pressure Error over time. Each time throttle position error is calculated:

1. The error is multiplied by Boost Control Integral Gain, which is then multiplied by the task time (0.01 seconds).
2. The result is added to the previous Boost Control Integral Term, resulting in a new value for the integral term.

BOOST CONTROL PROPORTIONAL TERM

One of two component values that are used to calculate the correction that will be applied to reduce Boost Pressure Error.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term.

The proportional term is directly proportional to the amount of error observed.

BOOST PRESSURE ERROR

Indicates the degree discrepancy between the target boost pressure set by the ECU (Boost Pressure Setpoint) and the actual boost pressure being achieved.

> **NOTE:** Boost pressure error ranges between -300 to 300 kPa. In most cases the boost pressure error can be calculated by subtracting the boost pressure setpoint and the manifold relative pressure (boost pressure setpoint - manifold relative pressure).

CLOSE LOOP BOOST CONTROL ACTIVE

If TRUE, the ECU is actively using real-time sensor feedback to adjust and regulate the boost pressure.

OPEN LOOP WASTEGATE DUTY CYCLE

If the boost control module is operating in open loop mode, this is the actual wastegate duty cycle output by the module.

If the boost control module is operating in closed loop mode, this is the target wastegate duty cycle that the boost control module is attempting to maintain.

NOTE: This value is copied from the open loop duty cycle map that is selected using Boost Control Map Select.

WASTEGATE DUTY CYCLE REQUESTED

Indicates the percentage the wastegate should be open, as commanded by the ECU. Too little wastegate duty cycle might lead to excessive boost pressure, risking engine damage, while too much might result in insufficient boost, reducing performance.

BOOST PRESSURE TARGET

This module is responsible for calculating the target boost pressure that boost control should attempt to maintain. This is called Boost Pressure Setpoint.

TUNABLE PARAMETERS (CHARACTERISTICS)

BOOST CONTROL MAP SELECT

Use this parameter to specify which of the boost control maps will be used. This allows rapid switching between up to four different stored configurations. For example, a tuner might set up different boost control maps for normal driving, high-performance scenarios, or fuel efficiency, allowing the driver to switch between them based on their preferences or driving needs.

This parameter controls map selection for:

- Boost pressure setpoint
- Open loop boost control duty cycle
- Over boost hard limiter threshold/hysteresis
- Over boost hard limiter cut delay

BOOST PRESSURE SETPOINT BAROMETRIC PRESSURE CORRECTION

This table specifies a correction to the target boost pressure in response to the barometric pressure.

Cell data range: -100 to 200%

BOOST PRESSURE SETPOINT ENGINE COOLANT TEMPERATURE CORRECTION

This table specifies a correction to the target boost pressure in response to the engine's coolant temperature.

Cell data range: -100 to 200%

BOOST PRESSURE SETPOINT GEAR CORRECTION

This table specifies an adjustment to the target boost pressure levels based on the active gear. For example, tuners may choose to increase boost pressure in higher gears.

BOOST PRESSURE SETPOINT INTAKE AIR TEMPERATURE CORRECTION

This table specifies an adjustment to the target boost pressure level based on the intake air temperature.

Cell data range: -100 to 200%

BOOST PRESSURE SETPOINT (MAP #1)

This is one of four tables that define the target boost pressure. This table will be used when Boost Pressure Map Selected equals 1.

Cell data range: 0 to 300 kPa

BOOST PRESSURE SETPOINT MAP #2

This is one of four tables that define the target boost pressure. This table will be used when Boost Pressure Map Selected equals 2.

Cell data range: 0 to 300 kPa

BOOST PRESSURE SETPOINT MAP #3

This is one of four tables that define the target boost pressure. This table will be used when Boost Pressure Map Selected equals 3.

Cell data range: 0 to 300 kPa

BOOST PRESSURE SETPOINT MAP #4

This is one of four tables that define the target boost pressure. This table will be used when Boost Pressure Map Selected equals 4.

Cell data range: 0 to 300 kPa

MEASUREMENTS

BOOST CONTROL MAP SELECTED

There are four different tables (maps) for each of the following items, allowing up to four different configurations to be stored:

- Boost pressure setpoint
- Open loop boost control duty cycle
- Over boost hard limiter threshold/hysteres
- Over boost hard limiter cut delay

This measurement indicates which of the four configurations is currently selected.

BOOST PRESSURE SETPOINT ENGINE COOLANT TEMPERATURE CORRECTION

Indicates the amount (in %) of adjustment being made to the target boost pressure based on the engine's coolant temperature.

BOOST PRESSURE SETPOINT

Indicates the target boost pressure that the ECU is trying to achieve.

> **NOTE:** This value is copied from Boost Pressure Setpoint Map 1, Map 2, Map 3, or Map 4, depending on the value of Boost Pressure Map Selected.

BOOST PRESSURE SETPOINT GEAR CORRECTION

Indicates the amount of adjustment being made (in %) to the target boost pressure due to the active drive gear.

BOOST PRESSURE SETPOINT INTAKE AIR TEMPERATURE CORRECTION

Indicates the amount (in %) of adjustment being made to the target boost pressure based on the intake air temperature.

OVER BOOST HARD LIMITER

Parameters for configuring overboost hard limiter.

TUNABLE PARAMETERS (CHARACTERISTICS)

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD (MAP #1)

This is one of four parameters that specify the minimum manifold relative pressure required to activate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 1.

Range: 0 to 500 kPa

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD HYSTERESIS

This is one of four parameters that specify the reduction in manifold relative pressure required to deactivate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 1. The actual pressure required for deactivation is equal to Over Boost Hard Limiter Manifold Relative Pressure Threshold (Map #1) minus this value.

Range: 0 to 200 kPa

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD HYSTERESIS MAP #2

This is one of four parameters that specify the reduction in manifold relative pressure required to deactivate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 2. The actual pressure required for deactivation is equal to Over Boost Hard Limiter Manifold Relative Pressure Threshold Map #2 minus this value.

Range: 0 to 200 kPa

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD MAP #2

This is one of four parameters that specify the minimum manifold relative pressure required to activate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 2.

Range: 0 to 500 kPa

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD HYSTERESIS MAP #3

This is one of four parameters that specify the reduction in manifold relative pressure required to deactivate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 3. The actual pressure required for deactivation is equal to Over Boost Hard Limiter Manifold Relative Pressure Threshold Map #3 minus this value.

Range: 0 to 200 kPa

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD MAP #3

This is one of four parameters that specify the minimum manifold relative pressure required to activate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 3.

Range: 0 to 500 kPa

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD HYSTERESIS MAP #4

This is one of four parameters that specify the reduction in manifold relative pressure required to deactivate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 4. The actual pressure required for deactivation is equal to Over Boost Hard Limiter Manifold Relative Pressure Threshold Map #4 minus this value.

Range: 0 to 200 kPa

OVER BOOST HARD LIMITER MANIFOLD RELATIVE PRESSURE THRESHOLD MAP #4

This is one of four parameters that specify the minimum manifold relative pressure required to activate the over boost hard limiter. This parameter is used when Boost Control Map Selected equals 4.

Range: 0 to 500 kPa

OVER BOOST HARD LIMITER CUT DELAY (MAP #1)

This is one of four maps that define over boost hard limiter cut delay time. This map will be used when Boost Control Map Selected equals 1.

Once all conditions for performing a cut are satisfied, the ECU will observe this amount of delay prior to cutting.

Range: 0 to 600 seconds

OVER BOOST HARD LIMITER MAP #2 CUT DELAY

This is one of four maps that define over boost hard limiter cut delay time. This map will be used when Boost Control Map Selected equals 2.

Once all conditions for performing a cut are satisfied, the ECU will observe this amount of delay prior to cutting.

Range: 0 to 600 seconds

OVER BOOST HARD LIMITER MAP #3 CUT DELAY

This is one of four maps that define over boost hard limiter cut delay time. This map will be used when Boost Control Map Selected equals 3.

Once all conditions for performing a cut are satisfied, the ECU will observe this amount of delay prior to cutting.

Range: 0 to 600 seconds

OVER BOOST HARD LIMITER MAP #4 CUT DELAY

This is one of four maps that define over boost hard limiter cut delay time. This map will be used when Boost Control Map Selected equals 4.

Once all conditions for performing a cut are satisfied, the ECU will observe this amount of delay prior to cutting.

Range: 0 to 600 seconds

OVER BOOST HARD LIMITER THROTTLE POSITION CUT ENABLED

Set to YES to manually enable over boost hard limiter throttle position cut. Set to NO to disable.

OVER BOOST HARD LIMITER THROTTLE POSITION CUT PATTERN

If over boost hard limiter throttle position cut is active, then the instantaneous throttle position will be cut by this amount.

Range: 0 to 100%

OVER BOOST HARD LIMITER THROTTLE POSITION CUT RATE LIMITER DOWN

Specifies the maximum rate at which the over boost hard limiter can decrease its throttle position cuts. The closer the value is to zero, the more gradual the decrease and vice versa (values are negative).

Values closer to zero are recommended. This provides smoother ramp out response when over boost hard limiter is deactivated.

Range: -1000 to 0

OVER BOOST HARD LIMITER THROTTLE POSITION CUT RATE LIMITER UP

Specifies the maximum rate at which the over boost hard limiter can cut throttle position. The larger the value, the steeper the cut and vice versa.

Higher values are recommended. Very rapid throttle position cuts are necessary to provide better control and safety.

Range: 0 to 1000

OVER BOOST HARD LIMITER WATERGATE DUTY CYCLE CUT ENABLED

Set to YES to manually enable over boost hard limiter wastegate (boost control) duty cycle cut.

OVER BOOST HARD LIMITER WASTEGATE DUTY CYCLE CUT PATTERN

If over boost hard limiter wastegate duty cycle cut is active, then cut the instantaneous wastegate duty cycle of both turbo wastegate actuators by this amount.

Range: -0 to 100%

OVER BOOST HARD LIMITER WASTEGATE DUTY CYCLE CUT RATE LIMITER DOWN

Specifies the maximum rate at which the over boost hard limiter can decrease its wastegate duty cycle cuts. The closer the value is to zero, the more gradual the decrease and vice versa (values are negative).

Higher values are recommended. This provides smoother ramp out response when over boost hard limiter get deactivated.

Range: -1000 to 0

OVER BOOST HARD LIMITER WASTEGATE DUTY CYCLE CUT RATE LIMITER UP

Specifies the maximum rate at which the over boost hard limiter can increase its wastegate duty cycle cuts. The larger the value, the steeper the cut and vice versa.

Higher values are recommended in order to cut the wastegate duty cycle rapidly when hard limiter becomes active. This helps to provide better control and safety.

Range: 0 to 1000

MEASUREMENTS

OVER BOOST HARD LIMITER ACTIVE

If TRUE, over boost hard limiter is active.

OVER BOOST HARD LIMITER IGNITION CUT ACTIVE

If TRUE, over boost hard limiter ignition cut is active.

OVER BOOST HARD LIMITER THROTTLE POSITION CUT ACTIVE

If TRUE, over boost hard limiter throttle position cut is active.

OVER BOOST HARD LIMITER THROTTLE POSITION CUT PATTERN REQUESTED

When over boost hard limiter is active, this indicates the amount (%) of throttle position cut being applied.

OVER BOOST HARD LIMITER WASTEGATE DUTY CYCLE CUT ACTIVE

If TRUE, over boost hard limiter wastegate duty cycle cut is active.

OVER BOOST HARD LIMITER WASTEGATE DUTY CYCLE CUT PATTERN REQUESTED

When over boost hard limiter is active, this indicates the amount (%) of wastegate duty cycle cut being applied.

OVER BOOST SOFT LIMITER

Parameters for configuring overboost soft limiter.

TUNABLE PARAMETERS (CHARACTERISTICS)

OVER BOOST SOFT LIMITER CLOSED LOOP MAXIMUM

Over boost soft limiter closed loop maximum term.

Range: 0 to 100%

OVER BOOST SOFT LIMITER CLOSED LOOP MINIMUM

Over boost soft limiter closed loop minimum term.

Range: 0 to 100%

OVER BOOST SOFT LIMITER INTEGRAL DEADBAND

If Over Boost Soft Limiter Manifold Relative Pressure Error is less than this value, it will be treated as zero error when updating the Over Boost Soft Limiter Integral Term. (In other words, the integral term will not change this cycle because the error is effectively zero.)

Range: 0 to 100 kPa

OVER BOOST SOFT LIMITER INTEGRAL GAIN

This table defines over boost soft limiter integral gain as a function of gear number index and over boost soft limiter manifold relative pressure error. The gain specified here specifies the overall magnitude of the integral term.

When calculating the integral term, this value is multiplied by the Over Boost Soft Limiter Manifold Relative Pressure Error, which is then multiplied by the time period between each calculation of the integral term. The resulting value is added to the integral term from the previous cycle.

Cell data range: 0 to 100 %/kPa/s

OVER BOOST SOFT LIMITER INTEGRAL TERM MAXIMUM

Specifies the maximum allowed value for the over boost soft limiter integral term. If the integral term exceeds this value, this value will be used instead.

Range: 0 to 100%

OVER BOOST SOFT LIMITER INTEGRAL TERM MINIMUM

Specifies the minimum allowed value for the over boost soft limiter integral term. If the integral term is below this value, this value will be used instead.

Range: -100 to 0%

OVER BOOST SOFT LIMITER PROPORTIONAL GAIN

This table defines over boost soft limiter proportional gain as a function of gear number index and over boost soft limiter manifold relative pressure error. The gain specified here adjusts the overall magnitude of the Over Boost Soft Limiter Proportional Term.

To calculate the proportional term, the value from this table is multiplied by the Over Boost Soft Limiter Manifold Relative Pressure Error.

Cell data range: -100 to 100 %/kPa

OVER BOOST SOFT LIMITER PROPORTIONAL TERM MAXIMUM

Specifies the maximum allowed value for the Over Boost Soft Limiter Proportional Term. If the calculated value for the proportional term exceeds this value, this value will be used instead.

Range: 0 to 100%

OVER BOOST SOFT LIMITER PROPORTIONAL TERM MINIMUM

Specifies the minimum allowed value for the Over Boost Soft Limiter Proportional Term. If the calculated value for the proportional term is less than this value, this value will be used instead.

Range: -100 to 0%

OVER BOOST SOFT LIMITER THRESHOLD HYSTERESIS (MAP #1)

This is one of four maps that define over boost soft limiter threshold hysteresis as a function of gear number index. This map will be used when Boost Control Map Selected equals 1.

Cell data range: 0 to 100 kPa

OVER BOOST SOFT LIMITER THRESHOLD HYSTERESIS MAP #2

This is one of four maps that define over boost soft limiter threshold hysteresis as a function of gear number index. This map will be used when Boost Control Map Selected equals 2.

Cell data range: 0 to 100 kPa

OVER BOOST SOFT LIMITER THRESHOLD HYSTERESIS MAP #3

This is one of four maps that define over boost soft limiter threshold hysteresis as a function of gear number index. This map will be used when Boost Control Map Selected equals 3.

Cell data range: 0 to 100 kPa

OVER BOOST SOFT LIMITER THRESHOLD HYSTERESIS MAP #4

This is one of four maps that define over boost soft limiter threshold hysteresis as a function of gear number index. This map will be used when Boost Control Map Selected equals 4.

Cell data range: 0 to 100 kPa

OVER BOOST SOFT LIMITER THRESHOLD (MAP #1)

This is one of four maps that define over boost soft limiter threshold as a function of gear number index. This map will be used when Boost Control Map Selected equals 1.

Cell data range: 0 to 300 kPa

OVER BOOST SOFT LIMITER THRESHOLD MAP #2

This is one of four maps that define over boost soft limiter threshold as a function of gear number index. This map will be used when Boost Control Map Selected equals 2.

Cell data range: 0 to 300 kPa

OVER BOOST SOFT LIMITER THRESHOLD MAP #3

This is one of four maps that define over boost soft limiter threshold as a function of gear number index. This map will be used when Boost Control Map Selected equals 3.

Cell data range: 0 to 300 kPa

OVER BOOST SOFT LIMITER THRESHOLD MAP #4

This is one of four maps that define over boost soft limiter threshold as a function of gear number index. This map will be used when Boost Control Map Selected equals 4.

Cell data range: 0 to 300 kPa

OVER BOOST SOFT LIMITER THROTTLE POSITION CUT ENABLED

Set to YES to enable the use of throttle position cuts by the soft limiter. Set to NO to prevent soft limiter from using throttle position cuts.

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT DECAY

This table defines over boost soft limiter wastegate (boost control) duty cycle cut decay as a function of wastegate duty cycle cut active time. The values here specify the rate of wastegate duty cycle cut when over boost soft limiter is active.

- If values are ascending, the rate of wastegate duty cycle cut increases with over boost soft limiter active time.
- If values are descending, the rate of wastegate duty cycle cut decreases with over boost soft limiter active time.

Cell data range: 0 to 100%

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT ENABLED

Set to YES to enable the use of wastegate duty cycle cuts by the soft limiter. Set to NO to prevent soft limiter from using wastegate duty cycle cuts.

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT (MAP #1)

This is one of four maps that define over boost soft limiter wastegate (boost control) duty cycle cut as a function of gear number index and over boost soft limiter manifold relative pressure error. This map will be used when Boost Control Map Selected equals 1.

Cell data range: 0 to 100%

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT MAP #2

This is one of four maps that define over boost soft limiter wastegate (boost control) duty cycle cut as a function of gear number index and over boost soft limiter manifold relative pressure error. This map will be used when Boost Control Map Selected equals 2.

Cell data range: 0 to 100%

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT MAP #3

This is one of four maps that define over boost soft limiter wastegate (boost control) duty cycle cut as a function of gear number index and over boost soft limiter manifold relative pressure error. This map will be used when Boost Control Map Selected equals 3.

Cell data range: 0 to 100%

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT MAP #4

This is one of four maps that define over boost soft limiter wastegate (boost control) duty cycle cut as a function of gear number index and over boost soft limiter manifold relative pressure error. This map will be used when Boost Control Map Selected equals 4.

Cell data range: 0 to 100%

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT RATE LIMITER DOWN

Specifies the maximum rate at which the over boost soft limiter can decrease its wastegate duty cycle cuts. The closer the value is to zero, the more gradual the decrease and vice versa (values are negative).

Higher values are recommended. This provides smoother ramp out response when over boost hard limiter get deactivated.

Cell data range: -1000 to 0

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT RATE LIMITER UP

Specifies the maximum rate at which the over boost soft limiter can increase its wastegate duty cycle cuts. The larger the value, the steeper the cut and vice versa.

Higher values provide a very fast cut when over boost soft limiter is active. This is recommended in order to obtain better control and safety.

Cell data range: 0 to 1000

MEASUREMENTS

OVER BOOST SOFT LIMITER FEED FORWARD TERM

Over boost soft limiter feed forward term (%).

OVER BOOST SOFT LIMITER INTEGRAL TERM

One of two component values that are used to calculate the correction that will be applied to reduce Over Boost Soft Limiter Manifold Relative Pressure Error.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term.

The integral term is based on the cumulative Over Boost Soft Limiter Manifold Relative Pressure Error over time. Each time manifold relative pressure error is calculated:

1. The error is multiplied by Over Boost Soft Limiter Integral Gain which is then multiplied by the time (in seconds) since the previous calculation of the integral term.
2. The result is added to the previous Over Boost Soft Limiter Integral Term, resulting in a new value for the integral term.

OVER BOOST SOFT LIMITER MANIFOLD RELATIVE PRESSURE ERROR

Over boost soft limiter manifold relative pressure error (over boost soft limiter threshold - manifold relative pressure) in kPa or psi.

OVER BOOST SOFT LIMITER PROPORTIONAL TERM

One of two component values that are used to calculate the correction that will be applied to reduce Over Boost Soft Limiter Manifold Relative Pressure Error.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term.

The proportional term is directly proportional to the amount of error observed.

OVER BOOST SOFT LIMITER THROTTLE POSITION CUT ACTIVE

If TRUE, over boost soft limiter throttle position cut is active.

OVER BOOST SOFT LIMITER THROTTLE POSITION REQUESTED

When over boost soft limiter is active, this indicates the throttle position requested (%).

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE ACTIVE

If TRUE, over boost soft limiter wastegate (boost control) duty cycle cut is active.

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT DECAY

Indicates that rate at which the over boost soft limiter is cutting (retarding) wastegate (boost control) duty cycle.

OVER BOOST SOFT LIMITER WASTEGATE DUTY CYCLE CUT PATTERN REQUESTED

The amount of wastegate (boost control) duty cycle cut requested by the over boost soft limiter (%).

ENGINE INPUT

Engine input parameters.

12V BATTERY

TUNABLE PARAMETERS (CHARACTERISTICS)

BATTERY VOLTAGE SENSOR DTC MAXIMUM

The maximum voltage that is considered valid for the vehicle's main battery. Battery voltage signals above this value will set a DTC.

BATTERY VOLTAGE SENSOR DTC MINIMUM

The minimum voltage that is considered valid for the vehicle's main battery. Battery voltage signals below this value will set a DTC.

BATTERY VOLTAGE FILTER COEFFICIENT

A filter can be applied to the battery voltage measurement. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

BATTERY VOLTAGE SENSOR INPUT

Indicates which pin on the ECU connector the battery voltage sensor is wired to.

> **NOTE:** Although this parameter is listed as a Characteristic, which are tunable parameters, there is actually only 1 option available. So, there is nothing to do here.

MEASUREMENTS

BATTERY VOLTAGE

Indicates the current voltage of the 12V battery.

BATTERY VOLTAGE DTC ACTIVE

If YES, a DTC has been set for the battery voltage sensor.

BATTERY VOLTAGE RAW

Current voltage of the 12V battery, raw value (unfiltered).

ALTERNATOR

There are two alternator modules:

- **Alternator.** This module checks to see if the engine has been running long enough to enable the alternator (Alternator Delay Time). If so, it gives the OK to run the alternator (Alternator Requested = TRUE).
- **Alternator Demand.** This module configures the alternator actuator source and source frequency. It also controls the duty cycle of the alternator actuator, which would normally be either on 100% (on) or 0% (off). But, Alternator Actuator Duty Cycle can be used to specify a lower maximum value.

TUNABLE PARAMETERS (CHARACTERISTICS)

ALTERNATOR ACTUATOR DUTY CYCLE

Specifies the duty cycle (%) to use when the alternator actuator is ON. (When OFF, duty cycle is 0%).

Range: 0 to 100%

ALTERNATOR ACTUATOR OUTPUT

Specifies which output pin on the ECU is connected to the generator L-terminal on the alternator.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "High Side Drivers." Selecting a high side driver tells the ECU which of these outputs is assigned to the generator L-terminal.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ALTERNATOR ACTUATOR OUTPUT FREQUENCY

Specifies the frequency (in Hz) used for the ECU output to the generator L terminal.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ALTERNATOR DELAY TIME

Alternator terminal L delay time. The engine must be running for this amount of time before enabling the alternator.

Range: 0 to 10 seconds

ALTERNATOR OVERRIDE ENABLED

Set to YES to force the alternator output on (Gen-L terminal manual override). Set to NO to turn off the manual override.

MEASUREMENTS

ALTERNATOR ACTIVE

If this is YES, the generator L terminal is active.

ALTERNATOR REQUESTED

If TRUE, the engine has been running longer than Alternator Delay Time. So, it's OK to turn the alternator on.

BAROMETRIC PRESSURE

The barometric pressure module is responsible for determining the barometric pressure. A dedicated sensor may be used for this purpose.

However, the module is also capable of estimating barometric pressure when there is no dedicated sensor present. To do this, the module repeatedly samples the manifold absolute pressure value from the MAP sensor when the engine speed is below Engine Speed (RPM) Cranking Threshold and an average is calculated from the samples.

TUNABLE PARAMETERS (CHARACTERISTICS)

BAROMETRIC PRESSURE (BARO) DEFAULT

Specifies the default barometric pressure reading to use when there is a problem obtaining a barometric pressure reading. This can be one of two issues:

- A dedicated barometric pressure sensor has been fitted, but a DTC has been set for the sensor.
- There is no barometric pressure sensor fitted and the barometric pressure estimation routine indicates that it is in fault mode.

Range: 50 to 150 kPa

BAROMETRIC PRESSURE (BARO) SENSOR DTC MAXIMUM

Specifies the maximum allowable pressure reading from the barometric pressure sensor. Sensor values above this threshold will set a DTC.

Range: 0 to 300 kPa

BAROMETRIC PRESSURE (BARO) SENSOR DTC MAXIMUM VOLTS

Specifies the maximum allowable voltage from the barometric pressure sensor (open circuit threshold). Voltages above this threshold will set a DTC.

Range: 3.5 to 5 volts

BAROMETRIC PRESSURE (BARO) SENSOR DTC MINIMUM

Specifies the minimum allowable pressure reading from the barometric pressure sensor. Sensor values below this threshold will set a DTC.

Range: 0 to 300 kPa

BAROMETRIC PRESSURE (BARO) SENSOR DTC MINIMUM VOLTS

Specifies the minimum allowable voltage from the barometric pressure sensor (short to ground threshold). Voltages below this threshold will set a DTC.

Range: 0 to 2 volts.

BAROMETRIC PRESSURE (BARO) FILTER COEFFICIENT

A filter can be applied to the signal from the barometric pressure sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output unfiltered signal (output signal is equal to input signal).
- **0** = output null signal. Not recommended.

BAROMETRIC PRESSURE (BARO) SENSOR GAIN

This is part of the calibration for the barometric pressure sensor. It specifies how much pressure each volt of signal from the barometric pressure sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 100 kPA/v

BAROMETRIC PRESSURE (BARO) SENSOR INVERTED

Set this to YES if the barometric pressure sensor signal is inverted (when barometric pressure increases, the voltage from the sensor decreases).

BAROMETRIC PRESSURE (BARO) SENSOR OFFSET

This is part of the calibration for the barometric pressure sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

Range: -99 to 99 kPa

BAROMETRIC PRESSURE (BARO) SENSOR INPUT

Specifies the pin on the ECU connector that the barometric pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the barometric pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU)

MEASUREMENTS

BAROMETRIC PRESSURE

The barometric pressure (in kPa or psi).

- If a dedicated barometric pressure sensor is installed and functioning correctly, this will be the reading from that sensor.

- If no dedicated sensor is installed, this will be an estimate based on sampling the output of the manifold absolute pressure (MAP) sensor when the engine is below Engine Speed (RPM) Cranking Threshold.
- If there is a fault detected with an installed sensor or with barometric pressure estimation, this will be the value specified in Barometric Pressure Default.

BAROMETRIC PRESSURE (BARO) DTC FAULT ACTIVE

If YES, a DTC has been set for the barometric pressure sensor.

BAROMETRIC PRESSURE (BARO) RAW

If a dedicated barometric pressure sensor is installed, this is the raw value from the sensor.

BAROMETRIC PRESSURE SENSOR VOLTAGE

The barometric pressure sensor voltage parameter measures the voltage from the barometric pressure sensor, which measures the atmospheric pressure.

MANIFOLD RELATIVE PRESSURE

The manifold relative pressure parameter measures the pressure difference between the intake manifold and barometric pressure.

> **NOTE:** Manifold relative pressure (manifold absolute pressure - barometric pressure).

PRESSURE RATIO

Pressure ratio = manifold absolute pressure / barometric pressure.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

This module configures the operation of the engine coolant temperature sensor (ECT).

It's important to make sure that this sensor is functioning and adjusted correctly early in the tuning process because accurate ECT data is required to tune features such as:

- **Fuel Mixture:** Cold engines require a richer mixture. But, leaning the mix as the engine warms up provides better fuel efficiency.
- **Ignition Timing:** Cold engines typically need more ignition timing advance to aid combustion.
- **Idle Control:** A cold engine might need a slightly higher idle to maintain stability.

TUNABLE PARAMETERS (CHARACTERISTICS)

ENGINE COOLANT TEMPERATURE (ECT) FILTER COEFFICIENT

A filter can be applied to the signal from the engine coolant temperature sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR DEFAULT

Specifies a failsafe temperature reading that will be used when the engine coolant temperature sensor has failed (one or more DTCs are being reported for the sensor).

ENGINE COOLANT TEMPERATURE (ECT) SENSOR DTC MAXIMUM

Specifies the maximum allowable reading from the engine coolant temperature sensor. If the engine coolant temperature exceeds this maximum threshold, it will set a DTC.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR DTC MAXIMUM VOLTS

Specifies the maximum allowable voltage for the signal from engine coolant temperature sensor (open circuit threshold). If the sensor reports a voltage higher than this value, the ECU will set a DTC.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR DTC MINIMUM

Specifies the minimum allowable reading from the engine coolant temperature sensor. If the engine coolant temperature drops below this minimum threshold, it will set a DTC.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR DTC MINIMUM VOLTS

Specifies the minimum allowable voltage for the signal from engine coolant temperature sensor (short to ground threshold). If the sensor reports a voltage lower than this value, the ECU will set a DTC.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR INPUT

Specifies the pin on the ECU connector that the engine coolant temperature sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "NTC temperature inputs." Selecting an temperature input tells the ECU which of these inputs is the engine coolant temperature sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ENGINE COOLANT TEMPERATURE (ECT) SCALED ENDPOINTS

Engine coolant temperature (ECT) sensors change their electrical resistance as the temperature increases. This table is used to convert the resistance of the sensor to the temperature represented by that resistance.

The values on the table's axis represent amounts of resistance (in Ohms) of the sensor. Enter the corresponding temperatures in the cells below.

MEASUREMENTS

ENGINE COOLANT TEMPERATURE (ECT)

The engine coolant temperature reading from the ECT sensor, after filtering has been applied.

ENGINE COOLANT TEMPERATURE (ECT) DTC FAULT ACTIVE

If YES, a fault has been set for the engine coolant temperature sensor.

ENGINE COOLANT TEMPERATURE (ECT) RAW

The engine coolant temperature from the ECT sensor, before filtering is applied.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR VOLTAGE

The voltage of the signal from the engine coolant temperature sensor.

INTAKE AIR TEMPERATURE SENSOR (IAT)

This module configures the intake air temperature sensor, which measures the temperature of the air is before it goes into the engine.

Like most engine inputs, this sensor's readings affect many other tuning tasks. Therefore, it is important to make sure that the intake air temperature sensor is operating and configured correctly early in the tuning process.

TUNABLE PARAMETERS (CHARACTERISTICS)

INTAKE AIR TEMPERATURE (IAT) SENSOR DEFAULT

This will be used as the reading from the intake air temperature sensor when the ECU detects a problem with intake air temperature sensor (and sets a DTC for it).

INTAKE AIR TEMPERATURE (IAT) FILTER COEFFICIENT

A filter can be applied to the signal from the intake air temperature sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output unfiltered signal (output signal is equal to input signal).
- **0** = output null signal. Not recommended.

INTAKE AIR TEMPERATURE (IAT) SCALED ENDPOINTS

Intake air temperature (IAT) sensors change their electrical resistance as the temperature increases. This table is used to convert the resistance of the sensor to the temperature represented by that resistance.

The values on the table's axis represent amounts of resistance (in Ohms) of the sensor. Enter the corresponding temperatures in the cells below.

INTAKE AIR TEMPERATURE (IAT) SENSOR DTC MAXIMUM

Specifies the maximum acceptable temperature reading for the intake air temperature sensor. Intake air temperature sensor readings above this threshold will set a DTC.

INTAKE AIR TEMPERATURE (IAT) SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum acceptable voltage for the signal from the intake air temperature sensor (open circuit threshold). Voltages above this value will set a DTC.

Typically, the voltage entered here will be a threshold above which the technician should suspect issues such as a faulty sensor a damaged wiring.

INTAKE AIR TEMPERATURE (IAT) SENSOR DTC MINIMUM

Specifies the minimum acceptable temperature reading for the intake air temperature sensor. Intake air temperature sensor readings below this threshold will set a DTC.

INTAKE AIR TEMPERATURE (IAT) SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum acceptable voltage for the signal from the intake air temperature sensor (short to ground threshold). Voltages below this threshold will set a DTC.

Typically, the voltage entered here will be a threshold below which the technician should suspect issues such as a faulty sensor a damaged wiring.

INTAKE AIR TEMPERATURE (IAT) SENSOR INPUT

Specifies the pin on the ECU connector that the intake air temperature sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "NTC temperature inputs." Selecting a temperature input tells the ECU which of these inputs is the intake air temperature sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

INTAKE AIR TEMPERATURE (IAT)

The intake air temperature sensor reading, after filtering is applied.

INTAKE AIR TEMPERATURE (IAT) DTC FAULT ACTIVE

If YES, a DTC has been set for the intake air temperature sensor.

INTAKE AIR TEMPERATURE (IAT) RAW

The intake air temperature sensor reading, before filtering is applied.

INTAKE AIR TEMPERATURE (IAT) SENSOR VOLTAGE

The voltage of the signal from the intake temperature sensor.

INTERNAL THERMISTOR

This module controls the ECU's internal thermistor. This thermistor is a temperature sensor that sits on the ECU's circuit board and provides the ECU with information about its own operating temperature.

This allows the ECU to issue appropriate DTCs when it is in danger of overheating or it is being negatively affected by extreme cold.

TUNABLE PARAMETERS (CHARACTERISTICS)

INTERNAL THERMISTOR SENSOR INPUT

Indicates which of the ECU's dedicated analog channels its internal thermistor is wired to.

(Cannot be tuned. This is informational only).

INTERNAL THERMISTOR TEMPERATURE DEFAULT

Specifies a failsafe temperature reading that will be used when the internal thermistor has failed (one or more DTCs are being reported for this sensor).

INTERNAL THERMISTOR TEMPERATURE FILTER COEFFICIENT

Indicates the strength of the filter applied to the temperature signal from the internal thermistor. Values closer to zero indicate stronger filtering.

(Cannot be tuned. This is informational only.)

- **1** = output unfiltered signal (output signal is equal to input signal).
- **0** = output null signal. Not recommended.

INTERNAL THERMISTOR TEMPERATURE SCALED ENDPOINTS

The internal thermistor changes its electrical resistance as the temperature increases. This table is used to convert the resistance of the sensor to the temperature represented by that resistance.

(Cannot be tuned. This is informational only.)

INTERNAL THERMISTOR TEMPERATURE SENSOR DTC MAXIMUM

Specifies the maximum allowable temperature reading for the ECU's internal thermistor. Temperature readings above this value may indicate that the ECU is in danger of overheating. Such readings will generate a DTC.

(Cannot be tuned. This is informational only.)

INTERNAL THERMISTOR TEMPERATURE SENSOR DTC MINIMUM

Specifies the minimum allowable temperature reading for the ECU's internal thermistor. Temperature readings below this value may indicate that the ECU is being impaired by extreme cold. Such readings will generate a DTC.

(Cannot be tuned. This is informational only.)

MEASUREMENTS

INTERNAL THERMISTOR SENSOR VOLTAGE

The voltage of the internal thermistor output signal. The ECU uses this value to calculate the raw temperature value indicated.

INTERNAL THERMISTOR TEMPERATURE

Indicates the temperature of the ECU's internal thermistor, after filtering is applied.

INTERNAL THERMISTOR TEMPERATURE DTC ACTIVE

If YES, a DTC has been set for the ECU's internal thermistor.

INTERNAL THERMISTOR TEMPERATURE MAXIMUM

Indicates the highest temperature that the internal thermistor measured during the most recent logging session.

INTERNAL THERMISTOR TEMPERATURE RAW

Indicates the temperature of the ECU's internal thermistor, before filtering is applied.

LAMBDA SENSOR

The Lambda Sensor module configures up to two lambda sensors.

> **NOTE:** Lambda is a measure of the air/fuel mixture in the combustion chamber. A lambda value of 1.0 indicates that there is exactly enough oxygen in the combustion chamber to burn the fuel present. Higher values indicate an excess of oxygen (a "lean" mix). Lower values indicate a shortage of oxygen (a "rich" mix).

TUNABLE PARAMETERS (CHARACTERISTICS)

INJECTOR INACTIVE LAMBDA DTC DISABLE TIME

Disable the lambda DTC for this amount of time after injector inactive interval to avoid false DTC activation.

LAMBDA SENSOR 1

This table defines the lambda indicated by lambda sensor 1 as a function of the voltage the sensor outputs (conversion from voltage to lambda value).

Cell Data Range: 0 to 12

LAMBDA SENSOR 1 INPUT

Specifies the pins on the ECU connector that lambda sensor 1 is wired to.

On the ECU connector, there are two groups of pins that are reserved for lambda sensor inputs. Selecting LambdaSensor1 or LambdaSensor2 tells the ECU which of these groups is lambda sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

LAMBDA SENSOR 2

This table defines the lambda indicated by lambda sensor 2 as a function of the voltage the sensor outputs (conversion from voltage to lambda value).

Cell Data Range: 0 to 12

LAMBDA SENSOR 2 INPUT

Specifies the pins on the ECU connector that lambda sensor 2 is wired to.

On the ECU connector, there are two groups of pins that are reserved for lambda sensor inputs. Selecting LambdaSensor1 or LambdaSensor2 tells the ECU which of these groups is lambda sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

LAMBDA SENSOR DEFAULT

Specifies a failsafe reading that will be used when the lambda sensor has failed (one or more DTCs are being reported for the sensors).

LAMBDA SENSOR DTC MAXIMUM

Specifies the maximum lambda sensor reading allowed. Sensor readings above this value will set a DTC.

Range: 0 to 12

LAMBDA SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum allowable voltage received from the lambda sensors (open circuit threshold). Voltages above this threshold will set a DTC.

Range: 3.5 to 5V

LAMBDA SENSOR DTC MINIMUM

Specifies the minimum lambda sensor reading allowed. Sensor readings below this value will set a DTC.

Range: 0 to 12

LAMBDA SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum allowable voltage received from the lambda sensors (short to ground threshold). Voltages below this value will set a DTC.

Range: 0 to 2V

MEASUREMENTS

INJECTOR INACTIVE LAMBDA DTC DISABLE ACTIVE

Set to TRUE to disable injector lambda DTCs. Set to FALSE to allow DTCs to be active.

LAMBDA SENSOR 1

The lambda value reported by lambda sensor 1.

LAMBDA BANK #1 DTC FAULT ACTIVE

If YES, a DTC has been set for the lambda bank 1 sensor.

LAMBDA SENSOR 1 DTC STATUS

Lambda sensor 1 ready status: a value of zero indicates that the lambda sensor is functional. Other values indicate lambda not functional.

LAMBDA SENSOR 1 INPUT STATUS

Indicates whether lambda sensor 1 is ready:

- Ignition starting
- Sensor heater disconnected
- Sensor up to temperature
- Sensor not up to temperature
- Sensor power low
- Sensor pins open circuit
- Sensor error

- Sensor off
- Sensor calibrating
- Sensor heater open circuit
- Sensor on
- Sensor heating up
- Check sensor
- No error detected
- Lambda circuit failure
- Lambda heater open circuit

LAMBDA SENSOR 1 VOLTAGE

The voltage of the signal received from lambda sensor 1.

LAMBDA SENSOR 2

The lambda value reported by lambda sensor 2.

LAMBDA BANK #2 DTC FAULT ACTIVE

If YES, a DTC has been set for the lambda bank 2 sensor.

LAMBDA SENSOR 2 DTC STATUS

Lambda sensor 2 ready status: a value of zero indicates that the lambda sensor is functional. Other values indicate lambda not functional.

LAMBDA SENSOR 2 INPUT STATUS

Indicates whether lambda sensor 2 is ready:

- Ignition starting
- Sensor heater disconnected
- Sensor up to temperature
- Sensor not up to temperature
- Sensor power low

- Sensor pins open circuit
- Sensor error
- Sensor off
- Sensor calibrating
- Sensor heater open circuit
- Sensor on
- Sensor heating up
- Check sensor
- No error detected
- Lambda circuit failure
- Lambda heater open circuit

LAMBDA SENSOR 2 VOLTAGE

The voltage of the signal received from lambda sensor 2.

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)

MAP sensors measure the air pressure in the intake manifold. In speed-density tunes, this data is used in conjunction with an intake air temperature (IAT) sensor and the volumetric efficiency (VE) tables to determine the mass air flow.

In naturally aspirated engines, the pressure measured will be roughly 1 bar (14.7 psi / 100 kPa), which is the normal pressure of the air we breathe at sea level. Therefore, these engines typically use a "1 bar" MAP sensor. Components such as turbochargers and superchargers that force more air into the engine increase the pressure measured and may require a MAP sensor rated for more than 1 bar.

To calibrate this sensor, configure its Gain and Offset values.

TUNABLE PARAMETERS (CHARACTERISTICS)

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DTC MAXIMUM

Specifies the maximum allowed pressure reading from the manifold absolute pressure sensor (in kPa or psi). Sensor readings above this threshold will set a DTC.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum allowed voltage for the manifold absolute pressure sensor signal (open circuit threshold). Voltages above this threshold will set a DTC.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DTC MINIMUM

Specifies the minimum allowed pressure reading from the manifold absolute pressure sensor (in kPa or psi). Sensor readings below this threshold will set a DTC.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DTC MINIMUM VOLTS

Specifies the minimum allowed voltage for the manifold absolute pressure sensor signal (short to ground threshold). Voltages below this threshold will set a DTC.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DEFAULT

The default pressure for the manifold absolute pressure sensor (in kPa or psi). This value will be used as the MAP sensor reading when the sensor diagnostic indicates that the sensor may be malfunctioning.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR GAIN

This is part of the calibration for the MAP sensor. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 1000 kPa/V

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INVERTED

Set to TRUE if the manifold absolute pressure sensor signal is inverted (when manifold absolute pressure increases, the voltage from the sensor decreases).

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR OFFSET

This is part of the calibration for the MAP sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

Range: -99 to 99 kPa

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INPUT

Specifies the pin on the ECU connector that the manifold absolute pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the manifold absolute pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

MANIFOLD ABSOLUTE PRESSURE (MAP)

The pressure reading (in kPa or psi) of the manifold absolute pressure sensor, after filtering is applied.

MANIFOLD ABSOLUTE PRESSURE (MAP) DTC FAULT ACTIVE

If YES, a DTC has been set for the manifold absolute pressure sensor.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DELTA

The rate at which manifold absolute pressure is changing (in kPa/s or psi/s).

MANIFOLD ABSOLUTE PRESSURE (MAP) RAW

The pressure reading (in kPa or psi) of the manifold absolute pressure sensor, before filtering is applied.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR VOLTAGE

The voltage of the signal received from the MAP sensor. The ECU uses this voltage to calculate the raw pressure reading.

MASS AIRFLOW SENSOR (MAF)

This module configures mass airflow sensors. MAF sensors measure the mass of air entering the throttle body. Some setups use this type of device to measure the mass air flow directly rather than (or in addition to) using speed density or other methods to determine it by calculation.

TUNABLE PARAMETERS (CHARACTERISTICS)

MASS AIRFLOW (MAF) SCALED ENDPOINTS

This table defines mass airflow (in g/s or lb/min) as a function of the frequency of the output from the MAF sensor. This is used to convert the frequency of the signal from the sensor to the mass airflow value represented by that frequency.

Cell Data Range: 0 to 512 g/s

MASS AIRFLOW (MAF) CORRECTION

This table defines a correction to mass airflow as a percentage of the measured mass airflow.

Cell Data Range: -100 to 100%

MASS AIRFLOW (MAF) SENSOR DEFAULT

This value will be used as the mass airflow reading when the ECU has detected a problem with the mass airflow sensor (and has set a DTC for it).

Range: 0 to 512 g/s

MASS AIRFLOW (MAF) SENSOR DTC MAXIMUM

Specifies the maximum allowed reading from the mass airflow sensor. Sensor readings above this threshold will set a DTC.

Exceeding the threshold specified here could impact the engine's performance and fuel efficiency.

MASS AIRFLOW (MAF) SENSOR DTC MAXIMUM FREQUENCY

Specifies the maximum allowable frequency for the signal from the mass airflow sensor. Signal frequencies above this threshold will set a DTC.

MAF sensor frequencies above the frequency specified here may indicate that the sensor is malfunctioning or has become dirty, leading to incorrect readings.

MASS AIRFLOW (MAF) SENSOR DTC MINIMUM

Specifies the minimum allowed reading from the mass airflow sensor. Sensor readings below this threshold will set a DTC.

MASS AIRFLOW (MAF) SENSOR DTC MINIMUM FREQUENCY

Specifies the minimum allowable frequency for the signal from the mass airflow sensor. Signal frequencies below this threshold will set a DTC.

MASS AIRFLOW (MAF) SENSOR INPUT

Specifies the pin on the ECU connector that the mass airflow sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the mass airflow sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MASS AIRFLOW (MAF) SMOOTHING FACTOR

This value is used to smooth out the raw signal from the MAF sensor. Roughly speaking, this value affects the output as follows:

- A value of 1 means no smoothing is applied. The output value will be exactly the same as the raw value from the sensor.
- For decimal values between 0.001 and 1, the smaller the smoothing factor, the more dampened the mass airflow signal will become.

More specifically, the current raw value is multiplied by the smoothing factor. The result is then added to the last calculated value multiplied by (1 - smoothing factor). So, if the smoothing factor equals 0.3, the output value will be:

(0.3 x raw value) + (0.7 x last calculated output)

MEASUREMENTS

MASS AIRFLOW (MAF)

The mass airflow reported by the MAF sensor (in g/s or lb/min), after filtering is applied.

MASS AIRFLOW (MAF) DTC FAULT ACTIVE

If YES, a DTC has been set for the mass airflow sensor.

MASS AIRFLOW (MAF) RAW

The mass airflow reported by the MAF sensor (in g/s or lb/min), before filtering is applied.

MASS AIRFLOW (MAF) SENSOR DUTY CYCLE

Indicates the mass airflow sensor signal duty cycle (%).

MASS AIRFLOW (MAF) SENSOR FREQUENCY

The frequency of the signal from the mass airflow sensor (in Hz).

NITROUS PRESSURE SENSOR

Parameters for nitrous pressure sensors.

TUNABLE PARAMETERS (CHARACTERISTICS)

NITROUS PRESSURE (NOS) FILTER COEFFICIENT

A filter can be applied to the signal from the nitrous pressure sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

NITROUS PRESSURE (NOS) SENSOR DTC MAXIMUM

Specifies the maximum allowable reading (in kPa or psi) for the nitrous pressure sensor. Sensor values above this threshold will set a DTC.

Typically, the value specified is used as a threshold above which the technician should suspect that there is a problem with the nitrous oxide system, such as over-pressurization..

NITROUS PRESSURE (NOS) SENSOR DTC MINIMUM

Specifies the minimum allowable reading (in kPa or psi) for the nitrous pressure sensor. Sensor values below this threshold will set a DTC.

Typically, the value specified is used as a threshold below which the technician should suspect that there is a problem with the nitrous oxide system, such as under-pressurization.

NITROUS PRESSURE (NOS) SENSOR DEFAULT

Specifies a failsafe value for the reading from the nitrous pressure sensor (in kPa or psi). The ECU will use this default reading when the ECU detects a potential problem with the nitrous pressure sensor (sets a DTC for it).

NITROUS PRESSURE (NOS) SENSOR DTC MAXIMUM VOLTS

Specifies the maximum allowable voltage for the signal from the nitrous pressure sensor. (open circuit threshold). Voltages above this threshold will set a DTC.

Typically, the voltage specified here serves as a threshold above which technicians should suspect that there is a problem with the nitrous pressure sensor or its wiring.

NITROUS PRESSURE (NOS) SENSOR DTC MINIMUM VOLTS

Specifies the minimum allowable voltage for the signal from the nitrous pressure sensor. (open circuit threshold). Voltages below this threshold will set a DTC.

Typically, the voltage specified here serves as a threshold above which technicians should suspect that there is a problem with the nitrous pressure sensor or its wiring.

NITROUS PRESSURE (NOS) SENSOR GAIN

This is part of the calibration for the nitrous pressure sensor. It specifies how much pressure each volt of signal from the nitrous pressure sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 10,000 kPa/V

NITROUS PRESSURE (NOS) SENSOR INVERTED

Set to TRUE if the nitrous pressure sensor signal is inverted (when nitrous pressure increases, the voltage from the sensor decreases).

NITROUS PRESSURE (NOS) SENSOR OFFSET

This is part of the calibration for the nitrous pressure sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

Range: 0 to 10,000 kPa

NITROUS PRESSURE (NOS) SENSOR INPUT

Specifies the pin on the ECU connector that the nitrous pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the nitrous pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

NITROUS PRESSURE (NOS)

The nitrous pressure (in kPa or psi) indicated by the nitrous pressure sensor, after filtering is applied.

NITROUS PRESSURE (NOS) DTC FAULT ACTIVE

If YES, a fault has been set for the nitrous pressure sensor.

NITROUS PRESSURE (NOS) RAW

The nitrous pressure (in kPa or psi) indicated by the nitrous pressure sensor, before filtering is applied.

NITROUS PRESSURE (NOS) SENSOR VOLTAGE

The voltage of the nitrous pressure sensor signal.

OIL PRESSURE SENSOR

Parameters for configuring the oil pressure sensor.

TUNABLE PARAMETERS (CHARACTERISTICS)

OIL PRESSURE DEFAULT

Specifies a failsafe value for the oil pressure sensor. The ECU will use this value for the oil pressure reading when it detects that the oil pressure sensor may be malfunctioning (sets a DTC for it).

OIL PRESSURE SENSOR DTC MAXIMUM

Specifies the maximum allowable reading for the oil pressure sensor (in kPa). Sensor readings above this threshold will set a DTC.

OIL PRESSURE SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum acceptable voltage for the signal from the oil pressure sensor (open circuit threshold). Voltages above this threshold will set a DTC.

Typically, this would be set to a voltage above which technicians should suspect issues such as a faulty sensor or damaged wiring.

OIL PRESSURE SENSOR DTC MINIMUM

Specifies the minimum allowable reading for the oil pressure sensor (in kPa or psi). Readings below this threshold will set a DTC.

OIL PRESSURE SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum acceptable voltage for the signal from the oil pressure sensor (short to ground threshold). Voltages below this threshold will set a DTC.

Typically, this would be set to a voltage below which technicians should suspect issues such as a faulty sensor or damaged wiring.

OIL PRESSURE FILTER COEFFICIENT

A filter can be applied to the signal from the oil pressure sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

OIL PRESSURE SENSOR GAIN

This is part of the calibration for the oil pressure sensor. It specifies how much pressure each volt of signal from the oil pressure sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 400 kPa/V

OIL PRESSURE SENSOR INVERTED

Set to TRUE if the oil pressure sensor signal is inverted (when oil pressure increases, the voltage from the sensor decreases).

OIL PRESSURE SENSOR OFFSET

This is part of the calibration for the oil pressure sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

Range: -199 to 99 kPa

OIL PRESSURE SENSOR INPUT

Specifies the pin on the ECU connector that the oil pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the oil pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

OIL PRESSURE

The oil pressure reading (in kPa or psi) from the oil pressure sensor, after filtering has been applied.

OIL PRESSURE DTC FAULT ACTIVE

If YES, a DTC has been set for the oil pressure sensor.

OIL PRESSURE RAW

The oil pressure reading (in kPa or psi) from the oil pressure sensor, before filtering has been applied.

OIL PRESSURE SENSOR VOLTAGE

The voltage of the signal from the oil pressure sensor.

ENGINE PROTECTION

Parameters for engine protection.

DECELERATION FUEL CUT

The Deceleration Fuel Cut module controls the deceleration fuel cut off (DFCO) feature. When this feature is activated, the module cuts off all fuel by switching off the injectors. In theory, this improves fuel economy by allowing the vehicle to coast on its momentum rather than burning fuel while decelerating.

The feature is enabled when all of the following conditions are met:

- Deceleration Fuel Cut Enabled is TRUE.
- The engine speed is greater than or equal to Deceleration Fuel Cut Enable Engine Speed Minimum.
- The engine coolant temperature is greater than or equal to Deceleration Fuel Cut Enable Engine Coolant Temperature Minimum.
- The engine isn't idling. (Idle Active is FALSE).

Once all four of these conditions are met, the feature begins watching for the following additional conditions. These conditions must be met to switch off the injectors:

- The measured throttle position is less than the value specified in Deceleration Fuel Cut Enable Throttle Position.
- The measured manifold absolute pressure falls below the value specified in Deceleration Fuel Cut Entry Enable MAP.

The feature will then be "active" (Deceleration Fuel Cut Active = TRUE). The injectors will be switched off after the amount of time specified in Deceleration Fuel Cut Delay.

This feature is deactivated (and the injectors are turned back on) when MAP rises to the level specified in Deceleration Fuel Cut Exit Enable MAP.

TUNABLE PARAMETERS (CHARACTERISTICS)

DECELERATION FUEL CUT (DFCO) DELAY

Deceleration fuel cut delay time. Once all conditions are for cutting fuel are met, wait this amount of time before turning off the injectors.

Range: 0 to 10 seconds

DECELERATION FUEL CUT (DFCO) DISABLE IGNITION ANGLE RETARD

Retard the ignition by this amount as soon as DFCO gets disabled.

DECELERATION FUEL CUT (DFCO) DISABLE IGNITION RETARD RECOVERY TIME

Indicates the period needed for the ignition timing to return to normal after disabling the fuel cut-off during deceleration.

DECELERATION FUEL CUT (DFCO) ENABLE ENGINE COOLANT TEMPERATURE MINIMUM

The minimum engine coolant temperature required to enable deceleration fuel cut.

Range: -40 to 125 °C.

DECELERATION FUEL CUT (DFCO) ENABLE ENGINE SPEED MINIMUM

Specifies the minimum engine speed required to enable deceleration fuel cut.

Range: 250 to 10,000 rpm

DECELERATION FUEL CUT (DFCO) ENABLE THROTTLE POSITION

This table defines the throttle position required to activate a deceleration fuel cut as a function of engine speed. Throttle position must be below the value in this table to activate the fuel cut.

Cell Data Range: 0 to 100%

DECELERATION FUEL CUT (DFCO) ENABLED

Set to YES to enable the deceleration fuel cut feature.

Set to NO to disable the feature entirely (fuel will never be cut by this feature).

DECELERATION FUEL CUT (DFCO) ENGINE SPEED MAXIMUM THRESHOLD

Indicates the maximum engine speed (in RPM) which the deceleration fuel cut-off system activates.

DECELERATION FUEL CUT (DFCO) ENGINE SPEED MAXIMUM THRESHOLD HYSTERESIS

If DFCO has been disabled because engine speed became greater than Deceleration Fuel Cut Engine Speed Maximum, the engine speed must fall this amount BELOW Deceleration Fuel Cut Engine Speed Maximum in order to reactivate DFCO.

Higher values prevent DFCO from being turned on and off frequently when engine speed hovers near the threshold.

DECELERATION FUEL CUT (DFCO) ENGINE SPEED MINIMUM THRESHOLD

Indicates the minimum engine speed (in RPM) which the deceleration fuel cut-off system activates.

DECELERATION FUEL CUT (DFCO) ENGINE SPEED MINIMUM THRESHOLD HYSTERESIS

If DFCO has been enabled because engine speed became greater than Deceleration Fuel Cut Engine Speed Minimum, the engine speed must fall this amount BELOW Deceleration Fuel Cut Engine Speed Minimum in order to deactivate DFCO.

Higher values prevent DFCO from being turned on and off frequently when engine speed hovers near the threshold.

DECELERATION FUEL CUT (DFCO) ENTRY ENABLE MAP

This table defines deceleration fuel cut entry enable manifold absolute pressure (MAP) as a function of barometric pressure. MAP must fall below this table value to activate the fuel cut.

Cell Data Range: 0 to 100 kPa

DECELERATION FUEL CUT (DFCO) EXIT ENABLE MAP

This table defines deceleration fuel cut exit enable manifold absolute pressure (MAP) as a function of barometric pressure. Once the fuel cut is active, MAP must rise above this table value to stop the fuel cut and turn the injectors back on.

> **NOTE:** The cell values in this table must be higher than the corresponding values in the Deceleration Fuel Cut Entry Enable MAP table.

Cell Data Range: 0 to 100 kPa

MEASUREMENTS

DECELERATION FUEL CUT (DFCO) ACTIVE

If TRUE, all required conditions for activating deceleration fuel cut have been met. The injectors will be shut off.

DECELERATION FUEL CUT (DFCO) IGNITION RETARD

The retard applied to the requested ignition angle when DFCO is disabled.

DECELERATION FUEL CUT (DFCO) REQUESTED

Indicates the amount of fuel cut requested. There are two possible values for this parameter:

- **1** = no fuel cut requested
- **2** = full fuel cut requested

HARD LIMITER

The hard limiter helps prevent engine damage due to overheating by attempting to limit engine speed when it exceeds the value defined in currently-selected version of the Hard Limiter Engine Speed Threshold map.

> **NOTE:** There are 4 versions of this table so multiple configurations can be stored. Use Hard Limiter Map Select to specify which of the 4 tables to employ.

This is the final line of defense should the soft limiter or staged cuts prove insufficient.

The method used to limit engine speed is selected using Hard Limiter Cut Mode.

When the engine speed falls below the Hard Limiter Engine Speed Threshold from the selected map minus the Hard Limiter Engine Speed Threshold Hysteresis from the selected map, the hard limiter will wait for the additional amount of time specified in Hard Limiter Timed Hysteresis. Then, it will stop trying to limit engine speed.

TUNABLE PARAMETERS (CHARACTERISTICS)

HARD LIMITER CUT MODE

The option selected here specifies what the hard limiter will cut in order to limit engine speed:

1. **Cut ignition coils (spark)** - This can yield a sharper response. However, it could potentially damage catalytic converters and/or exhaust valves.
2. **Cut fuel injectors** - Injection only cuts are safer, but yield a more sluggish response to the limiter due to fueling transport delays.

- **Cut both**

> **NOTE:** The rotating mass of the engine also plays a role in how fast the engine will "bounce" off the limiter.

HARD LIMITER ENGINE SPEED THRESHOLD (MAP #1)

This is one of several maps that define the engine limiter engine speed threshold as a function of engine coolant temperature. If the engine speed requested exceeds the value specified in this table, the hard limiter will attempt to limit the engine speed using the method specified in Hard Limiter Cut Mode.

Use Hard Limiter Map Select to specify which map should be used.

Cell data range: 0 to 11000 rpm

HARD LIMITER ENGINE SPEED THRESHOLD MAP #2

This is one of several maps that define the engine limiter engine speed threshold as a function of engine coolant temperature. If the engine speed requested exceeds the value specified in this table, the hard limiter will attempt to limit the engine speed using the method specified in Hard Limiter Cut Mode.

Use Hard Limiter Map Select to specify which map should be used.

Cell data range: 0 to 11000 rpm

HARD LIMITER ENGINE SPEED THRESHOLD MAP #3

This is one of several maps that define the engine limiter engine speed threshold as a function of engine coolant temperature. If the engine speed requested exceeds the value specified in this table, the hard limiter will attempt to limit the engine speed using the method specified in Hard Limiter Cut Mode.

Use Hard Limiter Map Select to specify which map should be used.

Cell data range: 0 to 11000 rpm

HARD LIMITER ENGINE SPEED THRESHOLD MAP #4

This is one of several maps that define the engine limiter engine speed threshold as a function of engine coolant temperature. If the engine speed requested exceeds the value specified in this table, the hard limiter will attempt to limit the engine speed using the method specified in Hard Limiter Cut Mode.

Use Hard Limiter Map Select to specify which map should be used.

Cell data range: 0 to 11000 rpm

HARD LIMITER ENGINE SPEED THRESHOLD HYSTERESIS (MAP 1)

This is one of several maps that define the engine limiter engine speed threshold hysteresis as a function of engine coolant temperature. If the engine speed falls below the value specified in Hard Limiter Engine Speed Threshold (Map 1) minus the value specified in this table, the hard limiter will stop trying to limit the engine speed.

Larger values help prevent hard limiter engine speed cuts from turning on and off too frequently.

Use Hard Limiter Map Select to specify which set of maps should be used.

Cell data range: 0 to 2000 rpm

HARD LIMITER ENGINE SPEED THRESHOLD HYSTERESIS MAP #2

This is one of several maps that define the engine limiter engine speed threshold hysteresis as a function of engine coolant temperature. If the engine speed falls below the value specified in Hard Limiter Engine Speed Threshold Map #2 minus the value specified in this table, the hard limiter will stop trying to limit the engine speed.

Larger values help prevent hard limiter engine speed cuts from turning on and off too frequently.

Use Hard Limiter Map Select to specify which set of maps should be used.

Cell data range: 0 to 2000 rpm

HARD LIMITER ENGINE SPEED THRESHOLD HYSTERESIS MAP #3

This is one of several maps that define the engine limiter engine speed threshold hysteresis as a function of engine coolant temperature. If the engine speed falls below the value specified in Hard Limiter Engine Speed Threshold Map #3 minus the value specified in this table, the hard limiter will stop trying to limit the engine speed.

Larger values help prevent hard limiter engine speed cuts from turning on and off too frequently.

Use Hard Limiter Map Select to specify which set of maps should be used.

Cell data range: 0 to 2000 rpm

HARD LIMITER ENGINE SPEED THRESHOLD HYSTERESIS MAP #4

This is one of several maps that define the engine limiter engine speed threshold hysteresis as a function of engine coolant temperature. If the engine speed falls below the value specified in Hard Limiter Engine Speed Threshold Map #4 minus the value specified in this table, the hard limiter will stop trying to limit the engine speed.

Larger values help prevent hard limiter engine speed cuts from turning on and off too frequently.

Use Hard Limiter Map Select to specify which set of maps should be used.

Cell data range: 0 to 2000 rpm

HARD LIMITER MAP SELECT

Specifies which of the Hard Limiter Engine Speed Threshold maps to use.

HARD LIMITER TIME HYSTERESIS

The hard limiter will remain active for this amount of additional time after engine speed reaches the hard limiter engine speed threshold minus the hard limiter engine speed threshold hysteresis.

Range: 0 to 0.5 seconds

> **NOTE:** Set to 0 to disable timed hysteresis.

MEASUREMENTS

HARD LIMITER ACTIVE

If TRUE, the hard limiter is actively limiting engine speed using the method specified in Hard Limiter Cut Mode.

HARD LIMITER MAP SELECTED

Indicates which of the Hard Limiter Engine Speed Threshold maps is currently selected.

HARD LIMITER STATE

Indicates the state of the hard limiter:

- **Inactive.** The hard limiter is NOT attempting to limit engine speed.
- **Active.** The hard limiter is actively trying to limit engine speed.
- **Timed Hysteresis Active.** The hard limiter is active, but will switch off shortly.

LAUNCH CONTROL

Launch control is a feature that allows the driver to launch from a standstill while the ECU carefully limits power in order to reduce wheel spin.

To use the feature, Launch Control Enabled must be set to YES. Once the feature is enabled, launch control will attempt to limit power when all of the following conditions are met:

- Throttle position is not below Launch Control Enable Throttle Position Minimum.
- Vehicle speed is not above Launch Control Enable Vehicle Speed Maximum.
- Engine Speed is above Launch Control Engine Speed Threshold.

Once activated, the feature limits power using the method(s) specified in Launch Control Cut Mode.

The feature will be deactivated (stop trying to limit power) when any of the following conditions are met:

- Throttle position is below Launch Control Enable Throttle Position Minimum.
- Vehicle speed is above Launch Control Enable Vehicle Speed Maximum.
- Engine Speed is below Launch Control Engine Speed Threshold minus Launch Control Engine Speed Hysteresis.

TUNABLE PARAMETERS (CHARACTERISTICS)

LAUNCH CONTROL CUT MODE

Specifies the method by which the engine power is regulated during launch control activation:

- Injection Only
- Ignition Only
- Ignition and Injection

The ECU momentarily interrupts ignition or fuel delivery to limit engine torque and prevent wheel spin, ensuring smooth and controlled acceleration off the line.

LAUNCH CONTROL ENABLE THROTTLE POSITION MINIMUM (MAP #1)

If Launch Control Map Select equals 1, throttle position must be equal to or greater than this value (%) in order to activate launch control . This helps ensure that launch control engages only when the driver intends to perform a launch from standstill.

LAUNCH CONTROL ENABLE THROTTLE POSITION MINIMUM MAP #2

If Launch Control Map Select equals 2, throttle position must be equal to or greater than this value (%) in order to activate launch control . This helps ensure that launch control engages only when the driver intends to perform a launch from standstill.

LAUNCH CONTROL ENABLE THROTTLE POSITION MINIMUM MAP #3

If Launch Control Map Select equals 3, throttle position must be equal to or greater than this value (%) in order to activate launch control . This helps ensure that launch control engages only when the driver intends to perform a launch from standstill.

LAUNCH CONTROL ENABLE THROTTLE POSITION MINIMUM MAP #4

If Launch Control Map Select equals 4, throttle position must be equal to or greater than this value (%) in order to activate launch control . This helps ensure that launch control engages only when the driver intends to perform a launch from standstill.

LAUNCH CONTROL ENABLE VEHICLE SPEED MAXIMUM (MAP #1)

If Launch Control Map Select equals 1, launch control will be disabled when vehicle speed is greater than or equal to this threshold (in mph or km/h). This helps ensure that the launch control is engaged only when the vehicle is stationary or moving at speeds below the specified limit.

LAUNCH CONTROL ENABLE VEHICLE SPEED MAXIMUM MAP #2

If Launch Control Map Select equals 2, launch control will be disabled when vehicle speed is greater than or equal to this threshold (in mph or km/h). This helps ensure that the launch control is engaged only when the vehicle is stationary or moving at speeds below the specified limit.

LAUNCH CONTROL ENABLE VEHICLE SPEED MAXIMUM MAP #3

If Launch Control Map Select equals 3, launch control will be disabled when vehicle speed is greater than or equal to this threshold (in mph or km/h). This helps ensure that the launch control is engaged only when the vehicle is stationary or moving at speeds below the specified limit.

LAUNCH CONTROL ENABLE VEHICLE SPEED MAXIMUM MAP #4

If Launch Control Map Select equals 4, launch control will be disabled when vehicle speed is greater than or equal to this threshold (in mph or km/h). This helps ensure that the launch control is engaged only when the vehicle is stationary or moving at speeds below the specified limit.

LAUNCH CONTROL ENABLED

Set to YES to enable the launch control feature. Set to NO to disable (launch control will not activate).

LAUNCH CONTROL ENGINE SPEED THRESHOLD (MAP #1)

If Launch Control Map Select equals 1, engine speed (in rpm) must be greater than or equal this value to activate launch control.

LAUNCH CONTROL ENGINE SPEED THRESHOLD MAP #2

If Launch Control Map Select equals 2, engine speed (in rpm) must be greater than or equal this value to activate launch control.

LAUNCH CONTROL ENGINE SPEED THRESHOLD MAP #3

If Launch Control Map Select equals 3, engine speed (in rpm) must be greater than or equal this value to activate launch control.

LAUNCH CONTROL ENGINE SPEED THRESHOLD MAP #4

If Launch Control Map Select equals 4, engine speed (in rpm) must be greater than or equal this value to activate launch control.

LAUNCH CONTROL ENGINE SPEED THRESHOLD HYSTERESIS (MAP #1)

If Launch Control Map Select equals 1, this specifies the amount that engine speed must fall below Launch Control Engine Speed Threshold in order to deactivate launch control.

Larger values help prevent rapid toggling of the launch control feature when the engine's RPM is near the threshold.

LAUNCH CONTROL ENGINE SPEED THRESHOLD HYSTERESIS MAP #2

If Launch Control Map Select equals 2, this specifies the amount that engine speed must fall below Launch Control Engine Speed Threshold in order to deactivate launch control.

Larger values help prevent rapid toggling of the launch control feature when the engine's RPM is near the threshold.

LAUNCH CONTROL ENGINE SPEED THRESHOLD HYSTERESIS MAP #3

If Launch Control Map Select equals 3, this specifies the amount that engine speed must fall below Launch Control Engine Speed Threshold in order to deactivate launch control.

Larger values help prevent rapid toggling of the launch control feature when the engine's RPM is near the threshold.

LAUNCH CONTROL ENGINE SPEED THRESHOLD HYSTERESIS MAP #4

If Launch Control Map Select equals 4, this specifies the amount that engine speed must fall below Launch Control Engine Speed Threshold in order to deactivate launch control.

Larger values help prevent rapid toggling of the launch control feature when the engine's RPM is near the threshold.

LAUNCH CONTROL MAP SELECT

Selects the launch control map to use. Up to four different configurations can be stored for several of the launch control activation and deactivation settings. Use this parameter to select which of the stored configurations you wish to use.

MEASUREMENTS

LAUNCH CONTROL ACTIVE

If TRUE, launch control is active. In other words, it is actively controlling acceleration.

LAUNCH CONTROL CUT REQUEST

Indicates the amount of cut requested by the launch control feature. There are two possible values for this parameter:

- **1** = no cut requested
- **2** = full cut requested

LAUNCH CONTROL MAP SELECTED

Indicates which launch control map is being used.

NITROUS CONTROL

Parameters for configuring nitrous control.

TUNABLE PARAMETERS (CHARACTERISTICS)

NITROUS (NOS) CONTROL ENABLED

Set to YES to enable the nitrous control feature. Set to NO to disable.

NITROUS (NOS) ACTIVE DUTY CYCLE

This table specifies nitrous active duty cycle (%) as a function of engine speed. It is used to regulate how frequently the nitrous system injects nitrous oxide into the engine.

NITROUS (NOS) ACTIVE DUTY CYCLE RATE LIMITER DOWN

Specifies how quickly the duty cycle of the nitrous injection system can decrease. Values closer to zero specify a more gradual change. The further away from zero, the more rapid the change.

Range: -1000 to 0

NITROUS (NOS) ACTIVE DUTY CYCLE RATE LIMITER UP

Specifies how quickly the duty cycle of the nitrous injection system can increase. Values closer to zero specify a more gradual change. The larger the value, the more rapid the change.

Range: 0 to 1000

NITROUS (NOS) CONTROL ACTUATOR OUTPUT

Specifies the pin on the ECU connector that the nitrous control actuator is wired to.

NITROUS (NOS) CONTROL ACTUATOR OUTPUT FREQUENCY

Specifies the frequency (in Hz) of the channel on which the ECU sends commands to the nitrous control actuator. This actuator regulates the flow of nitrous oxide to the engine.

NITROUS (NOS) CONTROL ENGINE COOLANT TEMPERATURE THRESHOLD

Specifies the minimum engine coolant temperature required to activate nitrous injection.

NITROUS (NOS) CONTROL ENGINE COOLANT TEMPERATURE THRESHOLD HYSTERESIS

Specific the amount that the engine coolant temperature must fall below Nitrous Control Engine Coolant Temperature Threshold in order to deactivate nitrous injection.

Larger values help prevent frequent activation and deactivation when the engine coolant temperature hovers near the threshold.

NITROUS (NOS) CONTROL ENGINE SPEED MAXIMUM THRESHOLD

Specifies the maximum engine speed (in rpm) at which the nitrous system can be active. Above this engine speed, nitrous injection will be deactivated.

NITROUS (NOS) CONTROL ENGINE SPEED MAXIMUM THRESHOLD HYSTERESIS

Specifies the amount (in rpm) that engine speed must fall below Nitrous Control Engine Speed Maximum Threshold in order to reactivate nitrous injection.

Higher values help prevent nitrous injection from being repeatedly activated and deactivated when engine speed hovers near the threshold.

NITROUS (NOS) CONTROL ENGINE SPEED MINIMUM THRESHOLD

Specifies the minimum engine speed (in rpm) needed to activate nitrous injection.

Setting this value appropriately helps ensure that the engine is spinning at a safe and responsive speed before introducing nitrous and reduces the chances of the engine struggling or stalling due to the sudden increase in power from nitrous.

NITROUS (NOS) CONTROL ENGINE SPEED MINIMUM THRESHOLD HYSTERESIS

Specifies the amount (in rpms) that engine speed must fall below Nitrous Control Engine Speed Minimum Threshold in order to deactivate nitrous injection.

Larger values help ensure that nitrous injection will not repeatedly switch between active and inactive when engine speed hovers near the threshold.

NITROUS (NOS) CONTROL FUEL ENRICHMENT RATE LIMITER DOWN

Specifies the maximum rate at which the nitrous control module can reduce fuel enrichment.

The larger the value, the more gradual the reduction and vice versa (values are negative, so -1 is greater than -100).

Higher values are recommended. This provides smoother ramp out response when nitrous gets deactivated.

NITROUS (NOS) CONTROL FUEL ENRICHMENT RATE LIMITER UP

Specifies the maximum rate at which the nitrous control module can increase fuel enrichment.

The larger the value, the faster enrichment increases and vice versa.

Higher values are recommended since rapid fuel enrichment is needed as soon as nitrous is activated. This helps provide better control and safety.

NITROUS (NOS) CONTROL IGNITION RETARD RATE LIMITER DOWN

Specifies the maximum rate at which the nitrous control module can increase ignition retard.

Smaller values yield faster increases in ignition retard and vice versa (values are negative, so -100 is smaller than -1).

Lower values are recommended, since ignition retard should occur rapidly as soon as nitrous is active. This helps provide better control and safety.

NITROUS (NOS) CONTROL IGNITION RETARD RATE LIMITER UP

Specifies the maximum rate at which the nitrous control module can decrease ignition retard.

The smaller the value, the more gradual the response and vice versa.

Smaller values are recommended. This tends to produce smoother ramp out response when nitrous gets deactivated.

NITROUS (NOS) CONTROL NITROUS PRESSURE MAXIMUM THRESHOLD

Specifies the maximum nitrous pressure for nitrous control (nitrous injection will be deactivated above this nitrous pressure value).

Range: 0 to 1595 psi / 0 to 11000 kPa

NITROUS (NOS) CONTROL NITROUS PRESSURE MAXIMUM THRESHOLD HYSTERESIS

Nitrous pressure must fall this amount below Nitrous Control Nitrous Pressure Maximum Threshold in order to deactivate nitrous injection.

Larger values help ensure that nitrous injection will not be repeatedly activated and deactivated when nitrous pressure hovers near the threshold.

Range: 0 to 145 psi / 0 to 1000 kPa

NITROUS (NOS) CONTROL NITROUS PRESSURE MINIMUM THRESHOLD

Specifies the minimum nitrous pressure required to activate nitrous injection.

Range: 0 to 1595 psi / 0 to 11000 kPa

NITROUS (NOS) CONTROL NITROUS PRESSURE MINIMUM THRESHOLD HYSTERESIS

Nitrous pressure must be this amount below Nitrous Control Nitrous Pressure Minimum Threshold in order to deactivate nitrous injection.

Higher values help ensure that nitrous injection is not repeatedly activated and deactivated when nitrous pressure hovers near the threshold.

Range: 0 to 145 psi / 0 to 1000 kPa

NITROUS (NOS) CONTROL THROTTLE POSITION THRESHOLD

Specifies the minimum throttle position (%) required to activate nitrous injection.

Range: 0 to 100%

NITROUS (NOS) CONTROL THROTTLE POSITION THRESHOLD HYSTERESIS

Throttle position must be this amount (in %) below Nitrous Control Throttle Position Threshold in order to deactivate nitrous injection.

Higher values help ensure that nitrous injection is not repeatedly activated and deactivated when throttle position hovers near the threshold.

Range: 0 to 50%

NITROUS (NOS) CONTROL VEHICLE SPEED THRESHOLD

Specifies the minimum vehicle speed required to activate nitrous injection.

Setting a reasonable speed threshold helps ensure that the system activates only when the vehicle is traveling at a speed where the additional power can be effectively managed and utilized.

Range: 0 to 200 mph / 0 to 322 km/h

NITROUS (NOS) CONTROL VEHICLE SPEED THRESHOLD HYSTERESIS

Vehicle speed must be this amount below Nitrous Control Vehicle Speed Threshold in order to deactivate nitrous injection.

Higher values help ensure that nitrous injection does not repeatedly activate and deactivate when vehicle speed hovers near the threshold.

Range: 0 to 100 mph / 0 to 161 km/h

NITROUS (NOS) FUEL ENRICHMENT

This table specifies the amount of fuel enrichment applied by the nitrous system as a function of cylinder airmass and engine speed.

NITROUS (NOS) IGNITION RETARD

This table specifies the amount of ignition retard (in degrees) applied by the nitrous system as a function of cylinder airmass and engine speed.

MEASUREMENTS

NITROUS (NOS) ACTIVE

If TRUE, the nitrous oxide (N2O) injection system is actively supplying a mixture of nitrous oxide and additional fuel into the engine's intake manifold.

NITROUS (NOS) CONTROL ACTUATOR OUTPUT STATUS

If YES, the nitrous control actuator is on. If NO, it is off.

NITROUS (NOS) ACTIVE DUTY CYCLE

Indicates how frequently the nitrous injection system is active (after rate limiter application).

NITROUS (NOS) FUEL ENRICHMENT

When nitrous control is active, this indicates the amount of fuel enrichment applied to injection time requested.

NITROUS (NOS) IGNITION RETARD

When nitrous control is active, this indicates the amount of ignition retard (in degrees) applied to the base ignition angle.

NITROUS (NOS) IGNITION RETARD ACTIVE

If TRUE, the nitrous control module is actively applying ignition retard.

SOFT LIMITER

The soft limiter is the primary line of defense against engine over speed conditions. To reduce engine speed, it can limit throttle position, employ ignition retard, or both.

Throttle position limits will become active if all three of the following conditions are met:

- Soft Limiter Enabled = YES (the feature has been manually enabled)
- Throttle Body Type = Drive By Wire or Dual Throttle Body (throttle can't be electronically controlled in Drive By Cable mode)
- The engine speed is greater than the Soft Limiter Threshold specified in the currently-selected map.

Ignition retard control will become active if all of the following conditions are met:

- Soft Limiter Enabled = YES (the feature has been manually enabled)
- Soft Limiter Ignition Retard Enabled = YES (soft limiter control of ignition retard has been manually enabled)
- The engine speed is greater than the Soft Limiter Threshold specified in the currently-selected map.

Throttle position and/or ignition retard limits will remain active until engine speed falls below Soft Limiter Threshold - Soft Limiter Threshold Hysteresis.

Once throttle position limiting is active, the soft limiter will begin making corrections to throttle position using its own PID controller, which uses Soft Limter Threshold as the target engine speed.

Once igntion retard control is active, soft limiter simply applies the amount of retard specified in the currently-selected Soft Limiter Ignition Retard Map.

TUNABLE PARAMETERS (CHARACTERISTICS)

SOFT LIMITER CLOSED LOOP MAXIMUM

Specifies the maximum throttle position (%) allowed by the soft limiter when the vehicle is operating in closed-loop mode.

SOFT LIMITER CLOSED LOOP MINIMUM

Specifies the minimum throttle position (%) allowed by the soft limiter when the vehicle is operating in closed-loop mode.

SOFT LIMITER ENABLED

Set to YES to enable the soft limiter feature. Set to NO to disable.

SOFT LIMITER FEED FORWARD (MAP 1)

This is one of four tables that specify soft limiter feed forward (%) as a function of gear number index. This table is used when Soft Limiter Map Select is set to 1.

The feed forward term is the portion of the total throttle position correction applied that is based on the current drive gear selected.

To fill out this table, correctly:

1. Ensure that Soft Limiter Threshold (Map #1) is configured to match the engine speed threshold that you want to use to activate the soft limiter.
2. For each drive gear in the table
   a. Run the engine in that gear.
   b. Apply throttle until you determine the amount of throttle (%) that you need to apply steadily to reach the soft limiter threshold.
   c. Enter this throttle % in the corresponding table cell.
3. You should now have a good initial value for the feed forward term. Adjust as necessary to achieve optimum results.

SOFT LIMITER FEED FORWARD MAP #2

This is one of four tables that specify soft limiter feed forward as a function of gear number index. This table is used when Soft Limiter Map Select is set to 2.

See the description for Soft Limiter Feed Forward (Map # 1) for more information.

SOFT LIMITER FEED FORWARD MAP #3

This is one of four tables that specify soft limiter feed forward as a function of gear number index. This table is used when Soft Limiter Map Select is set to 3.

See the description for Soft Limiter Feed Forward (Map # 1) for more information.

SOFT LIMITER FEED FORWARD MAP #4

This is one of four tables that specify soft limiter feed forward as a function of gear number index. This table is used when Soft Limiter Map Select is set to 4.

See the description for Soft Limiter Feed Forward (Map # 1) for more information.

SOFT LIMITER IGNITION RETARD (MAP #1)

This is one of four maps that specify the degrees of ignition retard applied by the soft limiter as a function of Soft Limiter Engine Speed Error and transmission gear selected. This map will be used when Soft Limiter Map selected equals 1.

SOFT LIMITER IGNITION RETARD MAP #2

This is one of four maps that specify the degrees of ignition retard applied by the soft limiter as a function of Soft Limiter Engine Speed Error and transmission gear selected. This map will be used when Soft Limiter Map selected equals 2.

SOFT LIMITER IGNITION RETARD MAP #3

This is one of four maps that specify the degrees of ignition retard applied by the soft limiter as a function of Soft Limiter Engine Speed Error and transmission gear selected. This map will be used when Soft Limiter Map selected equals 3.

SOFT LIMITER IGNITION RETARD MAP #4

This is one of four maps that specify the degrees of ignition retard applied by the soft limiter as a function of Soft Limiter Engine Speed Error and transmission gear selected. This map will be used when Soft Limiter Map Selected equals 4.

SOFT LIMITER INTEGRAL GAIN

This table specifies soft limiter integral gain (%/rpm/sec) as a function of gear number index and soft limiter engine speed error.

When calculating the integral term, this value is multiplied by the Soft Limiter Engine Speed Error, which is then multiplied by the time period between each calculation of the integral term (0.01 seconds). The resulting value is added to the integral term from the previous cycle.

In this calculation, the gain serves two purposes.

- It converts the error (rpm) to a throttle percentage.
- It specifies the overall magnitude of the integral term.

Cell data range: 0 to 100 %/kPa/s

SOFT LIMITER INTEGRAL TERM MAXIMUM

Specifies the maximum value (in %) for the soft limiter integral term. This value will be used as the integral term if the calculated integral term exceeds this value.

Range: 0 to 100%

SOFT LIMITER INTEGRAL TERM MINIMUM

Specifies the minimum value (in %) for the soft limiter integral term. This value will be used as the integral term if the calculated integral term is lower (more negative) than this value.

Range: -100 to 0%

SOFT LIMITER MAP SELECT

Several soft limiter parameters allow you to save up to four different configurations, called maps. Use this parameter to specify which of the four maps will be used.

SOFT LIMITER PROPORTIONAL GAIN

This table specifies soft limiter proportional gain (%/rpm) as a function of gear number index and soft limiter engine speed error.

When calculating the proportional term, the value from this table is multiplied by the Soft Limiter Engine Speed Error. In this calculation, the gain serves two purposes.

- It converts the error (rpm) to a throttle percentage.
- It specifies the overall magnitude of the proportional term.

Cell data range: -100 to 100 %/rpm

SOFT LIMITER IGNITION RETARD DECAY

This table specifies a multiplier to ignition retard as a function of the amount of time that soft limiter ignition retard has been active.

This allows the ignition retard to increase or decrease based on how long the soft limiter has been active:

- If values are ascending, the rate of ignition retard increases with soft limiter active time.
- If values are descending, the rate of ignition retard decreases with soft limiter active time.

Cell data range: 0 to 100 degrees

SOFT LIMITER IGNITION RETARD ENABLED

Set to YES to enable ignition retard portion of the soft limiter feature. This grants permission for the soft limiter to use ignition retard as part of its operation.

Set to NO to disable. Soft limiter will not use ignition retard even if engine speed is beyond the specified threshold.

SOFT LIMITER PROPORTIONAL TERM MAXIMUM

Specifies the maximum value (in %) for the soft limiter proportional term. This value will be used as the proportional term if the calculated proportional term exceeds this value.

Range: 0 to 100%

SOFT LIMITER PROPORTIONAL TERM MINIMUM

Specifies the minimum value (in %) for the soft limiter proportional term. This value will be used as the proportional term if the calculated proportional term is lower (more negative) than this value.

Range: -100 to 0%

SOFT LIMITER THRESHOLD (MAP #1)

This is one of four maps that specify the soft limiter threshold (in rpm) as a function of gear number index. This table will be used when Soft Limiter Map Selected equals 1.

This threshold serves two purposes:

- It specifies the engine speed at which the soft limiter will activate and begin to limit throttle and/or retard ignition.
- Once activated, soft limiter will use this value as the target engine speed when applying throttle control.

SOFT LIMITER THRESHOLD MAP #2

This is one of four maps that specify the soft limiter threshold (in rpm) as a function of gear number index. This table will be used when Soft Limiter Map Selected equals 2.

This threshold serves two purposes:

- It specifies the engine speed at which the soft limiter will activate and begin to limit throttle and/or retard ignition.
- Once activated, soft limiter will use this value as the target engine speed when applying throttle control.

SOFT LIMITER THRESHOLD MAP #3

This is one of four maps that specify the soft limiter threshold (in rpm) as a function of gear number index. This table will be used when Soft Limiter Map Selected equals 1.

This threshold serves two purposes:

- It specifies the engine speed at which the soft limiter will activate and begin to limit throttle and/or retard ignition.
- Once activated, soft limiter will use this value as the target engine speed when applying throttle control.

SOFT LIMITER THRESHOLD MAP #4

This is one of four maps that specify the soft limiter threshold (in rpm) as a function of gear number index. This table will be used when Soft Limiter Map Selected equals 4.

This threshold serves two purposes:

- It specifies the engine speed at which the soft limiter will activate and begin to limit throttle and/or retard ignition.
- Once activated, soft limiter will use this value as the target engine speed when applying throttle control.

SOFT LIMITER THRESHOLD HYSTERESIS (MAP #1)

This is one of four maps that specify the soft limiter threshold hysteresis (in rpm) as a function of gear number index. This map will be used when Soft Limiter Map Selected equals 1.

Soft Limiter will be deactivated when engine speed falls below Soft Limiter Threshold (Map #1) minus this value.

Higher values help ensure that soft limiter does not repeatedly activate and deactivate when engine speed hovers near the threshold.

SOFT LIMITER THRESHOLD HYSTERESIS MAP #2

This is one of four maps that specify the soft limiter threshold hysteresis (in rpm) as a function of gear number index. This map will be used when Soft Limiter Map Selected equals 2.

Soft Limiter will be deactivated when engine speed falls below Soft Limiter Threshold Map #2 minus this value.

Higher values help ensure that soft limiter does not repeatedly activate and deactivate when engine speed hovers near the threshold.

SOFT LIMITER THRESHOLD HYSTERESIS MAP #3

This is one of four maps that specify the soft limiter threshold hysteresis (in rpm) as a function of gear number index. This map will be used when Soft Limiter Map Selected equals 3.

Soft Limiter will be deactivated when engine speed falls below Soft Limiter Threshold Map #3 minus this value.

Higher values help ensure that soft limiter does not repeatedly activate and deactivate when engine speed hovers near the threshold.

SOFT LIMITER THRESHOLD HYSTERESIS MAP #4

This is one of four maps that specify the soft limiter threshold hysteresis (in rpm) as a function of gear number index. This map will be used when Soft Limiter Map Selected equals 4.

Soft Limiter will be deactivated when engine speed falls below Soft Limiter Threshold Map #4 minus this value.

Higher values help ensure that soft limiter does not repeatedly activate and deactivate when engine speed hovers near the threshold.

MEASUREMENTS

SOFT LIMITER ACTIVE

If TRUE, the soft limiter is actively managing throttle position in order to limit engine speed. If FALSE, the soft limiter is not active.

SOFT LIMITER ENGINE SPEED ERROR

The amount that the measured engine speed (in RPM) differs from the target engine speed, where target engine speed is the threshold specified by the currently-selected Soft Limiter Threshold map. This is calculated as:

Soft Limiter Threshold - Engine Speed

SOFT LIMITER FEED FORWARD TERM

The portion of the throttle position correction applied by soft limiter that is based solely on gear number index.

> **NOTE:** The total correction applied equals Feed Forward Term + Integral Term + Proportional term.

SOFT LIMITER IGNITION RETARD

The amount of ignition retard (in degrees) applied by soft limiter.

SOFT LIMITER IGNITION RETARD ACTIVE

If TRUE, the soft limiter is applying ignition retard. If FALSE, it is not.

SOFT LIMITER IGNITION RETARD DECAY

The multiplier being applied to the base amount ignition retard defined for soft limiter. Depending on how Soft Limiter Ignition Retard Decay has been tuned, this may increase or decrease over time.

SOFT LIMITER INTEGRAL TERM

One of three component values that are used to calculate the throttle correction that will be applied to reduce Engine Speed Error.

> **NOTE:** Total throttle correction applied is equal to Feed Forward Term + Proportional Term + Integral Term.

The integral term is based on the cumulative Soft Limiter Engine Speed Error over time. Each time engine speed error is calculated:

1. The error is multiplied by Soft Limiter Integral Gain which is then multiplied by the time (in seconds) since the previous calculation of the integral term.
2. The result is added to the previous Soft Limiter Integral Term, resulting in a new value for the integral term.

SOFT LIMITER MAP SELECTED

There are four versions of certain soft limiter parameters, allowing multiple configurations to be stored on the ECU. This indicates which of those configurations is currently being used.

SOFT LIMITER PROPORTIONAL TERM

One of three component values that are used to calculate the throttle correction (%) that will be applied to reduce Soft Limiter Engine Speed Error.

> **NOTE:** Total throttle correction applied is equal to Feed Forward Term + Proportional Term + Integral Term.

The proportional term is directly proportional to the amount of engine speed error observed.

SOFT LIMITER THROTTLE POSITION REQUESTED

When soft limiter is active, this indicates the final throttle position (%) requested by the soft limiter module.

ENGINE STATUS

Parameters that indicate engine status.

CYLINDER NUMBER

Parameters that indicate current cylinder number.

MEASUREMENTS

CURRENT CYLINDER NUMBER

Indicates the current cylinder number as per firing order.

ENGINE POSITION

Indicates the current engine position (in degrees).

HP Tuners, LLC
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Buffalo Grove, IL 60089, USA

DATA LOGGING INFO

Parameters from the ECU's internal data logging.

TUNABLE PARAMETERS (CHARACTERISTICS)

MEASUREMENTS

INTERNAL DATA LOGGER ACTIVE

If TRUE, the ECU's internal data logger is running. If FALSE, it is not running.

INTERNAL DATA LOGGER STORAGE USED

Shows how much storage has been used by the data logger, as a percentage of the total available for logging.

DIAGNOSTIC CHECK CONDITION

This module is responsible for determining when to run certain diagnostic checks. The checks this module controls are divided into three groups:

- **Group 1.** This group runs only when the ignition is ON, but the engine is not running.
- **Group 2.** This group runs only when the engine is running in a steady state (determined by the rate of change of manifold absolute pressure and throttle position).
- **Group 3.** This group runs periodically whenever the engine is running.

TUNABLE PARAMETERS (CHARACTERISTICS)

DIAGNOSTIC CHECK CONDITION 2 MANIFOLD ABSOLUTE PRESSURE DELTA THRESHOLD

Specifies the maximum rate of change to manifold absolute pressure for which the engine can be considered to be running in a steady state. If the rate of change is less than this value, check condition 2 can be activated.

Range: 0 to 1000 kpa per 100 ms

DIAGNOSTIC CHECK CONDITION 2 MANIFOLD ABSOLUTE PRESSURE DELTA THRESHOLD HYSTERESIS

If the rate of change to manifold absolute pressure increases above Diagnostic Check Condition 2 Manifold Absolute Pressure Delta Threshold plus this value, deactivate diagnostic check condition 2. The engine is no longer running in a steady state.

Range: 0 to 1000 kpa per 100 ms

DIAGNOSTIC CHECK CONDITION 2 THROTTLE POSITION DELTA THRESHOLD

Specifies the maximum rate of change to the throttle position for which the engine can be considered to be running in a steady state. If the rate of change is less than this value, check condition 2 can be activated.

Range: 0 to 1000% per 100 ms

DIAGNOSTIC CHECK CONDITION 2 THROTTLE POSITION DELTA THRESHOLD HYSTERESIS

If the rate of change to throttle position increases above Diagnostic Check Condition 2 Throttle Position Delta Threshold plus this value, deactivate diagnostic check condition 2. The engine is no longer running in a steady state.

Range: 0 to 1000% per 100 ms

MEASUREMENTS

DIAGNOSTIC CHECK CONDITION 1 ACTIVE

If YES, diagnostic check condition 1 is active. This occurs when the ignition switch is ON, but the engine is not running.

When this condition is active, checks are run for all sensor DTCs except the fuel pressure sensor and the lambda sensor heater.

DIAGNOSTIC CHECK CONDITION 2 ACTIVE

If YES, diagnostic check condition 2 is active, which means that the engine is running in a steady state. When this condition is active, diagnostic checks will be run on the sensors in group 2:

- Oil Pressure Sensor
- Barometric Pressure Sensor
- Lambda 1 & 2 Sensors
- Front/Rear Brake Pressure Sensor
- Nitrous Pressure Sensor
- Air Conditioner Refrigerant Pressure Sensor
- Transmission Line Pressure Sensor
- Fuel Pressure Sensor
- Knock Bank 1 & 2 Sensor

- Lambda Sensor Heater Sensor

DIAGNOSTIC CHECK CONDITION 3 ACTIVE

If YES, diagnostic check condition 3 is active (secondary time interval). This is applicable to following sensors only:

- Intake Air Temperature Sensor
- Engine Coolant Temperature Sensor
- Flex Fuel Sensor
- Air Conditioner Refrigerant Temperature Sensor
- Transmission Oil Temperature Sensor
- Internal Thermistor Temperature (ECU Temperature) Sensor
- Lambda Sensor Heater Sensor

ENGINE SPEED

Parameters that indicate engine speed.

TUNABLE PARAMETERS (CHARACTERISTICS)

ENGINE SPEED (RPM) FILTER COEFFICIENT

A filter can be applied to the engine speed. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

MEASUREMENTS

ENGINE SPEED (RPM)

The angular velocity of the engine (in rpm), after filtering is applied.

ENGINE SPEED (RPM) AVERAGE

The angular velocity of the engine (in rpm), calculated over the last 180 degrees of crankshaft rotation.

ENGINE SPEED (RPM) INSTANTANEOUS

The angular velocity of the engine (in rpm), calculated between the most recent tooth edges. This provides real-time information about how fast the engine is spinning at any given instant.

ENGINE SPEED (RPM) RAW

The angular velocity of the engine (in rpm), before filtering is applied.

ENGINE STATE

The Engine State module reports various information about the current status of the engine, such as how long it's been running (or how long since it was last running)

It also indicates whether the engine is stalled, cranking, ramping or running, based on the measured engine speed.

TUNABLE PARAMETERS (CHARACTERISTICS)

ENGINE SPEED (RPM) CRANKING THRESHOLD

Specifies the engine speed threshold between Stalled and Cranking. Engine speeds below this value will be considered to be stalled.

Engine speeds between this value and the Engine Ramping Threshold will be considered cranking.

Range: 0 to 1000 rpm

ENGINE SPEED (RPM) RAMPING THRESHOLD

Specifies the engine speed threshold between Cranking and Ramping. Engine speeds below this value, but above the Engine Cranking Threshold will be considered cranking.

Engine speeds above this value, but below the Engine Running Threshold will be considered ramping.

Range: 0 to 1000 rpm

ENGINE SPEED (RPM) RUNNING THRESHOLD

Specifies the engine speed threshold between Ramping and Running. Engine speeds below this value, but above the Engine Ramping Threshold will be considered ramping.

Engine speeds above this value will be considered running.

Range: 0 to 1000 rpm

MEASUREMENTS

ENGINE RUN TIME

The amount of time that engine speed has been above the Engine Running Threshold (in seconds).

SOAK TIME

The amount of time since the engine was last running (in seconds).

ENGINE STATE

Indicates the current engine state. There are four possible values for this:

- **Stalled** - the engine speed is lower than it would be if the starter was rotating the engine.
- **Cranking** - the engine speed is within the range that it would normally be when the starter motor has begun rotating the engine, but the engine has not yet started to rotate under its own power.
- **Ramping** - this is a momentary transitional state between cranking and running. The engine has likely started to run under its own power, but isn't yet up to the speed necessary to be considered running.
- **Running** - the engine is running under its own power.

> **NOTE:** State is determined by current engine speed, based on the thresholds set with Engine Cranking Threshold, Engine Ramping Threshold and Engine Running Threshold.

ENGINE RUN STATUS

Indicates whether the engine is currently running or if it's turned off.

GPID EXPANDER STATUS

Parameters that indicate GPID expander status.

MEASUREMENTS

BATTERY LOAD DUMP STATUS OK

If YES, everything is normal with battery load dump. If NO, there is an error.

HBRIDGE 1 STATUS OK

If YES, everything is normal with H-bridge 1. If NO, there is an error.

HBRIDGE 1 LOAD DUMP STATUS OK

If YES, everything is normal with H-bridge 1 load dump. If NO, there is an error.

HBRIDGE 2 STATUS OK

If YES, everything is normal with H-bridge 2. If NO, there is an error.

HBRIDGE 2 LOAD DUMP STATUS OK

If YES, everything is normal with H-bridge 2 load dump. If NO, there is an error.

HIGH SIDE DRIVER 1 STATUS OK

If YES, everything is normal with high side driver 1. If NO, there is an error.

HIGH SIDE DRIVER 2 STATUS OK

If YES, everything is normal with high side driver 2. If NO, there is an error.

HIGH SIDE DRIVER 3 STATUS OK

If YES, everything is normal with high side driver 3. If NO, there is an error.

HIGH SIDE DRIVER 4 STATUS OK

If YES, everything is normal with high side driver 4. If NO, there is an error.

IDLE AIR CONTROL VALVE DTC ACTIVE

If YES, a DTC has been set for the idle air control valve.

IDLE AIR CONTROL VALVE EF1 STATUS OK

If YES, everything is normal with idle air control valve EF1. If NO, there is an error.

IDLE AIR CONTROL VALVE EF2 STATUS OK

If YES, everything is normal with idle air control valve EF2. If NO, there is an error.

IDLE AIR CONTROL VALVE FAULT

Idle air control valve faults:

1. No Fault
2. Over Current Fault
3. Open Load Fault
4. Over Voltage / Over Temperature Fault

LAMBDA HEATER DTC ACTIVE

If YES, a DTC has been for lambda sensor 1 or 2 heater. The DTC check activates only when the engine is running.

LAMBDA SENSOR 1 HEATER STATUS OK

If YES, everything is normal with the lambda sensor 1 heater. If NO, there is an error.

LAMBDA SENSOR 2 HEATER STATUS OK

If YES, everything is normal with the lambda sensor 2 heater. If NO, there is an error.

LOW SIDE DRIVER 1 STATUS OK

If YES, everything is normal with low side driver 1. If NO, there is an error.

LOW SIDE DRIVER 2 STATUS OK

If YES, everything is normal with low side driver 2. If NO, there is an error.

LOW SIDE DRIVER 3 STATUS OK

If YES, everything is normal with low side driver 3. If NO, there is an error.

LOW SIDE DRIVER 4 STATUS OK

If YES, everything is normal with low side driver 4. If NO, there is an error.

LOW SIDE DRIVER 5 STATUS OK

If YES, everything is normal with low side driver 5. If NO, there is an error.

LOW SIDE DRIVER 6 STATUS OK

If YES, everything is normal with low side driver 6. If NO, there is an error.

LOW SIDE DRIVER 7 STATUS OK

If YES, everything is normal with low side driver 7. If NO, there is an error.

LOW SIDE DRIVER 8 STATUS OK

If YES, everything is normal with low side driver 8. If NO, there is an error.

LOW SIDE DRIVER 9 STATUS OK

If YES, everything is normal with low side driver 9. If NO, there is an error.

LOW SIDE DRIVER 10 STATUS OK

If YES, everything is normal with low side driver 10. If NO, there is an error.

LOW SIDE DRIVER 11 STATUS OK

If YES, everything is normal with low side driver 11. If NO, there is an error.

LOW SIDE DRIVER 12 STATUS OK

If YES, everything is normal with low side driver 12. If NO, there is an error.

LOW SIDE DRIVER 13 STATUS OK

If YES, everything is normal with low side driver (with pull-up) 13. If NO, there is an error.

LOW SIDE DRIVER 14 STATUS OK

If YES, everything is normal with low side driver (with pull-up) 14. If NO, there is an error.

POWER SUPPLY 5V DTC ACTIVE

If YES, a DTC has been set for power supply 5V sensor 1 or sensor 2.

POWER SUPPLY 5V LOCAL STATUS OK

If YES, everything is normal with the power supply 5v local . If NO, there is an error.

POWER SUPPLY 5V SENSOR 1 STATUS OK

If YES, everything is normal with power supply 5v sensor 1. If NO, there is an error.

POWER SUPPLY 5V SENSOR 2 STATUS OK

If YES, everything is normal with power supply 5v sensor 2. If NO, there is an error.

SWITCHED 6V POWER STATUS OK

If YES, everything is normal with switched 6v power. If NO, there is an error.

SWITCHED IGNITION LOAD DUMP STATUS OK

If YES, everything is normal with switched ignition load dump. If NO, there is an error.

SYNCHRO STATE

Synchro state parameters.

MEASUREMENTS

CURRENT ENGINE SYNCHRONOUS EVENT

Reports the current engine synchronous event count (zero based).

ENGINE SYNCHRONOUS EVENT COUNTER

Synchro count (engine synchronous event counter).

VIRTUAL TORQUE

Parameters for the virtual torque.

TUNABLE PARAMETERS (CHARACTERISTICS)

CYLINDER AIRMASS TORQUE COEFFICIENT

Indicates how the ECU calculates the torque produced by the engine based on the amount of air entering each cylinder and engine speed.

ENGINE SPEED TORQUE COEFFICIENT

Indicates how the ECU calculates the torque produced by the engine at different engine speeds.

SPARK AIRMASS TORQUE COEFFICIENT

Indicates how the ECU calculates and adjusts the torque produced by the engine based on the combination of ignition timing, the amount of air entering the cylinders, and engine speed.

SPARK SQUARED AIRMASS TORQUE COEFFICIENT

Indicates how the ECU calculates and adjusts the torque produced by the engine speed based on the squared value of ignition timing and the amount of air entering the cylinders.

SPARK SQUARED TORQUE COEFFICIENT

Indicates how the ECU calculates and adjusts the torque produced by the engine based on the squared value of the ignition timing and engine speed.

SPARK TORQUE COEFFICIENT

Indicates how the ECU calculates and adjusts the torque produced by the engine based on the ignition timing and engine speed.

MEASUREMENTS

ESTIMATED ENGINE TORQUE

The estimated engine torque parameter measures the engines torque output (in nm).

FUEL

Parameters for fuel.

CLOSED LOOP LAMBDA CONTROL

This module is responsible for calculating fuel trims, which are then passed on to the Injection Time module for use in calculating flow rate.

To do this, the module performs the following tasks:

1. Determines whether to activate closed loop lambda control for cylinder bank 1 and cylinder bank 2. This is based on a number of factors, including:
   - The lambda sensor for each cylinder bank's exhaust (Lambda Sensor 1/2 Input Status) must be ON.
   - The Closed Loop Lambda Control Enable table value for the current throttle position and engine speed must be 1 (enable).
   - Engine run time must be greater than Closed Loop Lambda Enable Delay.
   - Engine coolant temperature must be greater than Closed Loop Lambda Control Engine Coolant Temperature Threshold.
   - After Start Enrichment Disengaged must be TRUE.
2. Once closed loop lambda control has been enabled for a cylinder bank, the lambda error for the bank is calculated for that bank (Lambda Setpoint - measured lambda value).
3. A transport delay compensation control loop is used to calculate the delay compensation for each cylinder bank:
   a. The calculated lambda error and the length of time specified in Lambda Transport Delay are used to determine the amount of error due to transport delay (Lambda Transport Delay Error).
   b. The Lambda Transport Delay Error is used to calculate the Lambda Transport Delay Proportional Term and Lambda Transport Delay Integral Term.

c. The Lambda Transport Delay Weighting Factor Term is calculated by multiplying the Transport Delay Weighting Factor by the change in lambda correction over the period specified in Lambda Transport Delay.

4. A closed loop lambda controller determines the short term fuel trim that will be be applied to each cylinder in the bank (Lambda 1 Correction / Lambda 2 Correction):

a. The lambda error is used to calculate the closed loop proportional and integral terms for the cylinder bank.

b. A raw correction amount is determined using the closed loop proportional and integral terms as well as the output of the transport delay compensation controller.

c. The final correction is produced by comparing the raw correction to the Lambda Closed Loop Maximum and Lambda Closed Loop Minimum.

TUNABLE PARAMETERS (CHARACTERISTICS)

CLOSED LOOP LAMBDA CONTROL ENABLE DELAY

This table specifies how quickly (in seconds) the ECU transitions from open-loop operation to closed-loop operation, where it fine-tunes the air-fuel mixture based on real-time sensor data.

CLOSED LOOP LAMBDA CONTROL ENABLE

This table specifies whether closed loop lambda control should be enabled, based on engine speed and throttle position. Each cell has the following possible values:

- 0 = Turn closed loop lambda control OFF.
- 1 = Turn closed loop lambda control ON.
- 2 = Maintain current status.

> **NOTE:** This is only one factor in determining whether to activate closed loop lambda control for a particular cylinder bank. Other factors include: whether the lambda sensor is on, ECT temperature, engine run time, and after start enrichment.

CLOSED LOOP LAMBDA CONTROL ENGINE COOLANT TEMPERATURE THRESHOLD

Specifies the minimum engine coolant temperature needed to activate closed loop lambda control.

Range -40 to 140° Celsius

CLOSED LOOP LAMBDA CONTROL ENGINE COOLANT TEMPERATURE THRESHOLD HYSTERESIS

Engine coolant temperature must fall this number of degrees below Closed Loop Lambda Control Engine Coolant Temperature in order to deactivate closed loop lambda control.

Larger values help ensure that closed loop lambda control is not repeatedly activated and deactivated when the temperature hovers near the threshold.

Range -40 to 140° Celsius

LAMBDA BANK 1 INTEGRAL GAIN

This table defines lambda integral gain for cylinder bank 1 as a function of bank 1 lambda error. It us used to adjust the overall magnitude of the Integral Term for bank 1.

When calculating the integral term, this value is multiplied by the Lambda Bank 1 Error, which is then multiplied by 0.01 seconds (the time period between each calculation of the integral term). The resulting value is added to the integral term from the previous cycle.

> **NOTE:** Total error correction applied is equal to 1 + transport delay compensation - Proportional Term - Integral Term.

LAMBDA BANK 1 PROPORTIONAL GAIN

This table defines lambda proportional gain for cylinder bank 1 as a function of lambda bank 1 error. It is used to adjust the overall magnitude of the Lambda Bank 1 Proportional Term.

> **NOTE:** Total error correction applied is equal to 1 + transport delay compensation - Proportional Term - Integral Term.

In general, larger proportional gain values mean error is corrected faster because more corrective action is being taken.

However, larger values also increase the amount by which the total correction overshoots the target value. Although a small amount of overshoot is normal, too much of an overshoot may cause the error increase each cycle rather than decrease.

LAMBDA BANK 1 TRANSPORT DELAY

This table defines lambda transport delay for cylinder bank 1 as a function of engine speed. This is the time it takes the air/fuel mixture to leave the combustion chamber and reach the lambda sensor.

Cell data range: 0 to 10 seconds.

LAMBDA BANK 1 TRANSPORT DELAY WEIGHTING FACTOR

This is a multiplier that adjusts the overall magnitude of the Transport Delay Weighting Factor Term, which is one of three terms used to calculate the error correction needed to compensate for transport delay on cylinder bank 1.

LAMBDA BANK 2 INTEGRAL GAIN

This table defines lambda integral gain for cylinder bank 1 as a function of bank 2 lambda error. It us used to adjust the overall magnitude of the Integral Term for bank 2.

When calculating the integral term, this value is multiplied by the Lambda Bank 2 Error, which is then multiplied by 0.01 seconds (the time period between each calculation of the integral term). The resulting value is added to the integral term from the previous cycle.

> **NOTE:** Total error correction applied is equal to 1 + transport delay compensation - Proportional Term - Integral Term.

LAMBDA BANK 2 PROPORTIONAL GAIN

This table defines lambda proportional gain for cylinder bank 2 as a function of lambda bank 2 error. It is used to adjust the overall magnitude of the Lambda Bank 2 Proportional Term.

> **NOTE:** Total error correction applied is equal to 1 + transport delay compensation - Proportional Term - Integral Term.

In general, larger proportional gain values mean error is corrected faster because more corrective action is being taken.

However, larger values also increase the amount by which the total correction overshoots the target value. Although a small amount of overshoot is normal, too much of an overshoot may cause the error increase each cycle rather than decrease.

LAMBDA BANK 2 TRANSPORT DELAY

This table defines lambda transport delay for cylinder bank 2 as a function of engine speed. This is the time it takes the air/fuel mixture to leave the combustion chamber and reach the lambda sensor.

Cell data range: 0 to 10 seconds.

LAMBDA BANK 2 TRANSPORT DELAY WEIGHTING FACTOR

This is a multiplier that adjusts the overall magnitude of the Transport Delay Weighting Factor Term, which is one of three terms used to calculate the error correction needed to compensate for transport delay on cylinder bank 2.

LAMBDA CLOSED LOOP MAXIMUM

Specifies the maximum allowable value for Lambda Bank 1 Correction and Lambda Bank 2 Correction. If the calculated value for either of these parameters exceeds this value, this value will be used instead.

> **NOTE:** Lambda Bank 1 and Bank 2 corrections are also known as short term fuel trims).

LAMBDA CLOSED LOOP MINIMUM

Specifies the minimum allowable value for Lambda Bank 1 Correction and Lambda Bank 2 Correction. If the calculated value for either of these parameters is below this value, this value will be used instead.

> **NOTE:** Lambda Bank 1 and Bank 2 corrections are also known as short term fuel trims).

LAMBDA INTEGRAL DEADBAND

If either Lambda 1 Error or Lambda 2 Error is less than this value, it will be treated as zero error when updating the corresponding Integral Term. (In other words, the Integral Term will not change this cycle because the error is effectively zero.) This has the effect of freezing the integral value when lambda nears the desired setpoint.

> **NOTE:** This does not reset the Integral Term to zero. The term merely remains at its current value.

LAMBDA INTEGRAL TERM MAXIMUM

If the calculated value of Lambda Bank 1 Integral Term or Lambda Bank 2 Integral Term is greater than the value specified here, this value will be used instead.

LAMBDA INTEGRAL TERM MINIMUM

If the calculated value of Lambda Bank 1 Integral Term or Lambda Bank 2 Integral Term is less than the value specified here, this value will be used instead.

LAMBDA INTEGRATOR ENABLE MAXIMUM THRESHOLD

Specifies the maximum accumulated difference in air-fuel ratio, as measured by the lambda sensor integrator, required to activate specific adjustments or features in the ECU. Modifying this parameter allows tuners to set a maximum threshold for the integrator.

LAMBDA INTEGRATOR ENABLE MINIMUM THRESHOLD

Specifies the minimum accumulated difference in air-fuel ratio, as measured by the lambda sensor integrator, required to activate specific adjustments or features in the ECU. Modifying this parameter allows tuners to set a minimum threshold for the integrator.

LAMBDA PROPORTIONAL TERM MAXIMUM

If the calculated value of Lambda Bank 1 Proportional Term or Lambda Bank 2 Proportional Term is greater than the value specified here, this value will be used instead.

LAMBDA PROPORTIONAL TERM MINIMUM

If the calculated value of Lambda Bank 1 Proportional Term or Lambda Bank 2 Proportional Term is less than the value specified here, this value will be used instead.

LAMBDA TRANSPORT DELAY INTEGRAL DEADBAND

If either Lambda 1 Transport Delay Error or Lambda 2 Transport Delay Error is less than this value, it will be treated as zero error when updating the corresponding Integral Term. (In other words, the Integral Term will not change this cycle because the error is effectively zero.) This has the effect of freezing the integral value when lambda nears the desired setpoint.

LAMBDA TRANSPORT DELAY INTEGRAL GAIN

This multiplier is used to adjust the overall magnitude of the transport delay integral term.

LAMBDA TRANSPORT DELAY INTEGRAL TERM MAXIMUM

Specifies the maximum value for the transport delay integral term. If the calculated value for the transport delay integral term is larger, this value will be used instead.

LAMBDA TRANSPORT DELAY INTEGRAL TERM MINIMUM

Specifies the minimum value for the transport delay integral term. If the calculated value for the transport delay integral term is smaller, this value will be used instead.

LAMBDA TRANSPORT DELAY PROPORTIONAL GAIN

This multiplier adjusts the overall magnitude of the transport delay proportional term.

LAMBDA TRANSPORT DELAY PROPORTIONAL TERM MAXIMUM

Specifies the maximum value for the transport delay proportional term. If the calculated value for transport delay proportional term is larger, this value will be used instead.

LAMBDA TRANSPORT DELAY PROPORTIONAL TERM MINIMUM

Specifies the minimum value for the transport delay proportional term. If the calculated value for transport delay proportional term is smaller, this value will be used instead.

MEASUREMENTS

DELAY COMPENSATED LAMBDA BANK 1 CORRECTION DELTA

The amount of error correction used to compensate for transport delay on cylinder bank 1. This is one of three terms used to calculate the correction for Lambda Bank 1 Error. It is the output of the Lambda 1 Transport Delay PID controller.

> **NOTE:** Total error correction applied is equal to 1 + Delay Compensated Correction Delta - Proportional Term - Integral Term.

DELAY COMPENSATED LAMBDA BANK 2 CORRECTION DELTA

The amount of error correction used to compensate for transport delay on cylinder bank 1. This is one of three terms used to calculate the correction for Lambda Bank 2 Error. It is the output of the Lambda 2 Transport Delay PID controller.

> **NOTE:** Total error correction applied is equal to 1 + Delay Compensated Correction Delta - Proportional Term - Integral Term.

LAMBDA BANK 1 ERROR

Indicates the amount by which the lambda value reported by lambda (oxygen) sensor 1 differs from the desired target lambda (Lambda Setpoint).

> **NOTE:** Lambda Bank 1 Error = Lambda Setpoint - lambda measured by sensor 1.

LAMBDA BANK 1 CLOSED LOOP ACTIVE

If TRUE, closed loop lambda is active for cylinder bank 1. When closed loop is active, the ECU reads the lambda sensor (oxygen sensor) in the exhaust to determine whether the air/fuel mixture is correct and to determine how much adjustment to the fuel mix in cylinder bank 1 is needed.

LAMBDA BANK 1 CLOSED LOOP FREEZE ACTIVE

Lambda bank 1 closed loop freeze active indicates the ECU is reading the input from bank 1 lambda sensor (oxygen sensor) in the exhaust and measures/freezes the average reading.

LAMBDA BANK 1 CORRECTION

The short term fuel trim applied to cylinder bank 1.

LAMBDA BANK 1 INTEGRAL TERM

Lambda bank 1 integral term is one of two values used to calculate the correction for Lambda Bank 1 Error.

> **NOTE:** Total error correction applied is equal to 1 + Delay Compensated Correction Delta - Proportional Term - Integral Term.

The integral term is based on of the Lambda Bank 1 error over time. Each time the Bank 1 error is calculated:

1. The error is multiplied by Lambda 1 Integral Gain, which is then multiplied by the task time (0.01 seconds).
2. The result is added to the previous Lambda 1 Integral Term, resulting in a new value for the integral term.

LAMBDA BANK 1 PROPORTIONAL TERM

Lambda bank 1 proportional term is one of three terms used to calculate the correction for Lambda Bank 1 Error.

> **NOTE:** Total error correction applied is equal to 1 + Delay Compensated Correction Delta - Proportional Term - Integral Term.

This term is directly proportional to the current lambda error for cylinder bank 1.

LAMBDA BANK 1 TRANSPORT DELAY

The length of time (in seconds) it takes the air/fuel mixture to leave the combustion chamber and reach the lambda sensor.

LAMBDA BANK 1 TRANSPORT DELAY STEPS

Lambda bank 1 transport delay steps (if transport delay is 0.5 seconds, the delay steps would be 0.5*100 = 50 steps). Since the closed loop lambda module runs every 10 ms, 50 steps means 50*10 = 500 ms = 0.5 sec.

LAMBDA BANK 2 CLOSED LOOP ACTIVE

If TRUE, closed loop lambda is active for cylinder bank 2. When closed loop is active, the ECU reads the lambda sensor (oxygen sensor) in the exhaust to determine whether the air/fuel mixture is correct and to determine how much adjustment to the fuel mix in cylinder bank 2 is needed.

LAMBDA BANK 2 CLOSED LOOP FREEZE ACTIVE

Lambda bank 2 closed loop freeze active indicates the ECU is reading the input from bank 2 lambda sensor (oxygen sensor) in the exhaust and measures/freezes the average reading.

LAMBDA BANK 2 CORRECTION

The short term fuel trim applied to cylinder bank 2.

LAMBDA BANK 2 ERROR

Indicates the amount by which the lambda value reported by lambda (oxygen) sensor 2 differs from the desired target lambda (Lambda Setpoint).

> **NOTE:** Lambda Bank 2 Error = Lambda Setpoint - lambda measured by sensor 2.

LAMBDA BANK 2 INTEGRAL TERM

Lambda bank 2 integral term is one of two values used to calculate the correction for Lambda Bank 2 Error.

> **NOTE:** Total error correction applied is equal to 1 + Delay Compensated Correction Delta - Proportional Term - Integral Term.

The integral term is based on of the Lambda Bank 2 error over time. Each time the Bank 2 error is calculated:

1. The error is multiplied by Lambda 2 Integral Gain, which is then multiplied by the task time (0.01 seconds).
2. The result is added to the previous Lambda 1 Integral Term, resulting in a new value for the integral term.

LAMBDA BANK 2 TRANSPORT DELAY

The length of time (in seconds) it takes the air/fuel mixture to leave the combustion chamber and reach the lambda sensor.

LAMBDA BANK 2 TRANSPORT DELAY STEPS

Lambda bank 2 transport delay steps (if transport delay is 0.5 seconds, the delay steps would be 0.5*100 = 50 steps). Since the closed loop lambda module runs every 10 ms, 50 steps means 50*10 = 500 ms = 0.5 sec.

LAMBDA BANK 2 PROPORTIONAL TERM

Lambda bank 2 proportional term is one of three values used to calculate the correction for Lambda Bank 2 Error.

> **NOTE:** Total error correction applied is equal to 1 + Delay Compensated Correction Delta - Proportional Term - Integral Term.

This term is directly proportional to the current lambda error for cylinder bank 2.

LAMBDA BANK 2 TRANSPORT DELAY

The length of time (in seconds) it takes the air/fuel mixture to leave the combustion chamber and reach the lambda sensor.

LAMBDA TRANSPORT DELAY BANK 1 ERROR

The amount of lambda error on cylinder bank 1 that is due to transport delay.

LAMBDA TRANSPORT DELAY BANK 1 INTEGRAL TERM

One of three terms that is used to calculate the amount of lambda correction needed to compensate for transport delay on cylinder bank 1 (Delay Compensated Lambda Bank 1 Correction Delta).

This term is based on the cumulative bank 1 transport delay error over time.

LAMBDA TRANSPORT DELAY BANK 1 PROPORTIONAL TERM

One of three terms that is used to calculate the amount of lambda correction needed to compensate for transport delay on cylinder bank 1 (Delay Compensated Lambda Bank 1 Correction Delta).

This term is directly proportional to the current bank 1 transport delay error.

LAMBDA TRANSPORT DELAY BANK 1 WEIGHTING FACTOR TERM

This is one of three parameters used by the transport delay compensation PID controller to calculate the amount of error correction that should be applied due to transport delay.

This term is calculated by multiplying Lambda Bank 1 Transport Delay Weighting factor by the amount of change in the lambda correction applied over the time specified in Lambda Bank 1 Transport Delay.

LAMBDA TRANSPORT DELAY BANK 2 ERROR

The amount of lambda error on cylinder bank 2 that is due to transport delay.

LAMBDA TRANSPORT DELAY BANK 2 INTEGRAL TERM

One of three terms that is used to calculate the amount of lambda correction needed to compensate for transport delay on cylinder bank 2 (Delay Compensated Lambda Bank 2 Correction Delta).

This term is based on the cumulative bank 2 transport delay error over time.

LAMBDA TRANSPORT DELAY BANK 2 PROPORTIONAL TERM

One of three terms that is used to calculate the amount of lambda correction needed to compensate for transport delay on cylinder bank 2 (Delay Compensated Lambda Bank 2 Correction Delta).

This term is directly proportional to the current bank 2 transport delay error.

LAMBDA TRANSPORT DELAY BANK 2 WEIGHTING FACTOR TERM

This is one of three parameters used by the transport delay compensation PID controller to calculate the amount of error correction that should be applied due to transport delay.

This term is calculated by multiplying Lambda Bank 1 Transport Delay Weighting factor by the amount of change in the lambda correction applied over the time specified in Lambda Bank 1 Transport Delay.

SHORT TERM FUEL TRIM BANK 1

The short term fuel trim applied to cylinder bank 1.

SHORT TERM FUEL TRIM BANK 2

The short term fuel trim applied to cylinder bank 2.

CORRECTIONS

This module applies corrections to fuel mass based on engine coolant temperature and intake air temperature.

TUNABLE PARAMETERS (CHARACTERISTICS)

FUEL MASS ENGINE COOLANT TEMPERATURE CORRECTION

This table defines the fuel mass multiplier as a function of engine coolant temperature.

FUEL MASS ENGINE COOLANT TEMPERATURE CORRECTION DELAY

Specifies the amount of time (in seconds) to delay the activation of ECT (engine coolant temperature) correction after the engine running conditions are met.

FUEL MASS INTAKE AIR TEMPERATURE CORRECTION

This table defines the fuel mass multiplier as a function of intake air temperature.

MEASUREMENTS

FUEL MASS INTAKE AIR TEMPERATURE CORRECTION

Indicates the correction (multiplier) applied to fuel mass based on intake air temperature.

FUEL MASS ENGINE COOLANT TEMPERATURE CORRECTION

Indicates the correction (multiplier) applied to fuel mass based on intake air temperature.

CYLINDER-SPECIFIC FUEL CORRECTION

This module specifies the final fueling adjustments (%) for individual cylinders based on cylinder airmass and engine speed. Fine tuning these adjustments may be necessary if individual cylinders are running richer or leaner than they should.

TUNABLE PARAMETERS (CHARACTERISTICS)

CYLINDER 1 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 1 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

CYLINDER 2 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 2 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

CYLINDER 3 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 3 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

CYLINDER 4 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 4 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

CYLINDER 5 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 5 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

CYLINDER 6 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 6 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

CYLINDER 7 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 7 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

CYLINDER 8 FUEL CORRECTION

This table specifies the amount of correction to apply to the fuel injection for cylinder 8 as a function of cylinder airmass and engine speed.

Cell data range: -100% to 200%

MEASUREMENTS

CYLINDER 1 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 1.

CYLINDER 2 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 2.

CYLINDER 3 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 3.

CYLINDER 4 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 4.

CYLINDER 5 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 5.

CYLINDER 6 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 6.

CYLINDER 7 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 7.

CYLINDER 8 FUEL CORRECTION REQUEST

Indicates the amount of cylinder-specific fuel injection adjustment (%) applied to cylinder 8.

FLEX FUEL

This module determines flex fuel composition in vehicles that use a flex fuel composition sensor to determine the ethanol percentage used in the fuel. This percentage impacts multiple calculations, including those for fueling and ignition among others.

Having a correct value for flex fuel composition helps prevent engine damage or performance issues that could arise from using an incorrect value for the ethanol-gasoline blend. Different ethanol content levels require different air-fuel ratios and ignition timing to operate optimally.

Since fuel composition sensor readings may have sudden spikes during transient conditions, the fuel composition reported by this module will be locked at the last reported value when all three of the following all true:

- Cylinder airmass is above Flex Fuel Composition Lock Cylinder Airmass
- Engine speed is above Flex Fuel Composition Engine Speed
- Throttle position is above Flex Fuel Composition Lock Throttle Position

Flex fuel composition will be unlocked when these conditions are no longer met.

TUNABLE PARAMETERS (CHARACTERISTICS)

FLEX FUEL COMPOSITION

This table converts the frequency (in Hz) of the signal from the flex fuel sensor to the percentage of alcohol indicated.

FLEX FUEL COMPOSITION DTC MAXIMUM

Specifies the maximum ethanol percentage allowed in flex fuel mixes. Ethanol percentages above this value will set a DTC.

FLEX FUEL COMPOSITION DTC MAXIMUM FREQUENCY

Specifies the maximum frequency permitted for the signal from the flex fuel composition sensor. Frequencies above this value will set a DTC.

FLEX FUEL COMPOSITION DTC MINIMUM

Specifies the minimum ethanol percentage allowed in flex fuel mixes. Ethanol percentages below this value will set a DTC.

FLEX FUEL COMPOSITION DTC MINIMUM FREQUENCY

Specifies the minimum frequency permitted for the signal from the flex fuel composition sensor. Frequencies below this value will set a DTC.

FLEX FUEL COMPOSITION LOCK CYLINDER AIRMASS

Above this airmass, flex fuel composition may be locked. When composition is locked, the ethanol percentage reported by this module will not change.

> **NOTE:** In order to lock reported composition, the thresholds specified in all three Flex Fuel Composition Lock parameters must be exceeded.

FLEX FUEL COMPOSITION LOCK ENGINE SPEED

Above this engine speed (rpm), flex fuel composition may be locked. When composition is locked, the ethanol percentage reported by this module will not change.

> **NOTE:** In order to lock reported composition, the thresholds specified in all three Flex Fuel Composition Lock parameters must be exceeded.

FLEX FUEL COMPOSITION LOCK THROTTLE POSITION

Above this throttle position (%), flex fuel composition may be locked. When composition is locked, the ethanol percentage reported by this module will not change.

> **NOTE:** In order to lock reported composition, the thresholds specified in all three Flex Fuel Composition Lock parameters must be exceeded.

FLEX FUEL COMPOSITION SENSOR DEFAULT

Specifies the ethanol percentage that will be indicated by this module if diagnostics report that the flex fuel composition sensor is malfuctioning.

FLEX FUEL ENABLED

Set to YES to enable the flex fuel feature. Set to NO to disable the feature.

> **NOTE:** Ensure your vehicle/engine is capable of operating on all ethanol blends (up to 83%).

FLEX FUEL FILTER COEFFICIENT

Specifies the coefficient that is used to filter the signal from the flex fuel sensor. The filter can be useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

0 and 1 themselves have special meanings:

- **1** - output unfiltered signal (the output signal is equal to input signal).
- **0** - output null signal (not recommended).

FLEX FUEL SENSOR INPUT

Flex Fuel sensor signal frequency input. The physical frequency input, at the ECU connector, assigned to this function.

MEASUREMENTS

FLEX FUEL ACTIVE

If TRUE, the flex fuel feature has been enabled and a blend of gasoline and ethanol has been detected.

> **NOTE:** Ensure your vehicle/engine is capable of operating on any ethanol blend gasoline.

FLEX FUEL COMPOSITION

The flex fuel composition indicates the specific percentage of alcohol present in the fuel being used.

FLEX FUEL COMPOSITION FILTERED

Indicates the percentage of ethanol in the fuel, after filtering is applied.

FLEX FUEL COMPOSITION RAW

Indicates the percentage of ethanol in the fuel, before filtering is applied.

FLEX FUEL DTC FAULT ACTIVE

If YES, the a DTC has been set for the DTC flex fuel feature.

FLEX FUEL SENSOR FREQUENCY

The frequency (in Hz) of the signal generated by the flex fuel sensor, which varies with the ethanol content in the fuel.

FLOOD CLEAR

Flood clear is a feature that clears the fuel from a flooded engine. To do this, the ECU switches off the injectors and allows the engine to crank, but not run.

To use this feature, the driver must:

1. Press the accelerator pedal enough to open the throttle past the position specified in Flood Clear Throttle Position Threshold.
2. Crank the engine. This will cause the engine to enter flood clear mode.
3. When the flooding has cleared, the driver backs off the acceleration pedal by the amount specified in Flood Clear Throttle Position Threshold Hysteresis. This will exit flood clear mode and allow the engine to run normally.

TUNABLE PARAMETERS (CHARACTERISTICS)

FLOOD CLEAR ENABLED

Set this flag to TRUE to manually enable the flood clear feature. Set to FALSE to disable.

FLOOD CLEAR THROTTLE POSITION HYSTERESIS

Throttle position must be below the Flood Clear Throttle Position Threshold minus this value (%) to exit flood clear mode.

Higher values prevent repeatedly entering and exiting flood clear mode when throttle position hovers near the Flood Clear Throttle Position Threshold.

Range: 0 to 10%

FLOOD CLEAR THROTTLE POSITION THRESHOLD

The minimum throttle position (%) required to enter flood clear mode. If the driver presses the accelerator enough to open the throttle past this point and then cranks the engine, the ECU will activate flood clear mode.

Range: 0 to 100%

MEASUREMENTS

FLOOD CLEAR ACTIVE

If TRUE, flood clear mode is active (the engine is allowed to crank, but not run).

FUEL DENSITY

Parameters for fuel density.

TUNABLE PARAMETERS (CHARACTERISTICS)

FLEX FUEL DENSITY

This table specifies the energy content (mass of fuel per unit volume) in the fuel used as a function of alcohol composition/percentage when flex fuel is employed.

Cell data range: 0 to 10 g/cc

MEASUREMENTS

FUEL DENSITY REQUESTED

Indicates the density of fuel in grams per cubic centimeter (g/cc).

FUEL MASS

The Fuel Mass module is responsible for calculating a general fuel mass that is used as a starting point for each cylinder's injection timing calculation.

TUNABLE PARAMETERS (CHARACTERISTICS)

FLEX FUEL STOICHIOMETRIC RATIO

When a flex fuel vehicle is running on a flexible fuel like E85 or any other ethanol blend, this table specifies the air-fuel mixture ratio that the ECU should aim for as a function of ethanol percentage in the fuel mix.

MEASUREMENTS

FUEL MASS

Indicates the fuel mass (in grams) that will be used as a starting point for cylinder injection timing calculations.

STOICHIOMETRIC RATIO REQUEST

Indicates the air-fuel ratio that the ECU considers to be stoichiometric for the current fuel mix.

FUEL METERING

This module is responsible for determining the mass (in grams) as well as the volume (in liters or gallons) of fuel being used in a particular operation. It also determines the distance (km or miles) traveled by the vehicle and the fuel economy (in mpg or km/L).

TUNABLE PARAMETERS (CHARACTERISTICS)

FUEL CONSUMED OFFSET

Specifies the offset (in %) of fuel consumed that will be added to the value derived from the fuel consumed total.

MEASUREMENTS

DISTANCE TRAVELED SINCE FUEL RESET

Indicates the total distance (in miles or kilometers) the vehicle has covered since the last time the odometer was reset in conjunction with a fuel reset.

DISTANCE TRAVELED SINCE LAST STOP

Indicates the total distance (in miles or kilometers) that the vehicle has traveled since it was last brought to a complete stop.

DISTANCE TRAVELED SINCE TRIP RESET

Indicates the total distance (in miles) that the vehicle has traveled since the last time the trip odometer was reset to zero.

DISTANCE TRAVELED TOTAL

Indicates the cumulative distance (in miles or kilometers) that the vehicle has traveled over its entire lifespan.

FUEL CONSUMED SINCE FUEL RESET

Indicates the total amount of fuel (in gal) consumed by the vehicle since the last time the fuel consumption data was reset.

FUEL CONSUMED SINCE LAST STOP

Indicates the amount of fuel (in gallons or liters) that has been used by the vehicle since the last time it came to a complete stop.

FUEL CONSUMED SINCE TRIP RESET

Indicates the total amount of fuel (in gallons or liters) that the vehicle has consumed since the last time the trip odometer was reset to zero.

FUEL CONSUMED TOTAL

Indicates the total amount of fuel the vehicle has consumed over its entire lifespan (in gallons or liters).

FUEL ECONOMY SINCE FUEL RESET

Indicates the vehicle's fuel efficiency (in mpg or km/L) since the last fuel time consumption data was reset.

FUEL ECONOMY SINCE LAST STOP

Indicates the fuel economy since the last time the vehicle came to a complete stop.

FUEL ECONOMY SINCE TRIP RESET

Indicates the vehicle's fuel economy (in mpg or km/L) since the last time the trip odometer was reset to zero.

FUEL ECONOMY TOTAL

Indicates the average fuel economy (in mpg or km/L) of the vehicle over its entire lifespan.

FUEL MASS CONSUMED SINCE FUEL RESET

Indicates the total amount of fuel (in g) that has been used by your car since the last time the fuel consumption data was reset.

FUEL MASS CONSUMED SINCE LAST STOP

Indicates the total amount of fuel (in grams) consumed by the vehicle since the last time it came to a complete stop.

FUEL MASS CONSUMED SINCE TRIP RESET

Indicates the total mass of fuel (in grams) that the vehicle has consumed since the last time the trip odometer was reset to zero.

FUEL MASS CONSUMED TOTAL

Indicates the total amount of fuel (in grams) consumed by the vehicle over its entire lifespan.

FUEL REMAIN IN TANK

Indicates the amount of fuel (in gallons or liters) that remains in the tank.

INSTANTANEOUS AVERAGE FUEL MASS

Indicates the average fuel mass (in grams) calculated from the injection time demanded.

VEHICLE RUN TIME

The vehicle run time parameter measures the amount of time the vehicle speed has been above 3 mph (in seconds).

FUEL PRESSURE

This module governs the operation of the fuel pressure sensor.

TUNABLE PARAMETERS (CHARACTERISTICS)

FUEL PRESSURE FILTER COEFFICIENT

A filter can be applied to the signal from the fuel pressure sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output unfiltered signal. The output signal is equal to input signal.
- **0** = output null signal. Not recommended.

FUEL PRESSURE SENSOR DEFAULT

Specifies a fallback value for the fuel pressure sensor. This will be used as the sensor reading when the fuel pressure sensor diagnostic indicates that the sensor is malfunctioning.

FUEL PRESSURE SENSOR DTC MAXIMUM

Specifies the maximum allowable pressure reading from the fuel pressure sensor. Fuel pressure sensor readings above this threshold will set a DTC.

FUEL PRESSURE SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum allowable voltage for the signal from the fuel pressure sensor (open circuit threshold). Voltages above this threshold will set a DTC.

FUEL PRESSURE SENSOR DTC MINIMUM

Specifies the minimum allowable pressure reading from the fuel pressure sensor. Fuel pressure sensor readings below this threshold will set a DTC.

FUEL PRESSURE SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum allowable voltage for the signal from the fuel pressure sensor (short to ground threshold). Voltages below this threshold will set a DTC.

FUEL PRESSURE SENSOR GAIN

This is part of the calibration for the fuel pressure sensor. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

FUEL PRESSURE SENSOR INVERTED

Set to YES if the fuel pressure sensor signal is inverted. That is, signal voltage decreases when fuel pressure increases.

FUEL PRESSURE SENSOR OFFSET

This is part of the calibration for the fuel pressure sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

FUEL PRESSURE SENSOR INPUT

Specifies the pin on the ECU connector that the fuel pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the fuel pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

FUEL PRESSURE

The fuel pressure reported by the fuel pressure sensor, after filtering is applied.

FUEL PRESSURE DTC FAULT ACTIVE

If YES, a DTC has been set for the fuel pressure sensor.

FUEL PRESSURE RAW

The fuel pressure reported by the fuel pressure sensor, before filtering is applied.

FUEL PRESSURE SENSOR VOLTAGE

The voltage of the signal from the fuel pressure sensor.

FUEL PRIMING

This module is responsible for calculating the priming fuel time of fuel delivered through all injectors when the key is switched on and fuel pressure delay has expired.

TUNABLE PARAMETERS (CHARACTERISTICS)

FUEL PRIMING ENABLED

Set to TRUE to enable the fuel priming feature. Set to FALSE to disable.

When fuel priming is enabled, the vehicle's high-pressure fuel lines lubricate and pressurize the fuel system before the initial start up of the vehicle's engine. The benefits of enabling fuel priming are as follows:

- Easier Start-up
- Faster engine warm-up
- Improved reliability
- Assists in preventing engine flooding

PRIMING FUEL MASS

This table specifies the initial mass of fuel that's injected into the engine's combustion chamber during startup.

PRIMING FUEL MASS SOAK TIME MULTIPLIER

This table specifies a multiplier for the fuel mass based on the engine soak time (the time between engine off and engine restart).

MEASUREMENTS

PRIMING FUEL MASS

Indicates the additional mass of fuel injected into the engine during startup.

PRIMING FUEL TIME

Indicates how long the fuel injectors remain open during engine startup.

FUEL PUMP

Parameters for fuel pump.

TUNABLE PARAMETERS (CHARACTERISTICS)

FUEL PUMP ACTUATOR OUTPUT

Specifies the low side driver output on the ECU that the fuel pump is connected to.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FUEL PUMP OVERRIDE ENABLED

Set to YES to enable fuel pump override. When enabled, the ECU will command the fuel pump to be on continuously.

FUEL PUMP PRIME TIME

Specifies that amount of time that the fuel pump must run when the ignition switch goes from off to on. This builds the required amount of pressure in the fuel line.

Range: 1 to 10 seconds

MEASUREMENTS

FUEL PUMP ACTIVE

If TRUE, the fuel pump is on.

FUEL PUMP REQUESTED

If TRUE, the request to run the fuel pump is on.

INJECTION PHASE ANGLE

Parameters for injection phase angle.

TUNABLE PARAMETERS (CHARACTERISTICS)

PRIMARY INJECTION PHASE ANGLE

This table defines the primary injection phase angle (in degrees) as a function of engine coolant temperature and engine speed. This parameter determines the timing of the initial fuel injection event into the engine's combustion chamber.

SECONDARY INJECTION PHASE ANGLE

If a second set of fuel injectors is installed, this table defines the injection phase angle (in degrees) of the secondary set of injectors as a function of engine coolant temperature and engine speed.

MEASUREMENTS

PRIMARY INJECTION PHASE ANGLE REQUEST

Indicates the timing (in degrees) of the fuel injection by the primary injectors.

SECONDARY INJECTION PHASE ANGLE REQUEST

If a secondary set of fuel injectors is installed, this indicates the timing (in degrees) of the fuel injection by the secondary injectors.

INJECTION TIME

Parameters for injection time.

TUNABLE PARAMETERS (CHARACTERISTICS)

LAMBDA SENSOR CYLINDER SELECTION

This table specifies which cylinder bank each cylinder is assigned to (1= bank 1, 2 = bank 2) for the lambda sensor.

MAXIMUM PULSE WIDTH CORRECTION

Specifies the longest injection pulse width correction allowed, expressed as a percentage of maximum injection time.

PRIMARY PULSE WIDTH MINIMUM

This table specifies the minimum length of time that fuel injectors must remain open during the primary injection phase. If the calculated pulse width time is less than this value (after all other adjustments are made), the time specified here will be used instead.

> **NOTE:** Setting this value to at least 1.25 milliseconds is recommended.

Cell data range: 0 to 1 second

PRIMARY SHORT PULSE ADDER

This table specifies an adjustment (in milliseconds) to the primary fuel injection pulse width that is made during short pulse conditions.

PRIMARY SHORT PULSE LIMIT

If the calculated pulse width for any primary injector is shorter than the time specified here, the pulse width will be increased by the time specified in Primary Short Pulse Adder.

> **NOTE:** This is not the only minimum check for pulse width. The resulting value will be checked against the Primary Pulse Width Minimum.

PRESSURE REFERENCE SELECTION

Specifies the baseline pressure point used for making calculations and adjustments in the ECU.

SECONDARY PULSE WIDTH MINIMUM

This table specifies the minimum length of time that fuel injectors must remain open during the secondary injection phase. If the calculated pulse width time is less than this value (after all other adjustments are made), the time specified here will be used instead.

> **NOTE:** Setting this value to at least 1.25 milliseconds is recommended.

Cell data range: 0 to 1 second

SECONDARY SHORT PULSE ADDER

This table specifies an adjustment (in milliseconds) to the secondary fuel injection pulse width that is made during short pulse conditions, enhancing fueling response and drivability during rapid changes in engine speed or load.

SECONDARY SHORT PULSE LIMIT

If the calculated pulse width for any secondary injector is shorter than the time specified here, the pulse width will be increased by the time specified in Secondary Short Pulse Adder.

> **NOTE:** This is not the only minimum check for pulse width. The resulting value will be checked against the Secondary Pulse Width Minimum.

MEASUREMENTS

CLOSED LOOP LAMBDA CORRECTION

Indicates the overall average closed loop lambda correction (for both bank 1 and bank 2).

LAMBDA CORRECTED PRIMARY FUEL MASS

Indicates the amount of fuel injected during the primary injection phase, adjusted based on real-time lambda feedback.

LAMBDA CORRECTED SECONDARY FUEL MASS

Indicates the amount of additional fuel injected (in g) during the secondary injection phase, adjusted based on real-time lambda feedback.

PRIMARY INJECTION TIME REQUEST

Indicates the length of time that fuel injectors are open during the primary injection phase.

PRIMARY PULSE WIDTH

Indicates the base length of time calculated for pulse width during the primary injection phase, before the addition of the primary pulse width adder and application of min and max limits.

SECONDARY INJECTION TIME REQUEST

Indicates the length of time that fuel injectors are open during the secondary injection phase.

SECONDARY PULSE WIDTH

Indicates the base length of time calculated for pulse width during the secondary injection phase, before the addition of the secondary pulse width adder and application of min and max limits.

INJECTOR CHARACTERISTICS

Parameters for injector characteristics.

TUNABLE PARAMETERS (CHARACTERISTICS)

PRIMARY INJECTOR DEAD TIME

This table specifies the time delay between commanding primary injectors to open and the actual delivery of fuel.

Cell data range: 0 to 15 seconds

PRIMARY INJECTOR FLOW RATE

This table specifies the rate at which the primary injectors to deliver fuel to the engine.

Cell data range: 0 to 100 g/s

SECONDARY INJECTOR DEAD TIME

Secondary injector dead time is a parameter that accounts for the time delay between commanding secondary injectors to open and their actual delivery of fuel.

Cell data range: 0 to 15 seconds

SECONDARY INJECTOR FLOW RATE

This table specifies the rate at which the secondary injectors deliver extra fuel to the engine.

Cell data range: 0 to 100 g/s

MEASUREMENTS

MANIFOLD VACUUM

The difference in pressure between the intake manifold and the atmosphere.

PRIMARY INJECTOR DEAD TIME

The time delay between commanding the primary injectors to open and the actual delivery of fuel.

PRIMARY INJECTOR FLOW RATE

The rate at which the primary injectors deliver fuel to the engine.

SECONDARY INJECTOR DEAD TIME

The time delay between commanding the secondary injectors to open and the actual delivery of fuel.

SECONDARY INJECTOR FLOW RATE

The rate at which the secondary injectors deliver fuel to the engine.

INJECTOR CUT

Parameters for injector cut.

MEASUREMENTS

PRIMARY INJECTOR ACTIVE

If TRUE, the primary injector is active.

SECONDARY INJECTOR ACTIVE

If TRUE, the secondary injector is active.

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Buffalo Grove, IL 60089, USA

INJECTOR TARGET DEMAND

The injector target demand module determines the pulse width and phase angle that is actually sent to each injector.

This pulse width sent is based on the Primary and Secondary Injection Time Requests calculated to achieve the desired flow rate. However, this module incorporates cylinder-specific corrections as well as any injection cuts applied by features such as hard and soft limiters or traction control.

TUNABLE PARAMETERS (CHARACTERISTICS)

INJECTOR #1 ENABLED

Set to YES, to enable the fuel injector for cylinder 1. Set to NO to disable.

INJECTOR #2 ENABLED

Set to YES, to enable the injector for cylinder 2. Set to NO to disable.

INJECTOR #3 ENABLED

Set to YES, to enable the injector for cylinder 3. Set to NO to disable.

INJECTOR #4 ENABLED

Set to YES, to enable the injector for cylinder 4. Set to NO to disable

INJECTOR #5 ENABLED

Set to YES, to enable the injector for cylinder 5. Set to NO to disable.

INJECTOR #6 ENABLED

Set to YES, to enable the injector for cylinder 6. Set to NO to disable.

INJECTOR #7 ENABLED

Set to YES, to enable the injector for cylinder 7. Set to NO to disable.

INJECTOR #8 ENABLED

Set to YES, to enable the injector for cylinder 8. Set to NO to disable.

MEASUREMENTS

PRIMARY INJECTION PHASE ANGLE DEMANDED

Indicates the precise timing (in degrees) at which the primary fuel injectors release fuel into the engine's combustion chambers.

PRIMARY INJECTION #1 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 1 has been commanded to open (pulse width).

PRIMARY INJECTION #2 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 2 has been commanded to open (pulse width).

PRIMARY INJECTION #3 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 3 has been commanded to open (pulse width).

PRIMARY INJECTION #4 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 4 has been commanded to open (pulse width).

PRIMARY INJECTION #5 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 5 has been commanded to open (pulse width).

PRIMARY INJECTION #6 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 6 has been commanded to open (pulse width).

PRIMARY INJECTION #7 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 7 has been commanded to open (pulse width).

PRIMARY INJECTION #8 TIME DEMANDED

Indicates the amount of time that the primary injector on cylinder 8 has been commanded to open (pulse width).

PRIMARY INJECTOR #1 ACTIVE

If TRUE, the primary injector for cylinder 1 is currently operational and delivering fuel. If FALSE, this injector is not active.

PRIMARY INJECTOR #2 ACTIVE

If TRUE, the primary injector for cylinder 2 is currently operational and delivering fuel. If FALSE, this injector is not active.

PRIMARY INJECTOR #3 ACTIVE

If TRUE, the primary injector for cylinder 3 is currently operational and delivering fuel. If FALSE, this injector is not active.

PRIMARY INJECTOR #4 ACTIVE

If TRUE, the primary injector for cylinder 4 is currently operational and delivering fuel. If FALSE, this injector is not active.

PRIMARY INJECTOR #5 ACTIVE

If TRUE, the primary injector for cylinder 5 is currently operational and delivering fuel. If FALSE, this injector is not active.

PRIMARY INJECTOR #6 ACTIVE

If TRUE, the primary injector for cylinder 6 is currently operational and delivering fuel. If FALSE, this injector is not active.

PRIMARY INJECTOR #7 ACTIVE

If TRUE, the primary injector for cylinder 7 is currently operational and delivering fuel. If FALSE, this injector is not active.

PRIMARY INJECTOR #8 ACTIVE

If TRUE, the primary injector for cylinder 8 is currently operational and delivering fuel. If FALSE, this injector is not active.

SECONDARY INJECTION PHASE ANGLE DEMANDED

Indicates the precise timing (in degrees) at which the secondary fuel injectors release fuel into the engine's combustion chambers.

SECONDARY INJECTION #1 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 1 has been commanded to open (pulse width).

SECONDARY INJECTION #2 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 2 has been commanded to open (pulse width).

SECONDARY INJECTION #3 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 3 has been commanded to open (pulse width).

SECONDARY INJECTION #4 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 4 has been commanded to open (pulse width).

SECONDARY INJECTION #5 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 5 has been commanded to open (pulse width).

SECONDARY INJECTION #6 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 6 has been commanded to open (pulse width).

SECONDARY INJECTION #7 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 7 has been commanded to open (pulse width).

SECONDARY INJECTION #8 TIME DEMANDED

Indicates the amount of time that the secondary injector on cylinder 8 has been commanded to open (pulse width).

SECONDARY INJECTOR #1 ACTIVE

If TRUE, the secondary injector for cylinder 1 is currently in operation. If FALSE, this injector is not active.

SECONDARY INJECTOR #2 ACTIVE

If TRUE, the secondary injector for cylinder 2 is currently in operation. If FALSE, this injector is not active.

SECONDARY INJECTOR #3 ACTIVE

If TRUE, the secondary injector for cylinder 3 is currently in operation. If FALSE, this injector is not active.

SECONDARY INJECTOR #4 ACTIVE

If TRUE, the secondary injector for cylinder 4 is currently in operation. If FALSE, this injector is not active.

SECONDARY INJECTOR #5 ACTIVE

If TRUE, the secondary injector for cylinder 5 is currently in operation. If FALSE, this injector is not active.

SECONDARY INJECTOR #6 ACTIVE

If TRUE, the secondary injector for cylinder 6 is currently in operation. If FALSE, this injector is not active.

SECONDARY INJECTOR #7 ACTIVE

If TRUE, the secondary injector for cylinder 7 is currently in operation. If FALSE, this injector is not active.

SECONDARY INJECTOR #8 ACTIVE

If TRUE, the secondary injector for cylinder 8 is currently in operation. If FALSE, this injector is not active.

TRACTION CONTROL PRIMARY INJECTION CUT DEMANDED

The amount of primary injection cut demanded by the traction control feature.

TRACTION CONTROL SECONDARY INJECTION CUT DEMANDED

The amount of secondary injection cut demanded by the traction control feature.

LAMBDA CONTROL

The Lambda Control software module is responsible for determining the target lambda (Lambda Setpoint) values for both the engine cranking and the engine running phase.

In addition to serving as the target for lambda control, the current lambda target is fed into the Fuel Mass module to be used in fuel mass calculations.

TUNABLE PARAMETERS (CHARACTERISTICS)

AFTER START ENRICHMENT ACTIVATION DELAY

Specifies how long the ECU waits (in seconds) after starting before it begins enriching the air-fuel mixture.

AFTER START ENRICHMENT DECAY DELAY

This table specifies the amount of time it takes to transition from after start enrichment lambda to running lambda as a function of engine coolant temperature.

AFTER START ENRICHMENT LAMBDA SETPOINT

When after start enrichment begins, this table specifies the target lambda value as a function of manifold absolute pressure and engine coolant temperature. But, the target lambda will shift towards Running Lambda Setpoint as the after start enrichment period continues.

> **NOTE:** The total time this shift takes is defined in After Start Enrichment Decay Delay.

CRANKING COMMANDED FUEL ENLEANMENT

This table specifies a multiplier to Cranking Lambda Setpoint. Cell values range from 0 to 3, with the following results:

- If this multiplier is 1, there is no change to cranking lambda setpoint.

- If this multiplier is less than 1, the overall product becomes more rich. For example: if Cranking Lambda Setpoint is 0.9 and this parameter is 0.5, then 0.9 x 0.5 = 0.45 (More rich).
- If the multiplier is greater than 1, the overall product becomes more lean. For example: if Cranking Lambda Setpoint is 0.9 and this parameter equals 1.5, then 0.9 x 1 .5 = 1.35 (More lean).

CRANKING LAMBDA SETPOINT

This table defines the target air-fuel ratio (lambda) that will be used during the cranking phase.

LAMBDA SETPOINT MAP SELECT

Up to four versions of the following lambda control tables can be configured:

- Running Lambda Setpoint
- Power Enrichment Lambda Setpoint

This allows multiple configurations to be stored. Use this parameter to specify which of the maps will be used.

POWER ENRICHMENT BLENDING STEP

The rate at which target lambda is changed to reach the desired power enrichment value. This step size is also used when transitioning back to running lambda. A value of 1 represents an instantaneous switch.

POWER ENRICHMENT COLD THROTTLE POSITION THRESHOLD

This table specifies the amount of throttle (%) needed to enable power enrichment on a cold engine. Throttle position needs to be greater than or equal to this value for power enrichment to be enabled.

> **NOTE:** This table is used when the engine coolant temperature is below the value specified in Power Enrichment Hot Select Threshold.

POWER ENRICHMENT HOT SELECT THRESHOLD

When engine coolant temperature is above this threshold (in °C), the Power Enrichment Hot TPS Threshold table will be used to enable power enrichment.

POWER ENRICHMENT HOT THROTTLE POSITION THRESHOLD

This table specifies the amount of throttle (%) needed to enable power enrichment on a hot engine. Throttle position needs to be greater than or equal to this value for power enrichment to be enabled.

NOTE: This table is used when the engine coolant temperature specified in Power Enrichment Hot Select Threshold is exceeded (engine is hot).

POWER ENRICHMENT LAMBDA SETPOINT (MAP #1)

This is one of four maps that specify the target lambda to use when power enrichment mode is active. Each of these maps define the setpoint as a function of engine coolant temperature and engine speed. This map will be used when Lambda Setpoint Map Selected equals 1.

POWER ENRICHMENT LAMBDA SETPOINT MAP #2

This is one of four maps that specify the target lambda to use when power enrichment mode is active. Each of these maps define the setpoint as a function of engine coolant temperature and engine speed. This map will be used when Lambda Setpoint Map Selected equals 2.

POWER ENRICHMENT LAMBDA SETPOINT MAP #3

This is one of four maps that specify the target lambda to use when power enrichment mode is active. Each of these maps define the setpoint as a function of engine coolant temperature and engine speed. This map will be used when Lambda Setpoint Map Selected equals 3.

POWER ENRICHMENT LAMBDA SETPOINT MAP #4

This is one of four maps that specify the target lambda to use when power enrichment mode is active. Each of these maps define the setpoint as a function of engine coolant temperature and engine speed. This map will be used when Lambda Setpoint Map Selected equals 4.

POWER ENRICHMENT MANIFOLD ABSOLUTE PRESSURE THRESHOLD

Specifies the amount of manifold absolute pressure needed to enable power enrichment.

POWER ENRICHMENT MANIFOLD ABSOLUTE PRESSURE THRESHOLD HYSTERESIS

If manifold absolute pressure falls below Power Enrichment Manifold Absolute Pressure minus this value, power enrichment may be disabled.

Higher values help ensure that power enrichment isn't repeatedly activated and deactivated when manifold absolute pressure hovers around the threshold.

RUNNING LAMBDA SETPOINT (MAP #1)

This is one of four tables that define the target lambda value (setpoint) to be used when the engine is running. This table will be used when Lambda Setpint Map Selected equals 1.

RUNNING LAMBDA SETPOINT MAP #2

This is one of four tables that define the target lambda value (setpoint) to be used when the engine is running. This table will be used when Lambda Setpint Map Selected equals 2.

RUNNING LAMBDA SETPOINT MAP #3

This is one of four tables that define the target lambda value (setpoint) to be used when the engine is running. This table will be used when Lambda Setpint Map Selected equals 3.

RUNNING LAMBDA SETPOINT MAP #4

This is one of four tables that define the target lambda value (setpoint) to be used when the engine is running. This table will be used when Lambda Setpint Map Selected equals 4.

RUNNING LAMBDA STARTUP DELAY

Specifies the length of the delay (in seconds) employed when the engine transitions from cranking lambda to running lambda.

MEASUREMENTS

AFTER START ENRICHMENT ACTIVE

If TRUE, after start enrichment is active.

This will turn FALSE when the transition from after start enrichment to running lambda is completed.

LAMBDA SETPOINT

Indicates the target air-fuel ratio currently being used by the engine. At startup, this will be based on Cranking Lambda Setpoint and then After Start Enrichment Lambda Setpoint will be used to transition to running lambda.

When the engine is running, this will be equal to one of the following:

- Power Enrichment Lambda Setpoint (when power enrichment is active)
- Running Lambda Setpoint (when power enrichment is not active)

LAMBDA SETPOINT MAP SELECTED

Up to four versions of the following lambda control tables can be configured:

- Running Lambda Setpoint
- Power Enrich Lambda Setpoint

This measurement indicates which of the four configurations for these tables is currently selected.

POWER ENRICHMENT LAMBDA SETPOINT

Indicates the target air-fuel mixture (lambda value) that the ECU should maintain when the engine is in power enrichment mode. The value is copied from the Power Enrichment Lambda Setpoint Map indicated by Lambda Setpoint Map Selected.

RUNNING LAMBDA SETPOINT

Indicates the target air-fuel mixture (lambda value) that the ECU should maintain when the engine is running (but power enrichment is no longer active). The value is copied from the Running Lambda Setpoint Map indicated by Lambda Setpoint Map Selected.

SECONDARY FUELING

The Secondary Fueling module is primarily responsible for splitting the fuel mass into primary injector fuel mass and secondary injector fuel mass when twin injection is active. The fuel mass split ratio is a function of throttle position and engine speed.

Also, this module applies X-Tau (transient) correction to both primary and secondary fuel masses.

TUNABLE PARAMETERS (CHARACTERISTICS)

FUEL MASS SPLIT RATIO

This table defines the fuel mass split ratio (%) as a function of engine speed and engine position.

Fuel Mass Split Ratio is the percentage of fuel that will be added by the secondary injectors:

- If 0%, all fuel will be added by the primary injectors
- If 100%, all fuel will be added by the secondary injectors.

The final ratio to be used is derived by adding the value from this table to the Fuel Mass Split Ratio Offset.

FUEL MASS SPLIT RATIO OFFSET

The offset (%) specified here will be added to the value derived from the Fuel Mass Slit Ratio table in order to obtain the actual split ratio to be used.

> **NOTE:** Fuel Mass Split Ratio is the percentage of fuel that will be added by the secondary injectors (if 0%, all fuel will be added by the primary injectors).

SECONDARY X-TAU MAXIMUM DECELERATION ENLEANMENT

Specifies the maximum amount (%) of additional fuel enleanment that can be applied in response to rapid deceleration based on x-tau calculations.

SECONDARY X-TAU MAXIMUM ACCELERATION ENRICHMENT

Specifies the maximum amount (%) of additional fuel enrichment that can be applied in response to rapid acceleration based on x-tau calculations.

MEASUREMENTS

FUEL MASS SPLIT RATIO

The percentage of the total fuel mass that is added by the secondary fuel injectors.

- If 0%, all fuel is added by the primary injectors
- If 100%, all is added by the secondary injectors.

> **NOTE:** This ratio is derived by adding the value from the Fuel Mass Split Ratio table to the Fuel Mass Split Ratio Offset.

PRIMARY FUEL MASS

The amount of fuel delivered to the engine's cylinders by the primary fuel injectors.

PRIMARY FUEL MASS TO CYLINDER REQUEST

The amount of primary injector fuel mass specified in the request sent to the Injection Time module. Injection Time calculates the pulse width needed to provide the requested fuel mass.

SECONDARY FUEL MASS

The amount of fuel delivered to the engine's cylinders by the secondary fuel injectors.

SECONDARY FUELING ACTIVE

If TRUE, secondary fueling (aka twin injection) is active. If FALSE, secondary fueling is not active.

- When secondary fueling is active, delivery of fuel is split into primary and secondary injectors.
- When secondary fueling is NOT active, fuel delivery is accomplished only by a single set of injectors.

SECONDARY FUELING X-TAU ACTIVE

If TRUE, secondary fueling x-tau is active. If FALSE, secondary fueling x-tau is not active.

SECONDARY FUEL MASS TO CYLINDER REQUEST

The amount of secondary injector fuel mass specified in the request sent to the Injection Time module. Injection Time calculates the pulse width needed to provide the requested fuel mass.

X-TAU DIRECT

This module is responsible for compensating for the puddle of fuel that remains trapped in the injector ports rather than entering the cylinder.

It begins by calculating the following parameters based on engine speed and engine coolant temperature.:

- x (fraction of injected fuel that remains trapped in the puddle)
- tau (time for the release of the puddle mass into the cylinder)

These parameters are then used to determine a number of other factors, including:

- puddle fuel mass (the mass of fuel in the puddle)
- desired fuel mass (proportional to the estimated air charge)
- transient fuel compensation mass
- fuel mass inducted into the cylinder

Manifold absolute pressure and throttle position delta are deciding factors that are used to enable and disable the x-tau direct system.

TUNABLE PARAMETERS (CHARACTERISTICS)

SECONDARY TAU ACCELERATION TIME FACTOR

This table specifies the amount of time secondary fuel takes to evaporate from the puddle during acceleration as a function of engine speed and throttle position delta.

SECONDARY TAU DECELERATION TIME FACTOR

This table specifies the amount of time secondary fuel takes to evaporate from the puddle during deceleration as a function of engine speed and throttle position delta.

SECONDARY X ACCELERATION PUDDLING FACTOR

This table specifies the percentage of secondary fuel entering the wall puddle (the amount of fuel that remains trapped in the intake port) during acceleration as a function of engine speed and throttle position delta.

SECONDARY X DECELERATION PUDDLING FACTOR

This table specifies the percentage of secondary fuel entering the wall puddle (the amount of fuel that remains trapped in the intake port) during deceleration as a function of engine speed and throttle position delta.

TAU ACCELERATION TIME FACTOR

This table specifies the amount of time fuel takes to evaporate from the puddle during acceleration as a function of engine speed and throttle position delta.

TAU DECELERATION TIME FACTOR

This table specifies the amount of time fuel takes to evaporate from the puddle during deceleration as a function of engine speed and throttle position delta.

TAU TIME FACTOR ENGINE COOLANT TEMPERATURE CORRECTION

This table specifies the percent correction for tau characteristics as a function of Engine Coolant Temperature, where tau is the rate at which fuel is transported out of the puddle and into the cylinder.

X ACCELERATION PUDDLING FACTOR

This table specifies the percentage of fuel entering the wall puddle during acceleration as a function of engine speed and throttle position delta.

X DECELERATION PUDDLING FACTOR

This table specifies the percentage of fuel entering the wall puddle during deceleration as a function of engine speed and throttle position delta.

X PUDDLING FACTOR ENGINE COOLANT TEMPERATURE CORRECTION

This table specifies the percent correction for X characteristics as a function of Engine Coolant Temperature, where X is the percentage injected fuel that remains trapped in the intake port.

X TAU ACCEL/DECEL RATIO

Specifies the ratio of acceleration X Tau characteristics to deceleration X Tau characteristics when between Manifold Absolute Pressure rate thresholds.

X-TAU ACCELERATION MAP RATE THRESHOLD

The manifold absolute pressure rate must be greater than or equal to this value (in kPa/s) to use x-tau acceleration characteristics.

X-TAU DECELERATION MAP RATE THRESHOLD

The manifold absolute pressure rate must be less than or equal to this value (in kPa/s) to use x-tau deceleration characteristics.

X-TAU DECELERATION TRANSIENT ENABLED

Set to YES to enable X-Tau deceleration transient.

X-TAU DIRECT ENABLED

Set to YES to enable the X-Tau direct (transient fuel compensation) feature. Set to NO to disable.

X TAU ENABLE MANIFOLD ABSOLUTE PRESSURE DERIVATIVE THRESHOLD

The rate of change in Manifold Absolute Pressure must be greater than or equal to this value in order to enable X-Tau Direct (transient fuel correction).

X TAU ENABLE MANIFOLD ABSOLUTE PRESSURE DERIVATIVE THRESHOLD HYSTERESIS

The rate of change in manifold absolute pressure (in kPa/s) must be below X Tau Enable Manifold Absolute Pressure Threshold minus this value in order to disable X-Tau Direct (transient fuel correction).

Larger values help to avoid repeatedly enabling and disabling X-Tau Direct when the rate of change hovers near the threshold.

X-TAU ENABLE THROTTLE POSITION DERIVATIVE THRESHOLD

The rate of change of the throttle position must be greater than or equal to this value (in %/s) in order to enable X-Tau Direct (transient fuel compensation).

X-TAU ENABLE THROTTLE POSITION DERIVATIVE THRESHOLD HYSTERESIS

The rate of change of the throttle position (in %/s) must be less than or equal to X-Tau Enable Throttle Position Derivative minus this value in order to enable X-Tau Direct (transient fuel compensation).

Larger values help to avoid repeatedly enabling X-Tau Direct when the rate of change hovers near the threshold.

X TAU MAXIMUM ACCELERATION ENRICHMENT

Specifies the maximum amount (%) of enrichment that X-Tau Direct can apply due to acceleration.

X TAU MAXIMUM DECELERATION ENLEANMENT

Specifies the maximum amount (%) of enleanment that X-Tau Direct can apply due to deceleration.

MEASUREMENTS

FUEL MASS TO CYLINDER REQUEST

Indicates the actual fuel mass to be delivered to each cylinder for the combustion process (before lambda correction).

INJECTION FUEL MASS PREDICTED

The fuel mass injected into the cylinders after transient fuel compensation is applied (fuel mass + transient fuel compensation mass).

> **NOTE:** This should be the same value as Transient Fuel Compensation (TFC) Mass Corrected. However, it is derived using an alternate calculation method. It is used only as a sanity check for TFC Mass Corrected. It is not used in further calculations.

PUDDLE FUEL MASS

Indicates the amount of excess fuel that has accumulated in the intake port.

SECONDARY TAU

Indicates how quickly (in ms) the secondary injector puddle fuel mass is being released into the cylinder.

SECONDARY X

The secondary x parameter is a percentage of fuel injected by the secondary injectors that is trapped in the intake port puddle.

TAU

The time (in ms) that it takes for puddle mass to be released into the cylinder.

TRANSIENT FUEL COMPENSATION MASS

The mass of additional fuel injected by X-Tau Direct in order to compensate for transient fuel conditions.

This compensation helps prevent issues such as hesitation, stalling, or rough running during rapid changes in throttle input.

TRANSIENT FUEL COMPENSATION (TFC) MASS CORRECTED

The fuel mass injected into the cylinders after transient fuel compensation is applied (fuel mass + transient fuel compensation mass).

X

The percent age of fuel injected in the current cycle that is trapped in the intake port puddle for use in a future cycle.

X-TAU ACTIVE

If TRUE, X-Tau transient fuel compensation is active.

X-TAU ACCELERATION ACTIVE

If TRUE, X-Tau Acceleration is active.

X-TAU DECELERATION ACTIVE

If TRUE, X-Tau Deceleration is active.

IDLE

Idle parameters can be broken down in to the following groups:

- Idle Control Demands
- Idle Normalization
- Idle Target Demands

IDLE CONTROL DEMANDS

The Idle Control Demands module performs several functions:

- Calculates the target engine speed when idling (Idle Speed Setpoint).
- Calculates the difference between Idle Speed Setpoint and the current measured engine speed. This is called Idle Trajectory Error.
- Looks up an Idle Integral Gain and an Idle Proportional Gain in the appropriate tables. These values are used by the Idle Normalization module. These parameters are used to adjust spark advance and throttle position when the engine is idling.

TUNABLE PARAMETERS (CHARACTERISTICS)

IDLE ACTIVE ENGINE SPEED STARTUP THRESHOLD

At startup, idle speed control will be active until this engine speed is reached.

The threshold is an adder to the base idle speed setpoint (startup threshold = idle speed setpoint + startup threshold).

For example, if Idle Speed Setpoint is 900 rpm and Idle Active Engine Speed Startup Threshold is 1000 rpm, Idle Active Engine Speed Startup Threshold will equal 1900 rpm.

IDLE ACTIVE ENGINE SPEED THRESHOLD

Specifies the engine speed above which idle speed control will be deactivated.

This parameter is an adder to the base idle speed setpoint (final threshold = idle speed setpoint + idle active engine speed threshold).

For example, if Idle Speed Setpoint is 900 rpm and Idle Active Engine Speed Threshold is 375 rpm, the final/max engine speed idle threshold will equal 1275 rpm.

IDLE ACTIVE ENGINE SPEED THRESHOLD HYSTERESIS

To enable idle speed control, engine speed must fall below Idle Active Engine Speed Threshold + Idle Speed Setpoint minus this value.

IDLE ACTIVE ENGINE SPEED THRESHOLD RATE LIMITER DOWN

Specifies the rate at which the active engine speed threshold transitions from cranking to normal idling.

IDLE ACTIVE ENGINE SPEED THRESHOLD RATE LIMITER UP

Specifies the maximum rate at which the active engine speed threshold can be increased when transitioning from cranking to normal idling.

IDLE ACTIVE ENGINE SPEED THRESHOLD MULTIPLIER

This table defines a multiplier to the idle active threshold as a function of idle inactive time.

This table can be used to increase the idle active engine speed threshold when the driver is off the throttle, but the engine speed is not dropping below the threshold. The idea is that higher multiplier values will be defined for times when idle has been inactive longer. This makes it more likely that engine speed will fall below the current threshold (and enter idle mode).

IDLE INTEGRAL GAIN

This table defines idle integral gain as a function of idle trajectory error. It is used to adjust the overall magnitude of the Idle Integral Term.

> **NOTE:** The idle integral Term is used when calculating the requested airflow during engine idle. The integral term is added to Idle Airflow Percentage (or Startup Idle Airflow Percentage).

To calculate the integral term, this value is multiplied by the Idle Trajectory Error, which is then multiplied by the task time (0.01 seconds). The resulting value is added to the integral term from the previous cycle. For example: if Idle Trajectory Error is 50 rpm and the integral gain from this table is 100%/rpm/s, the Integral Term would increase by 50% (100 %/rpm/s x 50 rpm x 0.01 seconds).

Cell Data Range: -1000 to 1000 %/rpm/s

IDLE PROPORTIONAL GAIN

This table defines idle proportional gain as a function of idle trajectory error. It is used to adjust the overall magnitude of the Idle Proportional Term.

When calculating the Proportional Term, this value is multiplied by the Idle Trajectory Error. For example: if Idle Trajectory Error is 10 rpm and the proportional gain from this table is 0.5 degrees/rpm, the Proportional Term would be 5 degrees (multiply 0.5 by 10).

> **NOTE:** The Idle Proportional Term is used as a correction to the amount of spark advance to apply when the engine is idling. It is added to the Idle Ignition Angle specified in the Igntion Angle module. However, the values specified for Idle Ignition Demand Maximum and Idle Ignition Demand Minimum act as caps to prevent the use of spark advance values that are too large.

Cell Data Range: -100 to 100 degrees/rpm

IDLE SPEED SETPOINT

This table defines idle speed setpoint as a function of engine coolant temperature. This will be used as the target engine speed (in rpm) when the engine is idling.

Cell Data Range:-0 to 65535 rpm

MAXIMUM THROTTLE POSITION DELTA FOR IDLE ENABLE

The maximum rate at which the measured throttle position can be changing in order for idle to remain enabled. (If the throttle position sensor reading is changing faster than this, idle will be disabled.)

Range: 0 to 10%/s

MAXIMUM THROTTLE POSITION FOR IDLE ENABLE

The maximum percentage that the throttle blades can be open when idling. (If the throttle position sensor indicates a higher percentage, idle control will be disabled.)

Range: 0 to 30%

PARK IDLE PROPORTIONAL GAIN

This table defines park gear idle proportional gain as a function of idle trajectory error.

PARK IDLE SPEED SETPOINT

This table defines the target engine speed to be used when the transmission is in Park or Neutral gear as a function of engine coolant temperature.

MEASUREMENTS

IDLE ACTIVE

If TRUE, idle is active (the engine is idling).

IDLE ACTIVE HYSTERESIS

Idle active hysteresis (idle active threshold - idle active engine speed threshold hysteresis).

IDLE ACTIVE THRESHOLD

Idle active threshold [(idle active engine speed threshold + idle speed setpoint) * idle active threshold multiplier.

IDLE ACTIVE THRESHOLD MULTIPLIER

Idle active threshold multiplier.

IDLE SPEED SETPOINT

Indicates the target engine speed (in rpm) when the engine is idling.

IDLE TRAJECTORY ERROR

Indicates the amount by which the measured engine speed differs from the target engine speed when the engine is idling.

> **NOTE:** Idle Trajectory Error (in rpm) = Idle Speed Setpoint - measured engine speed.

IDLE NORMALIZATION

The Idle Normalization Module is responsible for determining the idle airflow percentage (the amount of throttle to use when the engine is idling).

It supports both electronically-controlled throttles ("drive by wire") and drive by cable throttles. For drive by wire throttles, the module outputs an idle throttle position (%). For drive by cable throttles, it outputs a number of steps for the Idle Air Control valve.

The process is as follows:

1. The Idle Integral Term is calculated, based on Idle Trajectory Error and Idle Integral Gain.
2. This is added to the value specified in either the Idle Airflow Percentage table (when in run mode) or the Startup Idle Airflow Percentage table (when cranking).
3. The resulting percentage is then checked against Idle Airflow Rate Limiter Up and Idle Airflow Rate Limiter Down to ensure that the airflow does not change too quickly while the engine is idling.
4. The idle airflow percentage is then checked against the specified Idle Airflow Percentage Maximum and Idle Airflow Percentage Minimum and adjusted if necessary. The final percentage is referred to as Idle Desired Airflow.
5. Idle Desired Airflow is then converted to the appropriate output for the type of throttle installed.

The module also determines the amount of spark advance to apply when the engine is idling. This task is much simpler. Spark advance is equal to the Idle Proportional Term, which is Idle Trajectory Error multiplied by Idle Proportional Gain.

TUNABLE PARAMETERS (CHARACTERISTICS)

IDLE AIRFLOW PERCENTAGE

This table defines idle airflow percentage as a function of engine coolant temperature.

When the engine state is Running, this value is added to the Idle Integral Term to calculate the Idle Desired Airflow.

Cell Data Range: 0 to 100%

IDLE AIRFLOW PERCENTAGE MAXIMUM

Specifies the maximum amount of airflow that can be requested when the engine is idling. This value will be used if the calculated Idle Airflow Percentage is larger.

Range: 0 to 100%

IDLE AIRFLOW PERCENTAGE MINIMUM

Specifies the minimum amount of airflow that can be requested when the engine is idling. This value will be used if the calculated Idle Airflow Percentage is smaller.

Range: 0 to 100%

IDLE AIRFLOW RATE LIMITER DOWN

This table specifies the maximum rate at which the Idle Desired Airflow can decrease.

Larger values will make Idle Desired Airflow change faster (be more responsive), but may make engine idling feel less smooth.

Range: -1000 to 0

IDLE AIRFLOW RATE LIMITER UP

This table specifies the maximum rate at which the Idle Desired Airflow can increase.

Larger values will make Idle Desired Airflow change faster (be more responsive), but may make engine idling feel less smooth.

Range: 0 to 1000

IDLE IGNITION DEMAND MAXIMUM

Specifies the maximum amount of spark advance (in degrees) that can be applied when the engine is idling.

Range: 0 to 20 degrees

IDLE IGNITION DEMAND MINIMUM

Specifies the minimum amount of spark advance (in degrees) that can be applied when the engine is idling.

Range: -20 to 0 degrees

IDLE INTEGRAL DEADBAND

If the idle trajectory error is less than this amount of rpm, it will be treated as zero error when updating the Integral Term. (In other words, the Integral Term will not change this cycle because the error is effectively zero.)

> **NOTE:** This does not reset the Integral Term to zero. The term merely remains at its current value.

Range: 0 to 1000 rpm

IDLE INTEGRAL DELAY

The delay (in seconds) before idle integral control is activated once idle conditions are reached. When active, idle integral control adjusts the amount of throttle demanded when the engine is idling based on the cumulative amount of Idle Trajectory Error.

Range: 0 to 10 seconds

IDLE INTEGRAL ENABLED

Set this parameter to YES to enable idle integral control. The Idle Integral Term will be used to adjust throttle position when the engine is idling.

Set to NO to disable.

IDLE INTEGRAL TERM MAXIMUM

Specifies the maximum allowable value for the idle integral term. If the calculated integral term is larger than this value, it will be capped at this value.

Range: 0 to 100%

IDLE INTEGRAL TERM MINIMUM

Specifies the largest allowable negative value for the idle integral term. If the calculated integral term is a larger negative number than this value, it will be capped at this value.

Range: -100 to 0%

IDLE PROPORTIONAL DELAY

The delay (in seconds) before idle proportional control is activated once idle conditions are reached. When active, idle proportional control adjusts the amount of spark advance when the engine is idling based on the current amount of Idle Trajectory Error.

Range: 0 to 10 seconds

PARK IDLE AIRFLOW PERCENTAGE

This table defines park gear idle airflow percentage as a function of engine coolant temperature.

PERCENTAGE AIRFLOW TO IAC COUNTS CONVERSION

When a drive by cable throttle is used, this table converts the Idle Desired Airflow percentage to the corresponding number steps for the Idle Air Control valve.

Cell Data Range: 0 to 500 steps

PERCENTAGE AIRFLOW TO IDLE THROTTLE CONVERSION

When a drive by wire throttle is used, this table converts the Idle Desired Airflow percentage to the corresponding throttle position percentage.

Cell Data Range: 0 to 30%

REVERSE GEAR IDLE AIRFLOW PERCENTAGE ADDER

Reverse gear idle airflow percentage adder.

RUNNING IDLE AIRFLOW MULTIPLIER

This table defines the running idle airflow multiplier as a function of gear number and engine speed.

STARTUP IDLE AIRFLOW PERCENTAGE

This table defines startup idle airflow percentage as a function of engine coolant temperature.

When the engine is cranking, this value is added to the Idle Integral Term to calculate the Idle Desired Airflow.

Cell Data Range: 0 to 100%

MEASUREMENTS

IDLE AIRFLOW CONTROL STEPS

When using a drive by cable throttle, this indicates the number Idle Air Control valve steps requested.

IDLE AIRFLOW PERCENTAGE

The idle airflow percentage to be requested, before rate limiting and idle airflow maximum and minimum values have been applied.

IDLE AIRFLOW REQUESTED

Indicates the final amount of idle airflow requested. The value differs according to throttle type installed:

- If using a drive by wire throttle, this is equal to Idle Desired Airflow (%).
- If using a drive by cable throttle, this is a number of control steps for the idle air control valve.

IDLE DESIRED AIRFLOW

The idle airflow percentage to be requested, after idle integral control, idle airflow rate limiting and percentage maximum and minimums have been applied.

> **NOTE:** The Idle Airflow Percentage measurement is the same value BEFORE rate limiting and max and min values have been applied.

IDLE IGNITION REQUESTED

Indicates the amount of spark advance (in degrees) applied when the engine is idling.

IDLE INTEGRAL TERM

The idle integral term is used when calculating the requested airflow during engine idle. To perform this calculation, the integral term is added to Idle Airflow Percentage (or Startup Idle Airflow Percentage).

IDLE PROPORTIONAL TERM

The Idle Proportional Term is used as the amount of spark advance (in degrees) to apply when the engine is idling. It is calculated by multiplying the difference between the target engine speed and the actual measured engine speed by Idle Proportional Gain.

> **NOTE:** The values specified for Idle Ignition Demand Maximum and Idle Ignition Demand Minimum act as caps to prevent the use of spark advance values that are too large.

IDLE TARGET DEMANDS

Parameters for idle target demand.

MEASUREMENTS

IDLE AIR CONTROL CALIBRATE ACTIVE

If TRUE, idle air control calibrate is active. This means that the Idle Air Control valve has been reset (is fully open). This is typically only true at the moment the ignition switch is turned on or at the moment the engine stall flag goes active.

After the reset, the IAC valve will go to the position indicated by the Idle Airflow Requested parameter.

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700 Eastwood Lane
Buffalo Grove, IL 60089, USA

INSTALLATION

Parameters used for installation.

ENGINE CONFIGURATION

Parameters for engine configuration.

TUNABLE PARAMETERS (CHARACTERISTICS)

CAM SENSOR TYPE

Specifies the type of cam sensor installed:

- Variable Reluctance
- Digital Hall Effect

(Cannot be live tuned. Requires flashing modifications back to the ECU).

CRANK CAM OFFSET

Specifies the offset of the crank and cam signal in degrees.

CRANK SENSOR TYPE

Specifies the type of crank sensor installed:

- Variable Reluctance
- Digital Hall Effect

(Cannot be live tuned. Requires flashing modifications back to the ECU).

CRANK TRIGGER EDGE

Specifies the trigger edge for crank signal: Rising or Falling edge.

RELUCTOR WHEEL TYPE

Indicates the type of reluctor wheel used in the vehicle. For LS engines, the reluctor wheel types supported by CORE include the following:

- 24x
- 58x

TDC OFFSET

Engine top dead center offset, used for the 58x configuration.

TWIN INJECTION ENABLED

Set to YES to enable twin injection. This is used if the engine has two sets of fuel injectors: a primary set and a secondary set.

> **NOTE:** If this feature is enabled, it is necessary to configure the parameters in the Secondary Fueling module. Among other functions, this module specifies the fuel mass split between the primary injectors and secondary injectors.

Set to NO to disable twin injection.

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FITTED FLAGS

These flags specify which components are installed in the vehicle.

TUNABLE PARAMETERS (CHARACTERISTICS)

ACCELERATION PEDAL POSITION 1 FITTED

Set to TRUE to indicate that acceleration pedal position sensor 1 is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

The ECU will support the installation of either 1 or 2 acceleration pedal position sensors. If a single sensor is fitted, it may be configured as either sensor 1 or sensor 2 and the final acceleration pedal position sensor value will come directly from the fitted sensor. If both sensors are fitted (and neither sensor is in error mode), the lower value of the two will be selected.

If no sensors are fitted, or if all fitted sensors are in error mode, the ECU will go into "acceleration pedal limp" mode, which sets the pedal position to 0.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ACCELERATION PEDAL POSITION 2 FITTED

Set to TRUE to indicate acceleration pedal position 2 is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

The ECU will support the installation of either 1 or 2 acceleration pedal position sensors. If a single sensor is fitted, it may be configured as either sensor 1 or sensor 2 and the final acceleration pedal position sensor value will come directly from the fitted sensor. If both sensors are fitted (and neither sensor is in error mode), the lower value of the two will be selected.

If no sensors are fitted, or if all fitted sensors are in error mode, the ECU will go into "acceleration pedal limp" mode, which sets the pedal position to 0.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

AIR CONDITIONER REFRIGERANT PRESSURE SENSOR FITTED

Set to TRUE to indicate that an air conditioner refrigerant pressure sensor is installed in the vehicle. Set to FALSE to indicate that one is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

AIR CONDITIONER REFRIGERANT TEMPERATURE SENSOR FITTED

Set to TRUE to indicate that an air conditioner refrigerant temperature sensor is installed in the vehicle. Set to FALSE to indicate that one is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

BAROMETRIC PRESSURE SENSOR FITTED

Set to TRUE to indicate that a barometric pressure sensor is installed in the vehicle. Set to FALSE to indicate that one is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

BRAKE SWITCH SENSOR FITTED

Set to TRUE if a brake switch sensor is installed in the vehicle. Set to FALSE if no such sensor is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ENGINE COOLANT TEMPERATURE SENSOR FITTED

Set to TRUE if an engine coolant temperature (ECT) sensor is installed in the vehicle. Set to FALSE if a sensor is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FIRST STAGE FAN FITTED

Set to TRUE if a first stage cooling fan is installed in the vehicle. Set to FALSE if one is not installed.

Control of this fan is enabled when engine coolant temperature reaches the temperature specified in Fan 1 Engine Coolant Temperature Threshold.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FLEX SENSOR FITTED

Set to TRUE to indicate that a flex fuel sensor is installed in the vehicle. Set to FALSE to indicate that one is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FRONT BRAKE PRESSURE SENSOR FITTED

Set to TRUE if a front brake pressure sensor is installed in the vehicle. Set to FALSE if no such sensor is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FRONT WHEEL 1 SPEED SENSOR FITTED

Set to TRUE to indicate that front wheel speed sensor 1 (left front wheel) is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FRONT WHEEL 2 SPEED SENSOR FITTED

Set to TRUE to indicate that front wheel speed sensor 2 (right front wheel) is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FUEL PRESSURE SENSOR FITTED

Set to TRUE if a fuel pressure sensor is installed in the vehicle. Set to FALSE if no such sensor is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GEAR SELECTOR SENSORS FITTED

Set to TRUE to indicate that gear selector sensors (1, 2, and 3) are installed in the vehicle. Set to FALSE to indicate that they is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

INTAKE AIR TEMPERATURE SENSOR FITTED

Set to TRUE if an Intake Air Temperature (IAT) sensor is installed in the vehicle. Set to FALSE if not.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

KNOCK BANK #1 SENSOR FITTED

Set to TRUE if knock bank 1 sensor is installed in the vehicle. Set to FALSE if no such sensor is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

KNOCK BANK #2 SENSOR FITTED

Set to TRUE if knock bank 2 sensor is installed in the vehicle. Set to FALSE if no such sensor is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MANIFOLD ABSOLUTE PRESSURE SENSOR FITTED

Set to TRUE if a Manifold Absolute Pressure (MAP) sensor is installed in the vehicle. Set to FALSE if not.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MAP SELECTION SWITCH FITTED

Set to TRUE if a map selection switch is installed in the vehicle. Set to FALSE if no such switch is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MASS AIRFLOW FITTED

Set to TRUE if a Mass Airflow (MAF) sensor is installed in the vehicle. Set to FALSE if not.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

NEUTRAL POSITION SWITCH SENSOR FITTED

Set to TRUE if a neutral position switch sensor is installed in the vehicle. Set to FALSE if no such sensor is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

NITROUS PRESSURE SENSOR FITTED

Set to TRUE if a nitrous pressure sensor is installed in the vehicle. Set to FALSE if not.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

OIL PRESSURE SENSOR FITTED

Set to TRUE to indicate that an oil pressure sensor is installed in the vehicle. Set to FALSE to indicate that one is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

REAR BRAKE PRESSURE SENSOR FITTED

Set to TRUE if a rear brake pressure sensor is installed in the vehicle. Set to FALSE if no such sensor is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

REAR WHEEL 1 SPEED SENSOR FITTED

Set to TRUE to indicate that rear wheel speed sensor 1 (left rear wheel) is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

REAR WHEEL 2 SPEED SENSOR FITTED

Set to TRUE to indicate that rear wheel speed sensor 2 (right rear wheel) is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

SECOND STAGE FAN FITTED

Set to TRUE if a second stage cooling fan is installed in the vehicle. Set to FALSE if one is not installed.

Control of this fan is enabled when engine coolant temperature reaches the temperature specified in Fan 2 Engine Coolant Temperature Threshold.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

SPEEDOMETER GAUGE FITTED

Set to TRUE if a speedometer gauge fitted is installed in the vehicle. Set to FALSE if no such gauge is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TACHOMETER GAUGE FITTED

Set to TRUE if a tachometer gauge fitted is installed in the vehicle. Set to FALSE if no such gauge is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

THROTTLE POSITION SENSOR 1 FITTED

Set to TRUE if a throttle position sensor (TPS) has been fitted as sensor 1. Set to FALSE if such a sensor has not been fitted.

The ECU will support the installation of either 1 or 2 throttle position sensors. If a single sensor is fitted, it may be configured as either sensor 1 or sensor 2 and the final throttle position sensor value will come directly from the fitted sensor. If both sensors are fitted (and neither sensor is in error mode), the higher value of the two will be selected.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

If no sensors are fitted, or if all fitted sensors are in error mode, the ECU will go into "throttle limp" mode, which limits the throttle position to the value set in Throttle Sensor Error Position (default: 14%).

THROTTLE POSITION SENSOR 2 FITTED

Set to TRUE if a throttle position sensor (TPS) has been fitted as sensor 2. Set to FALSE if such a sensor has not been fitted.

The ECU will support the installation of either 1 or 2 throttle position sensors. If a single sensor is fitted, it may be configured as either sensor 1 or sensor 2 and the final throttle position sensor value will come directly from the fitted sensor. If both sensors are fitted (and neither sensor is in error mode), the higher value of the two will be selected.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

If no sensors are fitted, or if all fitted sensors are in error mode, the ECU will go into "throttle limp" mode, which limits the throttle position to the value set in Throttle Sensor Error Position (default: 14%).

TRACTION CONTROL ARMING SWITCH FITTED

Set to TRUE if a traction control arming switch is installed in the vehicle. Set to FALSE if no such switch is installed.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TRANSMISSION LINE PRESSURE SENSOR FITTED

Set to TRUE to indicate that a transmission line pressure sensor is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TRANSMISSION OIL TEMPERATURE SENSOR FITTED

Set to TRUE to indicate that a transmission oil temperature sensor is installed in the vehicle. Set to FALSE to indicate that it is not fitted.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

VEHICLE SPEED SENSOR FITTED

Set to TRUE if a vehicle speed sensor is installed. Set to FALSE if not.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

KNOCK

Parameters for knock.

KNOCK CHARACTERISTICS

Characteristics for knock detection.

TUNABLE PARAMETERS (CHARACTERISTICS)

CYLINDER #1 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #1 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

CYLINDER #2 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #2 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

CYLINDER #3 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #3 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

CYLINDER #4 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #4 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

CYLINDER #5 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #5 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

CYLINDER #6 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #6 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

CYLINDER #7 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #7 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

CYLINDER #8 KNOCK DETECTION THRESHOLD

This table specifies the knock detection (sensor voltage) threshold for cylinder #8 as a function of manifold absolute pressure and engine speed. Sensor voltages above this threshold indicate that knock is present.

Cell data range: 0 to 5 volts

KNOCK CONTROL ENABLED

Set to YES to enable the knock control system. Set to NO to disable the feature.

KNOCK RETARD LIMIT

This table specifies the maximum allowed amount of knock retard (in degrees) as a function of cylinder airmass. This limit is the maximum amount by which the ECU may retard the ignition timing in response to knock, when not in power enrichment mode.

KNOCK RETARD LIMIT (POWER ENRICHMENT MODE)

This table specifies the maximum allowed amount of knock retard (in degrees) as a function of engine speed, when in power enrichment mode.

MEASUREMENTS

CYLINDER #1 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #1. Knock will be reported for cylinder #1, if the voltage received from the knock sensor is equal to or greater than this value.

CYLINDER #2 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #2. Knock will be reported for cylinder #2, if the voltage received from the knock sensor is equal to or greater than this value.

CYLINDER #3 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #3. Knock will be reported for cylinder #3, if the voltage received from the knock sensor is equal to or greater than this value.

CYLINDER #4 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #4. Knock will be reported for cylinder #4 if the voltage received from the knock sensor is equal to or greater than this value.

CYLINDER #5 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #5. Knock will be reported for cylinder #5 if the voltage received from the knock sensor is equal to or greater than this value.

CYLINDER #6 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #6. Knock will be reported for cylinder #6 if the voltage received from the knock sensor is equal to or greater than this value.

CYLINDER #7 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #7. Knock will be reported for cylinder #7 if the voltage received from the knock sensor is equal to or greater than this value.

CYLINDER #8 KNOCK DETECTION THRESHOLD

Indicates the knock detection threshold for cylinder #8. Knock will be reported for cylinder #8 if the voltage received from the knock sensor is equal to or greater than this value.

KNOCK DETECTION ACTIVE

If this is TRUE, the knock detection feature is active. If this is FALSE, the feature is not active.

KNOCK RETARD LIMIT

Knock retard limit is the maximum amount by which the ignition timing is delayed (in degrees) when the ECU detects engine knock.

KNOCK CONFIGURATION

Parameters for knock configuration.

TUNABLE PARAMETERS (CHARACTERISTICS)

CYLINDER #1 KNOCK GAIN

This table defines cylinder #1 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

CYLINDER #2 KNOCK GAIN

This table defines cylinder #2 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

CYLINDER #3 KNOCK GAIN

This table defines cylinder #3 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

CYLINDER #4 KNOCK GAIN

This table defines cylinder #4 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

CYLINDER #5 KNOCK GAIN

This table defines cylinder #5 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

CYLINDER #6 KNOCK GAIN

This table defines cylinder #6 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

CYLINDER #7 KNOCK GAIN

This table defines cylinder #7 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

CYLINDER #8 KNOCK GAIN

This table defines cylinder #8 knock gain as a function of engine speed. This adjusts the overall magnitude of the knock detection signal. Adjustment of this parameter allows tuners to make knock detection more sensitive (or less sensitive) as engine speed increases.

KNOCK BANDPASS CENTER FREQUENCY

The desired center frequency of the knock sensor bandpass filter (in kHz). This is normally set to the frequency at which knock is most easily detected in the current vehicle's engine. The optimal frequency typically varies by the depth of the cylinder bore.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

KNOCK GAIN

The options for this parameter are pre-defined knock sensor gain configurations. Select an option that is appropriate for the engine you are using.

Once an appropriate option is selected here, the cylinder-specific knock gain parameters can be used to fine tune gain at various engine speeds.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

KNOCK SENSOR TYPES

Specifies the type of knock sensor that is installed: Flat or Resonant

KNOCK START WINDOW ATDC

Configures the knock detection system when to start reading knock signal after Top Dead Center in Degrees.

Range: 10 - 70 degrees

KNOCK STOP WINDOW ATDC

Configures the knock detection system when to stop reading knock signal after Top Dead Center in degrees.

Range: 10 - 70 degrees

KNOCK TIME CONSTANT

Specifies knock sensor integration time constant (in microseconds). This is the amount of time it takes for the final, integrated knock sensor signal to rise from zero to it's full value.

(Cannot be live tuned. Requires flashing modifications back to the ECU)

KNOCK DETECTION

This module configures the ECUs response when knock is detected.

When the ECU detects knock, it applies ignition retard until the detected knock has been eliminated. The amount of additional ignition retard applied is calculated each cylinder cycle. The formula is as follows:

> (Voltage of Knock Sensor Signal - Knock Sensor Threshold) x Ignition Knock Retard Proportional Gain - Ignition Knock Retard Feed Forward.

However, on the first cycle only, Ignition Retard First Step Offset is added to the result in order to give an additional kick to the amount of ignition retard applied immediately.

Once the engine has stopped knocking, the ECU waits an additional period (Ignition Knock Cooling Cycles) before it begins to reduce the amount of ignition retard applied.

TUNABLE PARAMETERS (CHARACTERISTICS)

IGNITION KNOCK COOLING CYCLES

This specifies the amount of time (in cylinder cycles) that the ECU will continue to apply ignition retard, after the detected knock has been eliminated. At the end of this period, the ECU will begin reducing the amount of ignition retard applied.

IGNITION KNOCK RETARD FEED FORWARD

Each cylinder cycle that knock persists and the Knock Retard Limit has not been reached, an additional amount of ignition retard is applied to reduce knock. This is calculated by doing the following:

1. Ignition Knock Retard Proportional Gain (in degrees per volt) is multiplied by the amount that the knock sensor voltage exceeds the knock detection threshold.
2. The resulting amount of ignition retard (in degrees) is added to the value specified here.

IGNITION KNOCK RETARD FIRST STEP OFFSET

This specifies an additional amount (in degrees) by which the ignition timing will be retarded when knock is initially detected. This gives an extra push to eliminate knock as soon knock reduction actions begin.

IGNITION KNOCK RETARD PROPORTIONAL GAIN

Each cylinder cycle that knock persists and the Knock Retard Limit has not been reached, an additional amount of ignition retard is applied to reduce knock. This is calculated by doing the following:

1. The value specified here (in degrees per volt) is multiplied by the amount that the knock sensor voltage exceeds the knock detection threshold.
2. The resulting amount of ignition retard (in degrees) is added to Ignition Retard Feed Forward.

A higher gain value means the system will react more aggressively by applying a greater amount of ignition retard.

IGNITION KNOCK RETARD RECOVERY

This table specifies the rate (in degrees per cylinder cycle) at which the ECU decreases the amount of ignition retard applied after the detected knock has been eliminated. After the knock event has passed, the system starts to gradually advance (recover) the ignition timing back to its original settings.

KNOCK CONTROL ENABLE ENGINE SPEED MAXIMUM

Specifies the maximum engine speed at which knock control will remain enabled. If engine speed exceeds this value, knock control will be disabled.

Range: 0 to 10,000 rpm

KNOCK CONTROL ENABLE ENGINE SPEED MINIMUM

Specifies the minimum engine speed required to enable knock control. The engine speed must exceed this value to enable knock control.

Range: 0 to 10,000 rpm

KNOCK CONTROL ENABLE MANIFOLD ABSOLUTE PRESSURE MAXIMUM

Specifies the highest level of manifold absolute pressure at which the knock control system continues to actively monitor and respond to knock events. Above this pressure, knock control will be disabled.

KNOCK CONTROL ENABLE MANIFOLD ABSOLUTE PRESSURE MINIMUM

Specifies the minimum manifold absolute pressure required to enable the knock control system. Below this minimum MAP level, the knock control system remains inactive, even if knock is detected.

KNOCK DETECTION ACTIVATION DELAY CYCLES

This parameter specifies how many engine cycles it takes for the knock detection system to take action once knock is detected. The delay helps to avoid false knock detection by preventing a reaction to knock that is merely momentary.

Range: 1 to 255 cycles

KNOCK DETECTION THRESHOLD HYSTERESIS

The voltage reported by the knock voltage sensor for a given cylinder must fall beneath the knock detection threshold for that cylinder minus this value to allow ignition to advance back to the base value.

MEASUREMENTS

IGNITION KNOCK RETARD ACTIVE CYLINDER #1

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 1. If FALSE, it is not actively applying ignition retard on cylinder 1.

IGNITION KNOCK RETARD ACTIVE CYLINDER #2

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 2. If FALSE, it is not actively applying ignition retard on cylinder 2.

IGNITION KNOCK RETARD ACTIVE CYLINDER #3

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 3. If FALSE, it is not actively applying ignition retard on cylinder 3.

IGNITION KNOCK RETARD ACTIVE CYLINDER #4

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 4. If FALSE, it is not actively applying ignition retard on cylinder 4.

IGNITION KNOCK RETARD ACTIVE CYLINDER #5

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 5. If FALSE, it is not actively applying ignition retard on cylinder 5.

IGNITION KNOCK RETARD ACTIVE CYLINDER #6

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 6. If FALSE, it is not actively applying ignition retard on cylinder 6.

IGNITION KNOCK RETARD ACTIVE CYLINDER #7

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 7. If FALSE, it is not actively applying ignition retard on cylinder 7.

IGNITION KNOCK RETARD ACTIVE CYLINDER #8

If this is TRUE, the ECU is actively applying ignition retard to reduce knock on cylinder 8. If FALSE, it is not actively applying ignition retard on cylinder 8.

IGNITION KNOCK RETARD CYLINDER #1

Indicates the amount of ignition retard being applied to reduce knock on cylinder 1.

IGNITION KNOCK RETARD CYLINDER #2

Indicates the amount of ignition retard being applied to reduce knock on cylinder 2.

IGNITION KNOCK RETARD CYLINDER #3

Indicates the amount of ignition retard being applied to reduce knock on cylinder 3.

IGNITION KNOCK RETARD CYLINDER #4

Indicates the amount of ignition retard being applied to reduce knock on cylinder 4.

IGNITION KNOCK RETARD CYLINDER #5

Indicates the amount of ignition retard being applied to reduce knock on cylinder 5.

IGNITION KNOCK RETARD CYLINDER #6

Indicates the amount of ignition retard being applied to reduce knock on cylinder 6.

IGNITION KNOCK RETARD CYLINDER #7

Indicates the amount of ignition retard being applied to reduce knock on cylinder 7.

IGNITION KNOCK RETARD CYLINDER #8

Indicates the amount of ignition retard being applied to reduce knock on cylinder 8.

IGNITION KNOCK OCCURRING CYLINDER #1

If this is TRUE, ignition knock is detected in cylinder 1. If FALSE, ignition knock is not detected in cylinder 1.

IGNITION KNOCK OCCURRING CYLINDER #2

If this is TRUE, ignition knock is detected in cylinder 2. If FALSE, ignition knock is not detected in cylinder 2.

IGNITION KNOCK OCCURRING CYLINDER #3

If this is TRUE, ignition knock is detected in cylinder 3. If FALSE, ignition knock is not detected in cylinder 3.

IGNITION KNOCK OCCURRING CYLINDER #4

If this is TRUE, ignition knock is detected in cylinder 4. If FALSE, ignition knock is not detected in cylinder 4.

IGNITION KNOCK OCCURRING CYLINDER #5

If this is TRUE, ignition knock is detected in cylinder 5. If FALSE, ignition knock is not detected in cylinder 5.

IGNITION KNOCK OCCURRING CYLINDER #6

If this is TRUE, ignition knock is detected in cylinder 6. If FALSE, ignition knock is not detected in cylinder 6.

IGNITION KNOCK OCCURRING CYLINDER #7

If this is TRUE, ignition knock is detected in cylinder 7. If FALSE, ignition knock is not detected in cylinder 7.

IGNITION KNOCK OCCURRING CYLINDER #8

If this is TRUE, ignition knock is detected in cylinder 8. If FALSE, ignition knock is not detected in cylinder 8.

KNOCK SENSOR

This module reports the overall knock count as well as the voltages output by the knock sensor on each cylinder.

MEASUREMENTS

KNOCK COUNT READ

Indicates the number of times that the knock sensor has detected knocking events in the engine.

KNOCK SENSOR VOLTAGE CYLINDER #1

Indicates the voltage of the signal from the knock sensor for cylinder 1.

KNOCK SENSOR VOLTAGE CYLINDER #2

Indicates the voltage of the signal from the knock sensor for cylinder 2.

KNOCK SENSOR VOLTAGE CYLINDER #3

Indicates the voltage of the signal from the knock sensor for cylinder 3.

KNOCK SENSOR VOLTAGE CYLINDER #4

Indicates the voltage of the signal from the knock sensor for cylinder 4.

KNOCK SENSOR VOLTAGE CYLINDER #5

Indicates the voltage of the signal from the knock sensor for cylinder 5.

KNOCK SENSOR VOLTAGE CYLINDER #6

Indicates the voltage of the signal from the knock sensor for cylinder 6.

KNOCK SENSOR VOLTAGE CYLINDER #7

Indicates the voltage of the signal from the knock sensor for cylinder 7.

KNOCK SENSOR VOLTAGE CYLINDER #8

Indicates the voltage of the signal from the knock sensor for cylinder 8.

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KNOCK VOLTAGE

Knock voltage parameters.

TUNABLE PARAMETERS (CHARACTERISTICS)

KNOCK BANK 1 SENSOR DEFAULT

Specifies a fallback value for the knock bank 1 sensor. This will be used as the sensor reading when the knock bank 1 sensor diagnostic indicates that the sensor is malfunctioning.

KNOCK BANK 1 SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum allowable voltage for the signal from the knock bank 1 sensor (open circuit threshold). Voltages above this threshold will set a DTC.

KNOCK BANK 1 SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum allowable voltage for the signal from the knock bank 1 sensor (short to ground threshold). Voltages below this threshold will set a DTC.

KNOCK BANK 2 SENSOR DEFAULT

Specifies a fallback value for the knock bank 2 sensor. This will be used as the sensor reading when the knock bank 2 sensor diagnostic indicates that the sensor is malfunctioning.

KNOCK BANK 2 SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum allowable voltage for the signal from the knock bank 2 sensor (open circuit threshold). Voltages above this threshold will set a DTC.

KNOCK BANK 2 SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum allowable voltage for the signal from the knock bank 2 sensor (short to ground threshold). Voltages below this threshold will set a DTC.

KNOCK SENSOR VOLTAGE FILTER FREQUENCY

The frequency (in Hz) of the filter applied to signals from knock sensors.

The filter is used to smooth the signal so that momentary spikes in knock signal do not affect the sensor's accuracy. In the simplest terms, any signal spike that occurs faster than the frequency specified here will be flattened.

> **NOTE:** 0 = no filter.

MEASUREMENTS

KNOCK BANK #1 DTC FAULT ACTIVE

If YES, a DTC has been set for the knock bank 1 sensor.

KNOCK BANK #2 DTC FAULT ACTIVE

If YES, a DTC has been set for the knock bank 2 sensor.

KNOCK SENSOR RAW VOLTAGE CYLINDER #1

The voltage of the signal from the knock sensor on cylinder 1, before filtering is applied.

KNOCK SENSOR RAW VOLTAGE CYLINDER #2

The voltage of the signal from the knock sensor on cylinder 2, before filtering is applied.

KNOCK SENSOR RAW VOLTAGE CYLINDER #3

The voltage of the signal from the knock sensor on cylinder 3, before filtering is applied.

KNOCK SENSOR RAW VOLTAGE CYLINDER #4

The voltage of the signal from the knock sensor on cylinder 4, before filtering is applied.

KNOCK SENSOR RAW VOLTAGE CYLINDER #5

The voltage of the signal from the knock sensor on cylinder 5, before filtering is applied.

KNOCK SENSOR RAW VOLTAGE CYLINDER #6

The voltage of the signal from the knock sensor on cylinder 6, before filtering is applied.

KNOCK SENSOR RAW VOLTAGE CYLINDER #7

The voltage of the signal from the knock sensor on cylinder 7, before filtering is applied.

KNOCK SENSOR RAW VOLTAGE CYLINDER #8

The voltage of the signal from the knock sensor on cylinder 8, before filtering is applied.

SPARK

Spark (Ignition) parameters control the timing of the spark generated. This timing is generally expressed as an angle at which the spark occurs. This angle is the number of degrees of rotation before the piston reaches Top Dead Center (TDC). So, an ignition angle of -10° means that the spark plug will ignite when the piston is 10 degrees before its highest point in its rotation. This angle is sometimes called "spark advance."

Tuners adjust this value to fine-tune the engine's behavior under different conditions, taking into account factors that affect ignition timing and overall engine performance.

The actual ignition timing angle that the engine operates at will vary based on several factors, including engine load, engine speed (RPM), intake air temperature, and more. The ECU continually monitors these conditions and adjusts the ignition timing to match the "Ignition Angle Requested" as closely as possible to achieve the desired performance.

Tuners may need to make changes to the requested ignition angle based on their tuning objectives. For example, advancing the ignition timing angle can typically increase power output but may require careful consideration to prevent engine knock or damage. Retarding the timing angle can improve engine stability but may sacrifice some power.

CYLINDER-SPECIFIC IGNITION CORRECTION

This module determines a cylinder-specific ignition correction for each cylinder. It does this by looking up the correction in tables that define it based on engine speed and cylinder airmass. The correction request for each cylinder is then forwarded to the Ignition Demand module.

The Ignition Demand module will combine this with other cuts and retards as well as the base angle (Ignition Angle Requested) from the Ignition Angle module. The result is the final ignition angle demand applied to each cylinder.

TUNABLE PARAMETERS (CHARACTERISTICS)

CYLINDER #1 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 1. This allows fine tuning the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

CYLINDER #2 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 2. This allows fine tuning the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

CYLINDER #3 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 3. This allows fine tuning the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

CYLINDER #4 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 4. This allows fine tuning the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

CYLINDER #5 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 5. This allows fine tuning the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

CYLINDER #6 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 6. This allows fine tuning to the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

CYLINDER #7 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 7. This allows fine tuning to the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

CYLINDER #8 IGNITION CORRECTION

This table defines the correction (in degrees) to the ignition timing for cylinder 8. This allows fine tuning to the ignition timing in a specific cylinder.

> **NOTE:** Corrections are additive in nature.

MEASUREMENTS

CYLINDER #1 IGNITION CORRECTION REQUEST

The ignition correction request (in degrees) that will be sent to the Ignition Demand module for cylinder #1.

CYLINDER #2 IGNITION CORRECTION REQUEST

The ignition correction request (in degrees) that will be sent to the Ignition Demand module for cylinder #2.

CYLINDER #3 IGNITION CORRECTION REQUEST

The ignition correction request (in degrees) that will be sent to the Ignition Demand module for cylinder #3.

CYLINDER #4 IGNITION CORRECTION REQUEST

The ignition correction request that will be sent to the Ignition Demand module for cylinder #4.

CYLINDER #5 IGNITION CORRECTION REQUEST

The ignition correction request that will be sent to the Ignition Demand module for cylinder #5.

CYLINDER #6 IGNITION CORRECTION REQUEST

The ignition correction request that will be sent to the Ignition Demand module for cylinder #6.

CYLINDER #7 IGNITION CORRECTION REQUEST

The ignition correction request that will be sent to the Ignition Demand module for cylinder #7.

CYLINDER #8 IGNITION CORRECTION REQUEST

The ignition correction request that will be sent to the Ignition Demand module for cylinder #8.

DWELL TIME

The dwell time module calculates the amount of time that the primary winding on the ignition coil needs to be energized in order to yield a sufficient spark.

The process is as follows:

1. Base Dwell Time is calculated as a function of battery voltage and engine speed.
2. The base dwell time is corrected as a function of Manifold Absolute Pressure (Dwell Time Manifold Absolute Pressure Correction).
3. A cranking multiplier (Base Dwell Time Modifier) is factored in to increase the dwell time during engine start conditions.
4. The resulting dwell time is compared to safe maximum and minimum values (Dwell Time Maximum Limit and Dwell Time Minimum Limit) for the installed coil and modified if necessary.

The output of this module is Dwell Time Requested.

TUNABLE PARAMETERS (CHARACTERISTICS)

BASE DWELL TIME

This table defines base dwell time as a function of battery voltage and engine speed. The number retrieved from this table will serve as the basis for the dwell time request.

> **NOTE:** To calculate the final request, the ECU will further modify this value using the Base Dwell Time Modifier and Dwell Time Manifold Absolute Pressure Correction.

Cell Data Range: 0 to 0.032 seconds

BASE DWELL TIME MODIFIER

This table specifies a multiplier to apply to the dwell time when the engine is cranking. This multiplier is defined as a function of engine coolant temperature and battery voltage.

Cell Data Range: 0 to 10

DWELL TIME CYLINDER AIRMASS CORRECTION

This table defines a multiplier for dwell time based on the cylinder airmass.

Cell Data Range: 0 to 4

DWELL TIME MAXIMUM LIMIT

The maximum allowable (safe) dwell time for the installed primary ignition coil. This value will be used as the dwell time if the calculated dwell time exceeds this value.

Range: 0.004 to 0.01 seconds

DWELL TIME MINIMUM LIMIT

The minimum allowable (safe) dwell time for the installed primary ignition coil. This value will be used as the dwell time if the calculated dwell time is lower than this value.

Range: 0.002 to 0.004 seconds

MEASUREMENTS

DWELL TIME REQUESTED

The dwell time calculated by the ECU. This is the amount of time (in ms) that the primary winding on the ignition coil needs to be energized in order to yield a sufficient spark.

This is passed to the Ignition Target Demand module to formulate the actual dwell time demand for the hardware.

IGNITION ANGLE

Parameters for ignition angle.

TUNABLE PARAMETERS (CHARACTERISTICS)

BASE IGNITION ANGLE (MAP #1)

This is 1 of several maps that specify the base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 1.

This angle retrieved from these maps will serve as the base ignition angle when Engine State equals Running.

BASE IGNITION ANGLE MAP #2

This is 1 of several maps that specify the base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 2.

This angle retrieved from these maps will serve as the base ignition angle when Engine State equals Running.

BASE IGNITION ANGLE MAP #3

This is 1 of several maps that specify the base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 3.

This angle retrieved from these maps will serve as the base ignition angle when Engine State equals Running.

BASE IGNITION ANGLE MAP #4

This is 1 of several maps that specify the base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 4.

This angle retrieved from these maps will serve as the base ignition angle when Engine State equals Running.

BASE IGNITION ANGLE MAP SELECT

Use this parameter to select the base ignition angle map to be used.

CRANKING IGNITION ANGLE

This table specifies the ignition angle (in degrees) as a function of engine coolant temperature. This angle will serve as the base ignition angle when Engine State equals Cranking.

FLEX FUEL BASE IGNITION ANGLE BLENDING (MAP #1)

This is one of several maps that specify the amount of blending between the Base Ignition Angle and the Flex Fuel Base Ignition Angle. Each of these tables specify blending percentage as a function of alcohol composition / percentage. This map will be used when Base Ignition Angle Map Selected equals 1.

FLEX FUEL BASE IGNITION ANGLE BLENDING MAP #2

This is one of several maps that specify the amount of blending between the Base Ignition Angle and the Flex Fuel Base Ignition Angle. Each of these tables specify blending percentage as a function of alcohol composition / percentage. This map will be used when Base Ignition Angle Map Selected equals 1.

FLEX FUEL BASE IGNITION ANGLE BLENDING MAP #3

This is one of several maps that specify the amount of blending between the Base Ignition Angle and the Flex Fuel Base Ignition Angle. Each of these tables specify blending percentage as a function of alcohol composition / percentage. This map will be used when Base Ignition Angle Map Selected equals 3.

FLEX FUEL BASE IGNITION ANGLE BLENDING MAP #4

This is one of several maps that specify the amount of blending between the Base Ignition Angle and the Flex Fuel Base Ignition Angle. Each of these tables specify blending percentage as a function of alcohol composition / percentage. This map will be used when Base Ignition Angle Map Selected equals 4.

FLEX FUEL BASE IGNITION ANGLE MAP #1 (HIGH OCTANE)

This is one of several maps that specify the base ignition angle in flex fuel (high octane) applications. Each of these tables define base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 1.

In flex fuel applications, the ignition angle from this map will be blended with the ignition angle from Base Ignition Angle Map #1 using the blending percentage indicated by Flex Fuel Base Ignition Angle Blending Map #1. The blended value will serve as the Base Ignition angle when Engine State equals Running.

FLEX FUEL BASE IGNITION ANGLE MAP #2 (HIGH OCTANE)

This is one of several maps that specify the base ignition angle in flex fuel (high octane) applications. Each of these tables define base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 2.

In flex fuel applications, the ignition angle from this map will be blended with the ignition angle from Base Ignition Angle Map #2 using the blending percentage indicated by Flex Fuel Base Ignition Angle Blending Map #2. The blended value will serve as the Base Ignition angle when Engine State equals Running.

FLEX FUEL BASE IGNITION ANGLE MAP #3 (HIGH OCTANE)

This is one of several maps that specify the base ignition angle in flex fuel (high octane) applications. Each of these tables define base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 3.

In flex fuel applications, the ignition angle from this map will be blended with the ignition angle from Base Ignition Angle Map #3 using the blending percentage indicated by Flex Fuel Base Ignition Angle Blending Map #3. The blended value will serve as the Base Ignition angle when Engine State equals Running.

FLEX FUEL BASE IGNITION ANGLE MAP #4 (HIGH OCTANE)

This is one of several maps that specify the base ignition angle in flex fuel (high octane) applications. Each of these tables define base ignition angle (in degrees) as a function of engine speed and cylinder airmass. This map will be used when Base Ignition Angle Map Selected equals 4.

In flex fuel applications, the ignition angle from this map will be blended with the ignition angle from Base Ignition Angle Map #4 using the blending percentage indicated by Flex Fuel Base Ignition Angle Blending Map #4. The blended value will serve as the Base Ignition angle when Engine State equals Running.

IDLE IGNITION ANGLE

This table specifies the idle ignition angle (in degrees) as a function of cylinder air mass and engine speed. This will be used as the base ignition angle when Engine State equals Idle.

IGNITION ANGLE ECT CORRECTION

This table specifies an ignition angle correction (in degrees) as a function of cylinder airmass and engine coolant temperature.

When the engine is running, this correction is multiplied by Ignition Angle ECT Correction Multiplier and then added to the base ignition angle.

IGNITION ANGLE ECT CORRECTION MULTIPLIER

This table specifies a multiplier for the ignition angle correction as a function of engine speed and engine coolant temperature.

IGNITION ANGLE IAT CORRECTION

This table specifies an ignition angle correction (in degrees) as a function of cylinder airmass and intake air temperature.

When the engine is running, this correction is multiplied by Ignition Angle IAT Correction Multiplier and then added to the base ignition angle.

IGNITION ANGLE IAT CORRECTION MULTIPLIER

This table specifies a multiplier for the ignition angle correction as a function of engine speed and intake air temperature.

IGNITION ANGLE MAXIMUM LIMIT

Specifies the latest allowable timing (in degrees) for spark ignition in the engine. This value will be used for the requested ignition angle if the calculated Ignition Angle Requested is larger.

IGNITION ANGLE MINIMUM LIMIT

This table specifies the minimum ignition angle (maximum retardation) limit (in degrees) as a function of engine speed. This value will be used for the requested ignition angle if the calculated Ignition Angle Requested is smaller.

MEASUREMENTS

BASE IGNITION ANGLE

Indicates the base ignition angle to be used when the engine is running (in degrees before top dead center). This is copied from the currently-selected Base Ignition Angle Map.

To form the Ignition Angle Request sent to the Ignition Target Demand module, this value is added to two correction values:

- An Engine Coolant Temperature Correction calculated by multiplying Ignition Angle ECT Correction by Ignition Angle ECT Correction Multiplier.

- An Intake Air Temperature Correction calculated by multiplying Ignition Angle IAT Correction by Ignition Angle IAT Correction Multiplier.

BASE IGNITION ANGLE MAP SELECTED

Indicates which of the base ignition angle maps is currently selected.

IGNITION ANGLE AVERAGE

Average of all 8 demanded ignition angles/spark timing advance.

IGNITION ANGLE REQUESTED

The Ignition Angle Request sent to the Ignition Target Demand Module, expressed as a number of degrees before top dead center (BTDC). Depending on engine state, this will be based on one of the following:

- **Cranking.** The angle obtained from the Cranking Ignition Angle table
- **Idle.** The angle obtained from the Idle Ignition Angle table, corrected by adding the Idle Proportional Term from the Idle Control Demands module.
- **Running.** The angle obtained from the Base Ignition Angle Tables, with ECT and IAT corrections added in.

The final value is checked against the specified Ignition Angle Maximum Limit and Ignition Angle Minimum Limit (and adjusted if necessary).

> **NOTE:** This requested value is sent to the Ignition Target Demand module to determine the final demanded ignition timing for each cylinder.

IGNITION CUT

This module applies a global cut (shut off) for all spark plugs. The cut is a safety feature that can be activated for a number of reasons, including:

- Requested by the hard limiter for engine protection
- Requested by launch control
- Required if transmission is not in Park at startup (automatic transmission only)

MEASUREMENTS

IGNITION ACTIVE

If FALSE, a global ignition cut is in effect. If TRUE, no global cut is in effect.

IGNITION TARGET DEMAND

The Ignition Target Demand module calculates the final ignition angles applied to the spark plugs.

To perform this calculation, the following angles are added together:

- The Ignition Angle Requested by the Ignition Angle Module. However, if knock is detected, the ignition angle may be modified by an amount of ignition knock retard for the cylinder(s) in which the knock is occurring.
- When using nitrous fuel, a Nitrous Ignition Retard may be applied.
- Ignition Angle Correction requests for the individual cylinders

The following angles are then subtracted from the total:

- The Traction Control Ignition Cut Requested
- An ignition retard value that is derived based on soft limiters, hard limiters, and Shift Ignition Retard

The module also calculates the final Dwell Time Demanded based on the Dwell Time Requested generated by the Dwell Time module.

TUNABLE PARAMETERS (CHARACTERISTICS)

IGNITION #1 ENABLED

Set to YES to enable ignition in cylinder 1. Set to NO to disable.

> **NOTE:** This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION #2 ENABLED

Set to YES to enable ignition in cylinder 2. Set to NO to disable.

NOTE: This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION #3 ENABLED

Set to YES to enable ignition in cylinder 3. Set to NO to disable.

NOTE: This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION #4 ENABLED

Set to YES to enable ignition in cylinder 4. Set to NO to disable.

NOTE: This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION #5 ENABLED

Set to YES to enable ignition in cylinder 5. Set to NO to disable.

NOTE: This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION #6 ENABLED

Set to YES to enable ignition in cylinder 6. Set to NO to disable.

> **NOTE:** This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION #7 ENABLED

Set to YES to enable ignition in cylinder 7. Set to NO to disable.

> **NOTE:** This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION #8 ENABLED

Set to YES to enable ignition in cylinder 8. Set to NO to disable.

> **NOTE:** This setting CANNOT be used to override the global Ignition Cut safety feature. If Ignition Cut has deactivated the spark plugs (Ignition Active equals FALSE), ignition for all cylinders has been deactivated. Period.

IGNITION ANGLE OVERRIDE DEMAND

Specifies the ignition angle to use when Ignition Angle Override Enabled is set to TRUE. This parameter allows tuners to manually override the calculated ignition timings.

Range: -10 to 20 degrees

IGNITION ANGLE OVERRIDE ENABLED

Set to TRUE to override the calculated ignition angle. The ignition angle specified in Ignition Angle Override Demand will be used instead.

NITROUS DEACTIVATION IGNITION CUT DELAY CYCLES

Specifies the number of cylinder cycles to wait before applying the ignition cut after nitrous deactivation.

This is used to manage the transition between deactivating the nitrous system and implementing ignition cuts.

Range: 1 to 1000

MEASUREMENTS

DWELL TIME DEMANDED

Indicates dwell time demanded (in ms). This is the final dwell time value output to the hardware. It is essentially the same value as the Dwell Time Requested by the Dwell Time module. However, when Ignition Active is FALSE, this value is forced to zero.

IGNITION #1 ACTIVE

If TRUE, ignition is active on cylinder 1.

If FALSE, the ignition for cylinder 1 has been deactivated, either by the Ignition Cut safety feature or by Ignition #1 Enabled being set to FALSE.

IGNITION #2 ACTIVE

If TRUE, ignition is active on cylinder 2.

If FALSE, the ignition for cylinder 2 has been deactivated, either by the Ignition Cut safety feature or by Ignition #2 Enabled being set to FALSE.

IGNITION #3 ACTIVE

If TRUE, ignition is active on cylinder 3.

If FALSE, the ignition for cylinder 3 has been deactivated, either by the Ignition Cut safety feature or by Ignition #3 Enabled being set to FALSE.

IGNITION #4 ACTIVE

If TRUE, ignition is active on cylinder 4.

If FALSE, the ignition for cylinder 4 has been deactivated, either by the Ignition Cut safety feature or by Ignition #4 Enabled being set to FALSE.

IGNITION #5 ACTIVE

If TRUE, ignition is active on cylinder 5.

If FALSE, the ignition for cylinder 5 has been deactivated, either by the Ignition Cut safety feature or by Ignition #5 Enabled being set to FALSE.

IGNITION #6 ACTIVE

If TRUE, ignition is active on cylinder 6. The spark plug for cylinder #6 is allowed to fire, and the engine is using the combustion in this cylinder to produce power.

If FALSE, the ignition for cylinder 6 has been deactivated, either by the Ignition Cut safety feature or by Ignition #6 Enabled being set to FALSE.

IGNITION #7 ACTIVE

If TRUE, ignition is active on cylinder 7.

If FALSE, the ignition for cylinder 7 has been deactivated, either by the Ignition Cut safety feature or by Ignition #7 Enabled being set to FALSE.

IGNITION #8 ACTIVE

If TRUE, ignition is active on cylinder 8.

If FALSE, the ignition for cylinder 8 has been deactivated, either by the Ignition Cut safety feature or by Ignition #1 Enabled being set to FALSE.

IGNITION ANGLE #1 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 1.

IGNITION ANGLE #2 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 2.

IGNITION ANGLE #3 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 3.

IGNITION ANGLE #4 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 4.

IGNITION ANGLE #5 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 5.

IGNITION ANGLE #6 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 6.

IGNITION ANGLE #7 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 7.

IGNITION ANGLE #8 DEMANDED

The actual ignition/spark timing demand (degrees BTDC) that is sent to the spark plug for cylinder 8.

TRACTION CONTROL IGNITION CUT DEMANDED

The amount of ignition retard demanded by the traction control feature.

Range: -20 to 45 degrees

SHIFT IGNITION CUT

This module controls the amount of additional ignition cut applied when shifting gears.

The amount of ignition cut requested is output by this module as Gear Shift Ignition Retard. This is sent to the Ignition Target Demand module, where it is combined the with other cuts and retards and applied to the base ignition angle in order to determine the final ignition angle demand sent to the spark plugs.

TUNABLE PARAMETERS (CHARACTERISTICS)

NORMAL MODE DOWN SHIFT IGNITION RETARD 2 TO 1

In normal mode, this table defines the amount of additional ignition retard applied when shifting from second to first gear as a function of engine speed.

NORMAL MODE DOWN SHIFT IGNITION RETARD 3 TO 2

In normal mode, this table defines the amount of additional ignition retard applied when shifting from third to second gear as a function of engine speed.

NORMAL MODE DOWN SHIFT IGNITION RETARD 4 TO 3

In normal mode, this table defines the amount of additional ignition retard applied when shifting from fourth to third gear as a function of engine speed.

NORMAL MODE GEAR SHIFT IGNITION RETARD RATE LIMITER DOWN

When shifting in normal mode, this specifies the maximum rate at which the Shift Ignition Cut module can increase its ignition retard request.

The larger the value (magnitude, since values are negative), the steeper the cut and vice versa. That is, larger magnitudes yield faster responses and smaller values yield slower responses.

Large values are recommended in order to retard ignition quickly (step change response) as shift change is initiated.

NORMAL MODE GEAR SHIFT IGNITION RETARD RATE LIMITER UP

When shifting in normal mode, this specifies the maximum rate at which the Shift Ignition Cut module can decrease its ignition retard request.

The larger the value (magnitude), the steeper the cut and vice versa. That is, larger magnitudes yield faster responses and smaller values yield slower responses.

Small value are recommended in order to slowly ramp up to normal operating ignition timing after shift is complete.

NORMAL MODE UP SHIFT IGNITION RETARD 1 TO 2

In normal mode, this table defines the amount of additional ignition retard applied when shifting from first to second gear as a function of engine speed.

NORMAL MODE UP SHIFT IGNITION RETARD 2 TO 3

In normal mode, this table defines the amount of additional ignition retard applied when shifting from second to third gear as a function of engine speed.

NORMAL MODE UP SHIFT IGNITION RETARD 3 TO 4

In normal mode, this table defines the amount of additional ignition retard applied when shifting from third to fourth gear as a function of engine speed.

PERFORMANCE MODE DOWN SHIFT IGNITION RETARD 2 TO 1

In performance mode, this table defines the amount of additional ignition retard applied when shifting from second to first gear as a function of engine speed.

PERFORMANCE MODE DOWN SHIFT IGNITION RETARD 3 TO 2

In performance mode, this table defines the amount of additional ignition retard applied when shifting from third to second gear as a function of engine speed.

PERFORMANCE MODE DOWN SHIFT IGNITION RETARD 4 TO 3

In performance mode, this table defines the amount of additional ignition retard applied when shifting from fourth to third gear as a function of engine speed.

PERFORMANCE MODE GEAR SHIFT IGNITION RETARD RATE LIMITER DOWN

When shifting in performance mode, this specifies the maximum rate at which the Shift Ignition Cut module can increase its ignition retard request.

The larger the value (magnitude, as values are negative), the steeper the cut and vice versa. That is, larger magnitudes produce faster responses and smaller magnitudes produce slower responses.

Large values are recommended in order to retard ignition quickly (step change response) as shift changes are initiated.

PERFORMANCE MODE GEAR SHIFT IGNITION RETARD RATE LIMITER UP

When shifting in performance mode, this specifies the maximum rate at which the Shift Ignition Cut module can decrease its ignition retard request.

The larger the value (magnitude), the steeper the cut and vice versa. That is, larger magnitudes produce faster responses and smaller values produce slower responses.

Small values are recommended in order to ramp up to normal operating ignition timing after shift is complete.

PERFORMANCE MODE UP SHIFT IGNITION RETARD 1 TO 2

In performance mode, this table defines the amount of additional ignition retard applied when shifting from first to second gear as a function of engine speed.

PERFORMANCE MODE UP SHIFT IGNITION RETARD 2 TO 3

In performance mode, this table defines the amount of additional ignition retard applied when shifting from second to third gear as a function of engine speed.

PERFORMANCE MODE UP SHIFT IGNITION RETARD 3 TO 4

In performance mode, this table defines the amount of additional ignition retard applied when shifting from third to fourth gear as a function of engine speed.

MEASUREMENTS

GEAR SHIFT IGNITION RETARD

This is the amount of ignition retard requested by the Shift Ignition Retard module:

- In normal mode, this is equal to Normal Mode Gear Shift Ignition Retard.
- In performance mode, this is equal to Performance Mode Gear Shift Ignition Retard.

This is sent to the Ignition Target Demand module, where it is combined the with other cuts and retards and applied to the base ignition angle in order to determine the final ignition angle demand sent to the spark plugs.

NORMAL MODE GEAR SHIFT IGNITION RETARD

In normal mode, this is the amount of ignition retard requested by the Shift Ignition Retard module.

It is obtained by plugging the current engine speed into the appropriate Normal Mode Up (or Down) Shift Ignition Retard table. However, its rate of change is limited by Normal Mode Gear Shift Ignition Retard Rate Limiter Down and Normal Mode Gear Shift Rate Limiter Up.

PERFORMANCE MODE GEAR SHIFT IGNITION RETARD

In performance mode, this is the amount of ignition retard requested by the Shift Ignition Retard module.

It is obtained by plugging the current engine speed into the appropriate Performance Mode Up (or Down) Shift Ignition Retard table. However, its rate of change is limited by Performance Mode Gear Shift Ignition Retard Rate Limiter Down and Performance Mode Gear Shift Rate Limiter Up.

THROTTLE

Throttle parameters can be broken down into the following groups:

- Pedal Request
- Stuck Throttle
- Throttle Position Regulation
- Throttle Position Sensor (TPS)
- Throttle Target
- Throttle Target Demand

PEDAL REQUEST

The parameters in this group specify how to translate the position of the accelerator pedal into an amount of throttle being requested by the driver.

TUNABLE PARAMETERS (CHARACTERISTICS)

THROTTLE POSITION PER ACCELERATOR PEDAL REQUEST (MAP #1)

This is one of four maps that specify how much throttle is being requested by the driver based on the position of the accelerator pedal and the current engine speed.

> **NOTE:** Each map can be used to store a different configuration. Use Throttle Position Requested Via Pedal Map Select to specify the map the ECU should employ.

The data in this table is a requested throttle percentage.

Range: 0 - 100%

THROTTLE POSITION PER ACCELERATOR PEDAL REQUEST MAP #2

This is one of four maps that specify how much throttle is being requested by the driver based on the position of the accelerator pedal and the current engine speed.

NOTE: Each map can be used to store a different configuration. Use Throttle Position Requested Via Pedal Map Select to specify the map the ECU should employ.

The data in this table is a requested throttle percentage.

Range: 0 to 100%

THROTTLE POSITION PER ACCELERATOR PEDAL REQUEST MAP #3

This is one of four maps that specify how much throttle is being requested by the driver based on the position of the accelerator pedal and the current engine speed.

NOTE: Each map can be used to store a different configuration. Use Throttle Position Requested Via Pedal Map Select to specify the map the ECU should employ.

The data in this table is a requested throttle percentage.

Range: 0 to 100%

THROTTLE POSITION PER ACCELERATOR PEDAL REQUEST MAP #4

This is one of four maps that specify how much throttle is being requested by the driver based on the position of the accelerator pedal and the current engine speed.

NOTE: Each map can be used to store a different configuration. Use Throttle Position Requested Via Pedal Map Select to specify the map the ECU should employ.

The data in this table is a requested throttle percentage.

Range: 0 to 100%

THROTTLE POSITION REQUESTED VIA PEDAL MAP SELECT

Use this parameter to select the throttle position requested map to be used.

MEASUREMENTS

THROTTLE POSITION REQUESTED VIA ACCELERATOR PEDAL

Indicates the throttle position (%) requested by the driver, based on both the pedal position and the current engine speed.

This is obtained by referring to the Throttle Position Via Pedal Map tables. The value here is the value indicated by the currently-selected table.

THROTTLE POSITION REQUESTED VIA PEDAL MAP SELECTED

Indicates which of the throttle position via pedal maps is currently selected.

STUCK THROTTLE

The Stuck Throttle module detects if the electronic throttle motor is mechanically stuck (not responding to control). This is done by comparing the measured throttle position and the target throttle position. If the difference between the two values exceed Stuck Throttle Position Error Threshold for longer than Stuck Throttle Error Time, stuck throttle security activates.

When stuck throttle security activates, the electronic throttle motor is inhibited and engine kill is requested. This also triggers a DTC.

The engine kill is achieved by shutting off both ignition and injection one cylinder at a time.

NOTE: The stuck throttle system is only applicable to electronic throttle applications.

TUNABLE PARAMETERS (CHARACTERISTICS)

STUCK THROTTLE POSITION ERROR THRESHOLD

If the difference between the measured throttle position and the target throttle position is greater than this value for longer than Stuck Throttle Position Activation Delay, stuck throttle security will be activated.

Range: 0 to 100%

(Cannot be live tuned. Requires flashing modifications back to the ECU).

STUCK THROTTLE POSITION ACTIVATION DELAY

The amount of time that the stuck throttle position error must exceed Stuck Throttle Position Error Threshold in order for stuck throttle security to be activated.

Range: 0 to 60 seconds

STUCK THROTTLE SECURITY ENABLED

Set to TRUE to enable the stuck throttle security feature. Set to FALSE to disable it.

STUCK THROTTLE CUT DELAY

After stuck throttle security is activated, the ECU will wait this amount of time before implementing cuts to kill the engine.

Range: 0 to 1 seconds.

> **NOTE:** The resolution of this characteristic is limited to the nearest 0.005 seconds.

MEASUREMENTS

STUCK THROTTLE CUT REQUESTED

Stuck throttle cut pattern.

STUCK THROTTLE POSITION ERROR

Stuck throttle position error (absolute value of difference between throttle position & throttle position setpoint).

STUCK THROTTLE SECURITY ACTIVE

If TRUE, stuck throttle security has been activated (stuck throttle was detected).

THROTTLE POSITION REGULATION

The throttle position regulation module acts as a throttle controller, regulating how much the throttle blades are open. To do this, it takes the Throttle Position Setpoint from the Throttle Target module and the measured throttle position from the throttle position sensor and uses them to determine how much the throttle blades must be adjusted.

This involves performing the following tasks once per millisecond:

1. Computing the difference between the Throttle Position Setpoint and the throttle position reported by the sensor. This difference is called Throttle Position Error.
2. Determining a throttle position to be used as the basis for the throttle position to be sent to the hardware. This is called the **Feed Forward Term**.
3. Calculating an amount of desired correction to apply. The desired correction for each cycle includes three components, which are added together to form the total amount of correction:
   - A **Proportional Term** - This portion of the correction is meant to be directly proportional to the amount of error.
   - An **Integral Term** - This portion of the correction is based on the sum of the error over time.
   - A **Derivative Term** - The derivative is based on how much the error has changed over the last millisecond. So the faster the error changes, the larger this term becomes.
4. Calculating the actual throttle position sent to the hardware (Throttle Position Demanded) by adding the total correction to the Feed Forward Term.

TUNABLE PARAMETERS (CHARACTERISTICS)

ELECTRONIC THROTTLE CLOSE LOOP MAXIMUM

The maximum allowable value for Throttle Position Demanded. This is the value that will be used for Throttle Position Demanded if the computed value exceeds this number.

Range: -100% - 100%

ELECTRONIC THROTTLE CLOSE LOOP MINIMUM

The minimum allowable value for Throttle Position Demanded. This is the value that will be used for Throttle Position Demanded if the computed value is less than this number.

Range: -100% - 100%

ELECTRONIC THROTTLE CONTROL INTEGRAL ENABLE MAXIMUM THRESHOLD

When the throttle position error is between this value and the Integral Enable Minimum Threshold, the Integral Term will be reset to zero and frozen there.

Normal calculation of the Integral Term will resume when the error crosses outside of this range again.

Range: 0% to 1%

ELECTRONIC THROTTLE CONTROL INTEGRAL ENABLE MINIMUM THRESHOLD

When the throttle position error exceeds this value (but remains below the maximum threshold), the Integral Term will be reset to zero. Moreover, it will not be updated again until the throttle position error crosses one of these two thresholds.

Normal calculation of the Integral Term will resume when the error crosses outside of this range again.

Range: -1 to 0%

ELECTRONIC THROTTLE DERIVATIVE FILTER ENABLED

Set this field to YES to enable filtering during calculation of the Derivative Term. This filters out changes to the Throttle Position Error that are faster than Electronic Throttle Derivative Filter Frequency (which may help remove noise from the error component of this calculation).

ELECTRONIC THROTTLE DERIVATIVE FILTER FREQUENCY

This specifies the filter frequency to be used when electronic throttle derivative filtering is enabled. Spikes in the throttle position error that are faster than the frequency specified here will be flattened.

Range: 0 - 6500Hz

ELECTRONIC THROTTLE DERIVATIVE GAIN

This table defines electronic throttle derivative gain as a function of throttle position error and throttle position. It us used to adjust the overall magnitude of the Electronic Throttle Derivative Term.

To calculate the Derivative Term, the value from this table is multiplied by the rate of change of the error (error now - error from 1 ms ago)/0.001 seconds. For example: if the error has changed has changed by 4% in the last millisecond and the derivative gain from this table is 20 %/s, the Derivative Term would be .008% (multiply 4% / 0.001 seconds by 20%/s).

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term + Derivative Term.

Range: -100 to 100 %/s

ELECTRONIC THROTTLE DERIVATIVE TERM MAXIMUM

Specifies the largest allowable value for the Derivative Term. This value will be used as the Derivative Term if the calculated Derivative Term exceeds it.

> **NOTE:** The Derivative Term is calculated by multiplying the amount that the measured throttle position has changed over the last millisecond by Electronic Throttle Derivative Gain.

Range: -100% to 100%

ELECTRONIC THROTTLE DERIVATIVE TERM MINIMUM

Specifies the largest allowable NEGATIVE value for the Derivative Term. This value will be used as the Derivative Term if the calculated value for the Derivative Term is a larger negative number.

> **NOTE:** The Derivative Term is calculated by multiplying the amount that the measured throttle position has changed over the last millisecond by Electronic Throttle Derivative Gain.

Range: -100% to 100%

ELECTRONIC THROTTLE DITHER AMPLITUDE

Electronic throttle dither amplitude.

Range: 0 to 100%

ELECTRONIC THROTTLE DITHER DISABLE THRESHOLD

Shannon dither will be disabled when Throttle Position Error meets or exceeds this threshold.

Range: 0 to 100%

ELECTRONIC THROTTLE DITHER ENABLE HYSTERESIS

Shannon dither will be enabled when Throttle Position Error falls below Electronic Throttle Dither Disable Threshold minus this value.

Higher values prevent frequent enabling and disabling of dithering when engine remains near the threshold.

Range: 0 to 100%

ELECTRONIC THROTTLE DITHER ENABLED

Set this field to YES to enable the electronic throttle dithering feature. This feature applies a Shannon dither to final throttle position calculation when Throttle Position Error is relatively low.

ELECTRONIC THROTTLE DITHER FREQUENCY

Electronic throttle dither frequency.

Range: 0 to 6500Hz

ELECTRONIC THROTTLE FEED FORWARD

This table defines the Electronic Throttle Feed Forward Term (%) as a function of throttle position error and Throttle Position Setpoint.

Error corrections are then applied to this value to produce the final throttle position sent to the throttle hardware (Throttle Position Demanded).

Cell Range: -100% to 100%

ELECTRONIC THROTTLE INTEGRAL DEADBAND

If the throttle position error is less than this percentage, it will be treated as zero error when updating the Integral Term. In other words, the Integral Term will not change this cycle because the error is effectively zero.

> **NOTE:** This does not reset the Integral Term to zero. The term merely remains at its current value.

Range: 0 to 10%

ELECTRONIC THROTTLE INTEGRAL GAIN

This table defines electronic throttle integral gain as a function of throttle position error and throttle position. It us used to adjust the overall magnitude of the Electronic Throttle Integral Term.

When calculating the integral term, this value is multiplied by the Throttle Position Error, which is then multiplied by the task time (0.0001 seconds). The resulting value is added to the integral term from the previous cycle. For example: if Throttle Position Error is 4% and the integral gain from this table is 25%, the Integral Term would increase by 0.0001% (4% x 25% x 0.0001 seconds).

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term + Derivative Term.

Range: -100 to 100 %/s

ELECTRONIC THROTTLE INTEGRAL TERM MAXIMUM

Specifies the largest allowable value for the Integral Term. This value will be used as the Integral Term if the calculated Integral Term exceeds it.

> **NOTE:** The Integral Term is calculated each cycle by adding Throttle Position Error multiplied by Electronic Throttle Integral Gain to the previous value for integral gain.

Range: 0 to 100%

ELECTRONIC THROTTLE INTEGRAL TERM MINIMUM

Specifies the largest allowable NEGATIVE value for the Integral Term. This value will be used as the Integral Term if the calculated value for the Integral Term is a larger negative number.

> **NOTE:** The Integral Term is calculated each cycle by adding Throttle Position Error multiplied by Electronic Throttle Integral Gain to the previous value for integral gain.

Cell data range: -100 to 0%

ELECTRONIC THROTTLE INTEGRAL RESET REQUEST

Setting this parameter to TRUE forces the Throttle Position Integral Term to the value specified in Electronic Throttle Integral Reset Value.

ELECTRONIC THROTTLE INTEGRAL RESET VALUE

If an integral term reset is triggered (by setting Integral Term Reset Request to TRUE), the integral term will be reset to this value.

Range: -100 to 100%

ELECTRONIC THROTTLE PROPORTIONAL GAIN

This table defines electronic throttle proportional gain as a function of throttle position error and throttle position. It is used to adjust the overall magnitude of the Throttle Position Proportional Term.

Proportional gain is the percentage of the Throttle Position Error to use when calculating the Proportional Term. For example: if Throttle Position Error is 6% and the proportional gain from this table is 10, the Proportional Term would be 60% (multiply 6% by 10).

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term + Derivative Term.

In general, larger proportional gain values mean error is corrected faster because more corrective action is being taken.

However, larger values also increase the amount by which the total correction may overshoot the target value. Although a small amount of overshoot is normal, too much of an overshoot may cause the error to increase each cycle rather than decrease.

Cell data range: -100 to 100

ELECTRONIC THROTTLE PROPORTIONAL TERM MAXIMUM

Specifies the largest allowable value for the Proportional Term. This value will be used as the Proportional Term if the calculated Proportional Term exceeds it.

> **NOTE:** When calculated, Proportional Term is equal to Throttle Position Error multiplied by Electronic Throttle Proportional Gain.

Range: 0 to 100%

ELECTRONIC THROTTLE PROPORTIONAL TERM MINIMUM

Specifies the largest allowable NEGATIVE value for the Proportional Term. This value will be used as the Proportional Term if the calculated Proportional Term is a larger negative number.

> **NOTE:** When calculated, Proportional Term is equal to Throttle Position Error multiplied by Electronic Throttle Proportional Gain.

Range: -100% to 0%

THROTTLE BODY (TPS) TYPE

Specifies throttle body type:

1. Drive by wire (electronic throttle).
2. Drive by cable (use IAC valve to control idle speed).
3. Dual throttle body.

WIDE OPEN THROTTLE THRESHOLD

Specifies the minimum throttle position required to enable wide open throttle.

Range: 0 to 100%

WIDE OPEN THROTTLE THRESHOLD HYSTERESIS

Wide open throttle may be disabled when throttle position falls below Wide Open Throttle Threshold minus this value.

Higher values prevent frequent enabling and disabling of wide open throttle when throttle position remains near the threshold.

Range: 0% to 100%

MEASUREMENTS

THROTTLE POSITION DEMANDED

The actual throttle position (%) sent to the throttle hardware after all corrections have been applied. This is calculated as:

> Throttle Position Feed Forward Term - Throttle Position Proportional Term - Throttle Position Integral Term - Throttle Position Derivative Term

THROTTLE POSITION DERIVATIVE TERM

One of three component values that are used to calculate the correction that will be applied to reduce Throttle Position Error.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term + Derivative Term.

The derivative term is the amount of error correction that is based on how fast the amount of error changes. So, the faster throttle error increases or decreases, the larger this term becomes.

THROTTLE POSITION ERROR

Throttle position regulation error (target throttle position - throttle position reported by sensor).

Each time through the control loop, the ECU computes the difference between the target throttle position and the actual throttle position measured by the throttle position sensor. This difference is called the Throttle Position Error.

The ECU will then attempt to correct the error by adjusting the Demanded Throttle Position sent to the throttle hardware.

THROTTLE POSITION FEED FORWARD TERM

The feed forward term is used as the basis of the final throttle position calculation.

Since Throttle Position Error is essentially Throttle Position Setpoint minus the measured throttle position, changing the setpoint can immediately increase the error. So, the basis of the actual throttle position to be sent to the hardware takes changes to both of these values into account.

> **NOTE:** Three error correction terms are added to this term when calculating the Throttle Position Demand sent to the hardware: Proportional Term + Integral Term + Derivative Term.

THROTTLE POSITION INTEGRAL TERM

One of three component values that are used to calculate the correction that will be applied to reduce Throttle Position Error.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term + Derivative Term.

The integral term is based on of the throttle position error over time. Each time throttle position error is calculated:

1. The error is multiplied by Electronic Throttle Integral Gain, which is then multiplied by the task time (0.001 seconds).
2. The result is added to the previous Throttle Position Integral Term, resulting in a new value for the integral term.

THROTTLE POSITION PROPORTIONAL TERM

One of three component values that are used to calculate the correction that will be applied to reduce Throttle Position Error.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term + Derivative Term.

The proportional term is directly proportional to the amount of error observed.

WIDE OPEN THROTTLE ACTIVE

If this output is TRUE, wide open throttle is active.

THROTTLE POSITION SENSOR (TPS)

Parameters for the throttle position sensor.

TUNABLE PARAMETERS (CHARACTERISTICS)

THROTTLE POSITION 1 SENSOR (TPS 1) DTC MAXIMUM

Specifies the maximum allowable reading (%) for throttle position sensor 1. Readings above this value will set a DTC.

This would typically be set at a point where higher readings would indicate a potential issue with the throttle position detection (or actual throttle position).

THROTTLE POSITION 1 SENSOR (TPS 1) DTC MAXIMUM VOLTS

Specifies the maximum allowable voltage for the signal form throttle position sensor 1 (open circuit threshold). Voltages above this threshold will set a DTC.

Typically, the voltage entered here would be the threshold above which technicians should suspect an electrical problem, such as a faulty sensor, damaged wiring, or poor connections.

THROTTLE POSITION 1 SENSOR (TPS 1) DTC MINIMUM

Specifies the minimum allowable reading (%) for throttle position sensor 1. Readings below this value will set a DTC.

This would typically be set at a point where higher readings would indicate a potential issue with the throttle position detection (or actual throttle position).

THROTTLE POSITION 1 SENSOR (TPS 1) DTC MINIMUM VOLTS

Specifies the minimum allowable voltage for the signal form throttle position sensor 2 (short to ground threshold). Voltages below this threshold will set a DTC.

Typically, the voltage entered here would be the threshold below which technicians should suspect an electrical problem, such as a faulty sensor, damaged wiring, or poor connections.

THROTTLE POSITION 1 (TPS 1) FILTER FREQUENCY

Specifies how often how often the ECU samples the raw signal from throttle position sensor 1. The filter applied to the signal averages the samples in order to smooth the signal out.

The result is that signal spikes that occur faster than the sampling rate (filter frequency) tend to be flattened.

> **NOTE:** Set to 0 to disable the filter.

THROTTLE POSITION 1 (TPS 1) SCALED ENDPOINTS

This table is used to convert the voltage produced by throttle position sensor 1 to the throttle position (%) represented by that voltage.

The values on the table's axis represent possible voltages of the sensor signal. Enter the corresponding percentages in the cells below.

THROTTLE POSITION 1 (TPS 1) SENSOR INPUT

Specifies the pin on the ECU connector that acceleration throttle position sensor 1 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is acceleration throttle position sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

THROTTLE POSITION 2 SENSOR (TPS 2) DTC MAXIMUM

Specifies the maximum allowable reading (%) for throttle position sensor 2. Readings above this value will set a DTC.

This would typically be set at a point where higher readings would indicate a potential issue with the throttle position detection (or actual throttle position).

THROTTLE POSITION 2 SENSOR (TPS 2) DTC MAXIMUM VOLTS

Specifies the maximum allowable voltage for the signal form throttle position sensor 2 (open circuit threshold). Voltages above this threshold will set a DTC.

Typically, the voltage entered here would be the threshold above which technicians should suspect an electrical problem, such as a faulty sensor, damaged wiring, or poor connections.

THROTTLE POSITION 2 SENSOR (TPS 2) DTC MINIMUM

Specifies the minimum allowable reading (%) for throttle position sensor 2. Readings above this value will set a DTC.

This would typically be set at a point where higher readings would indicate a potential issue with the throttle position detection (or actual throttle position).

THROTTLE POSITION 2 SENSOR (TPS 2) DTC MINIMUM VOLTS

Specifies the minimum allowable voltage for the signal form throttle position sensor 2 (short to ground threshold). Voltages below this threshold will set a DTC.

Typically, the voltage entered here would be the threshold below which technicians should suspect an electrical problem, such as a faulty sensor, damaged wiring, or poor connections.

THROTTLE POSITION 2 (TPS 2) FILTER FREQUENCY

Specifies how often how often the ECU samples the raw signal from throttle position sensor 2. The filter applied to the signal averages the samples in order to smooth the signal out.

The result is that signal spikes that occur faster than the sampling rate (filter frequency) tend to be flattened.

> **NOTE:** Set to 0 to disable the filter.

THROTTLE POSITION 2 (TPS 2) SCALED ENDPOINTS

This table is used to convert the voltage produced by throttle position sensor 2 to the throttle position (%) represented by that voltage.

The values on the table's axis represent possible voltages of the sensor signal. Enter the corresponding percentages in the cells below.

THROTTLE POSITION 2 (TPS 2) SENSOR INPUT

Specifies the pin on the ECU connector that acceleration throttle position sensor 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is acceleration throttle position sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

THROTTLE SENSOR ERROR POSITION

Specifies the throttle position (%) that will be used as the default when both sensors are in error or not fitted (limp home throttle position).

MEASUREMENTS

THROTTLE (TPS) LIMP CONTROL REQUESTED

If TRUE, limp home mode has been requested because the ECU has detected a failure of the throttle position sensors.

THROTTLE POSITION

The throttle position (%) as measured by the throttle position sensor(s). If both throttle sensors are fitted and functioning, this will be the higher of the two sensor readings.

THROTTLE POSITION #1 (TPS 1) DTC FAULT ACTIVE

If YES, a DTC has been set for throttle position sensor 1.

THROTTLE POSITION 1 SENSOR (TPS 1)

The throttle position (%) reading from throttle position sensor 1, after filtering.

THROTTLE POSITION 1 SENSOR (TPS 1) RAW

The throttle position (%) reading from throttle position sensor 1, before filtering.

THROTTLE POSITION 1 SENSOR (TPS 1) VOLTAGE

The voltage of the signal from throttle position sensor 1.

THROTTLE POSITION #2 (TPS 2) DTC FAULT ACTIVE

If YES, a DTC has been set for throttle position sensor 2.

THROTTLE POSITION 2 SENSOR (TPS 2)

The throttle position (%) reading from throttle position sensor 2, after filtering.

THROTTLE POSITION 2 SENSOR (TPS 2) RAW

The throttle position (%) reading from throttle position sensor 2, before filtering.

THROTTLE POSITION 2 SENSOR (TPS 2) VOLTAGE

The voltage of the signal from throttle position sensor 2.

THROTTLE POSITION DELTA

The rate of change in the measured throttle position (in %/second).

THROTTLE TARGET

The Throttle Target module determines the target throttle position (Throttle Position Setpoint) based on either the throttle position requested by the driver or idle throttle demand.

The Throttle Position Setpoint output by this module is then sent to the Throttle Position Regulation module to determine the final throttle request sent to the throttle hardware.

TUNABLE PARAMETERS (CHARACTERISTICS)

ELECTRONIC THROTTLE POSITION MAXIMUM

This table defines maximum allowable value for Throttle Position Setpoint as a function of the throttle position requested by the driver (accelerator pedal position). This value will be used as the Throttle Position Setpoint if the calculated setpoint is greater than this maximum.

Cell Data Range: 0 to 100%

PEDAL RATE LIMIT DOWN

This table specifies the maximum rate at which the Throttle Position Setpoint can decrease (decelerate) as a function of throttle position requested.

> **NOTE:** Although the request typically comes from the driver (pedal position), it can actually be from any of the sources indicated by Torque Demand Source.

Larger values will make throttle position setpoint change faster (be more responsive), but may make the throttle feel less smooth.

Cell Data Range: -5000 to 0

PEDAL RATE LIMIT UP

This table specifies the maximum rate at which the Throttle Position Setpoint can increase (accelerate) as a function of throttle position requested.

> **NOTE:** Although the request typically comes from the driver (pedal position), it can actually be from any of the sources indicated by Torque Demand Source.

Larger values will make throttle position setpoint change faster (be more responsive), but may make the throttle feel less smooth.

Cell Data Range: 0 to 5000

THROTTLE POSITION SETPOINT OVERRIDE ENABLED

Set this parameter to TRUE to force the throttle position setpoint to the value specified with Throttle Position Setpoint Override Value.

THROTTLE POSITION SETPOINT OVERRIDE VALUE

The value to use for throttle position setpoint if Throttle Position Setpoint Override is enabled.

Range: 0 to 100%

MEASUREMENTS

TORQUE DEMAND SOURCE

Indicates the source of the current throttle demand:

- Idle throttle demand
- Throttle position requested by pedal
- Soft limit demand
- Overboost soft limiter demand
- Overboost hard limiter demand

- Traction control demand
- Vehicle speed limit demand

THROTTLE POSITION SETPOINT

This is the target throttle position (%) based on the request from the current Torque Demand Source (driver pedal position, idle throttle demand, etc.)

This value is passed onto the Throttle Position Regulation module to determine the final throttle request sent to the throttle hardware.

TRACTION CONTROL THROTTLE POSITION CUT DEMANDED

Indicates the amount of throttle position cut demanded by the traction control module. The resulting cut in engine power can help address wheel slippage and therefore improve traction.

THROTTLE TARGET DEMAND

Parameters for throttle target demand.

TUNABLE PARAMETERS (CHARACTERISTICS)

ELECTRONIC THROTTLE ACTUATOR 2 (H-BRIDGE 2) OUTPUT FREQUENCY

The frequency (in Hz) of the ECU output signals that control electronic throttle actuator 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ELECTRONIC THROTTLE ACTUATOR 2 (H-BRIDGE 2) OUTPUT INVERTED

Set to TRUE, if the H-bridge wiring for Electronic Throttle 2 Control is negated (The negative lead is connected to the positive pin and the positive lead is connected to the negative pin).

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ELECTRONIC THROTTLE ACTUATOR 2 DUTY CYCLE CORRECTION

This table defines electronic throttle actuator 2 duty cycle correction as a function of throttle position error and target throttle position.

Range: -100% to 100%

ELECTRONIC THROTTLE ACTUATOR 2 OUTPUT

Specifies which pins on the ECU connector are used for Electronic Throttle Control output 2. Each output consists of two pins: a positive (P) and a negative (N). However, they are selected as a pair: Throttle Body H-Bridge 1 or Throttle Body H-Bridge 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ELECTRONIC THROTTLE ACTUATOR OUTPUT

Specifies which pins on the ECU connector are used for Electronic Throttle Control output 1. Each output consists of two pins: a positive (P) and a negative (N). However, they are selected as a pair: Throttle Body H-Bridge 1 or Throttle Body H-Bridge 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ELECTRONIC THROTTLE ACTUATOR (H-BRIDGE) OUTPUT FREQUENCY

The frequency (in Hz) of the ECU output signals that control electronic throttle actuator 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ELECTRONIC THROTTLE CONTROL INHIBIT MANUAL

Set to YES to manually force the electronic throttle into inhibit mode (H-Bridge outputs will be tri-stated). This causes the throttle controller to freeze its operation and allows the throttle hardware to return to its resting position.

Set to NO to return to normal operation.

ELECTRONIC THROTTLE ACTUATOR (H-BRIDGE) OUTPUT INVERTED

Set to TRUE, if the H-bridge wiring for Electronic Throttle 1 Control is negated (The negative lead is connected to the positive pin and the positive lead is connected to the negative pin).

(Cannot be live tuned. Requires flashing modifications back to the ECU).

ELECTRONIC THROTTLE OVERRIDE DEMAND

When Electronic Throttle Override Enabled is set to TRUE, the throttle position will be forced to the value specified here.

Range: -100 to 100%

ELECTRONIC THROTTLE OVERRIDE ENABLED

If using a fly by wire throttle, set this to TRUE to manually override the throttle position. This will force the throttle position to the value specified in Electronic Throttle Override Demand.

Set to FALSE to return the throttle to normal operation.

MEASUREMENTS

ELECTRONIC THROTTLE ACTUATOR SOURCE DUTY CYCLE

The duty cycle of electronic throttle actuator #1.

ELECTRONIC THROTTLE ACTUATOR 2 SOURCE DUTY CYCLE

The duty cycle of electronic throttle actuator #2.

ELECTRONIC THROTTLE INHIBIT MODE ACTIVE

If TRUE, electronic throttle actuator 1 inhibit mode is active.

ELECTRONIC THROTTLE OVERRIDE DTC ACTIVE

If TRUE, a DTC has been set for electronic throttle override.

TRACTION CONTROL

SLIP CALCULATION

Parameters for slip calculation.

TUNABLE PARAMETERS (CHARACTERISTICS)

DRIVE TYPE

Specifies the vehicle's drive type (dedicated rear wheel drive, front wheel drive, all wheel drive).

MEASUREMENTS

SLIP

Calculated slip (%).

Slip is the percentage difference between driving wheel speed and driven wheel speed.

TRACTION CONTROL DEMAND

This module is responsible for determining when to activate and deactivate traction control. It also sets some of the inputs for the Traction Control Regulation module, which controls the behavior of traction control when it's activated.

Traction control is enabled when all of the following conditions are met:

- Traction Control Mode = Conventional TC (the feature has been enabled by the tuner).
- Engine speed exceeds Traction Control Engine Speed Threshold
- Throttle position exceeds Traction Control Throttle Position Threshold
- Vehicle speed exceeds Traction Control Vehicle Speed Threshold
- If a traction control arming switch is fitted, the switch must be active (ON).
- At least 1 left or right wheel speed sensor must be fitted in the front and in the back.

If all conditions are met, the feature will indicate its readiness, by setting Traction Control Allowed to TRUE. At this point, traction control will be activated and deactivated by the amount of slip detected:

- TC Becomes active when Slip exceeds Slip Setpoint.
- TC is deactivated when Slip falls below Slip Setpoint minus Slip Setpoint Threshold Hysteresis.

However, traction control will also be deactivated if any one of the criteriea for enabling the feature are lost:

- Egnine speed falls below Traction Control Engine Speed Threshold minus Traction Control Engine Speed Threshold Hysteresis.
- Throttle position falls below Traction Control Throttle Position Threshold minus Traction Control Throttle Position Threshold Hystersis.
- Vehicle speed falls below Traction Control Vehicle Speed Threshold minus Traction Control Vehicle Speed Threshold Hysteresis.
- The traction control arming switch is turned OFF (if fitted).

TUNABLE PARAMETERS (CHARACTERISTICS)

SLIP SETPOINT

This table defines slip setpoint as a function of vehicle speed and gear number. This is the amount of slip that the traction control demand module should try to maintain.

This parameter also serves as a threshold for activating the traction control feature. Slip must be above this threshold in order to activate traction control.

> **NOTE:** This is one of many criteria needed to activate traction control. See the module overview for more information.

Range: -100 to 100%

SLIP SETPOINT THRESHOLD HYSTERESIS

If Slip falls below Slip Setpoint minus this value, traction control will be deactivated.

Higher values help prevent traction control from being repeatedly activated and deactivated when slip hovers near the threshold.

> **NOTE:** This is one of many factors that can deactivate traction control. See the module overview for more information.

Range: 0 to 100%

TRACTION CONTROL ENGINE SPEED THRESHOLD

Specifies the minimum engine speed required to activate traction control. If engine speed goes above this threshold, then activate traction control.

> **NOTE:** This is one of many criteria needed to activate traction control. See the module overview for more information.

Range: 0 to 10,000 rpm

TRACTION CONTROL ENGINE SPEED THRESHOLD HYSTERESIS

If engine speed falls below Traction Control Engine Speed Threshold minus this value, traction control will be deactivated.

Higher values help prevent traction control from being repeatedly enabled and disabled when engine speed hovers near the threshold.

> **NOTE:** This is one of many factors that can deactivate traction control. See the module overview for more information.

Range: 0 to 1,000 rpm

TRACTION CONTROL INTEGRAL GAIN

This table defines traction control integral gain as a function of slip error. It us used to adjust the overall magnitude of the Traction Control Integral Term.

When calculating the integral term, this value is multiplied by the Slip Error, which is then multiplied by the length of time since the proportional term was last calculated (0.005 seconds). The resulting value is added to the integral term from the previous cycle.

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term.

Cell data range: -100/sec to 100/sec

TRACTION CONTROL MODE

Specifies the Traction Control Mode.

- **Conventional TC.** Enables the traction control feature.
- **Traction Control None Selected.** Disables traction control.

TRACTION CONTROL PROPORTIONAL GAIN

This table defines traction control proportional gain as a function of slip error. It is used to adjust the overall magnitude of the Traction Control Proportional Term.

To calculate the proportional term, this value is multiplied by the slip error and the length of time since the proportional term was last calculated (0.005 seconds)

> **NOTE:** Total error correction applied is equal to Proportional Term + Integral Term.

In general, larger proportional gain values mean error is corrected faster because more corrective action is being taken.

However, larger values also increase the amount by which the total correction may overshoot the target value. Although a small amount of overshoot is normal, too much of an overshoot may cause the error to increase each cycle rather than decrease.

Range: -100 to 100

TRACTION CONTROL THROTTLE POSITION THRESHOLD

Specifies the throttle position required to activate traction control. If throttle position goes above this threshold, then traction control can be activated.

> **NOTE:** This is one of many criteria needed to activate traction control. See the module overview for more information.

Range: 0 to 100%

TRACTION CONTROL THROTTLE POSITION THRESHOLD HYSTERESIS

If throttle position falls below Traction Control Throttle Position Threshold minus this value, then deactivate traction control.

Higher values help prevent traction control from being repeatedly activated and deactivated when throttle position hovers near the threshold.

> **NOTE:** This is one of many factors that can deactivate traction control. See the module overview for more information.

Range: 0 to 100%

TRACTION CONTROL VEHICLE SPEED THRESHOLD

Specifies the vehicle speed required to activate traction control. If vehicle speed goes above this threshold, then traction control can be activated.

> **NOTE:** This is one of many criteria needed to activate traction control. See the module overview for more information.

Range: 0 to 1000 mph

TRACTION CONTROL VEHICLE SPEED THRESHOLD HYSTERESIS

If vehicle speed falls below Traction Control Vehicle Speed Threshold minus this value, then deactivate traction control.

Higher values help prevent traction control from being repeatedly activated and deactivated when vehicle speed hovers near the threshold.

> **NOTE:** This is one of many factors that can deactivate traction control. See the module overview for more information.

Range: 0 to 100 mph

MEASUREMENTS

SLIP ERROR

Indicates the current slip error .

This is calculated as Slip Setpoint - Slip, where Slip is the percent difference between driving wheel speed and driven wheel speed.

SLIP SETPOINT

The amount of slip (%) that the traction control module is attempting to maintain.

This parameter also serves as one of the thresholds required to activate traction control.

TRACTION CONTROL ALLOWED

If TRUE, all the criteria for enabling the traction control feature have been met. Activation and deactivation of the feature are now being controlled by the amount of slip detected.

TRACTION CONTROL CUT ACTIVE

If TRUE, traction control cut is active. The traction control feature is applying ignition, injection and/or throttle cuts to bring slip under control.

TRACTION CONTROL FREEZE ACTIVE

If TRUE, Traction Control Freeze is active.

This happens when traction control is active, but other cuts and limiters (such as soft limiter or overboost limiters) also get activated. In response, the traction control feature freezes its slip correction at the current value.

For example, if the overall ignition angle is 30 deg degrees and slip crosses the threshold, causing traction control to activate and its initial traction control ignition correction is 5 degrees, the resulting ignition angle would be 30-5 = 25

However, soft limiter also gets activated and it demands a 3 degree ignition angle cut. So, traction control freezes its cut at 5 degrees, making the final ignition angle 30 - 5 - 3 = 22 degrees. While frozen, the cut due to traction control will remain frozen at 5 degrees, no matter how much slip changes.

TRACTION CONTROL INTEGRAL GAIN

This is a multiplier that adjusts the overall magnitude of the Traction Control Integral Term, which is the portion of the Slip Error correction that is based on the cumulative Slip Error over time.

TRACTION CONTROL PROPORTIONAL GAIN

This is a multiplier that adjusts the overall magnitude of the Traction Control Proportional Term, which is the portion of the Slip Error correction that is directly proportional to the current Slip Error.

TRACTION CONTROL REGULATION

When traction control has been activated, this module is responsible for applying the necessary cuts to control slip.

TUNABLE PARAMETERS (CHARACTERISTICS)

TRACTION CONTROL CLOSED LOOP MAXIMUM

Specifies the minimum value for Traction Control Slip Requested. This value will be used for Traction Control Slip Requested if the calculated value for slip requested is larger.

Range: 0 to 100%

TRACTION CONTROL CLOSED LOOP MINIMUM

Specifies the minimum value for Traction Control Slip Requested. This value will be used for Traction Control Slip Requested if the calculated value for slip requested is a larger negative value (further away from zero).

Range: -100 to 0%

TRACTION CONTROL IGNITION CUT

When traction control is active, cut the ignition timing by this percentage of Close Loop Traction Control Slip Correction.

For example: if Close Loop Traction Control Slip Correction is 70% and Traction Control Ignition Cut is 25%, then:

Traction Control Ignition Cut Requested = (25 * 70)/100 = 17.5%

Range: 0 to 100%

TRACTION CONTROL INJECTION CUT

When traction control is active, cut the injection by this percentage of Close Loop Traction Control Slip Correction.

For example: If Close Loop Traction Control Slip Correction is 70% and Traction Control Injection Cut is 25%, then:

Traction Control Injection Cut Requested = (25 * 70)/100 = 17.5%

Range: 0 to 100%

TRACTION CONTROL INTEGRAL DEADBAND

If the slip error is less than this percentage, it will be treated as zero error when updating the Integral Term. (In other words, the Integral Term will not change this cycle because the error is effectively zero.)

> **NOTE:** This does not reset the Integral Term to zero. The term merely remains at its current value.

Range: 0 to 100%

TRACTION CONTROL INTEGRAL TERM MAXIMUM

Specifies the maximum allowable value for the Traction Control Integral Term. This value will be used as the integral term if the calculated value for the integral term is higher.

Range: 0 to 100%

TRACTION CONTROL INTEGRAL TERM MINIMUM

Specifies the minimum allowable value for the Traction Control Integral Term. This value will be used as the integral term if the calculated value for the integral term is a larger negative value (further away from zero).

Range: -100 to 0%

TRACTION CONTROL PROPORTIONAL TERM MAXIMUM

Specifies the maximum allowable value for the Traction Control Proportional Term. This value will be used as the proportional term if the calculated value for the proportional term is higher.

Range: 0 to 100%

TRACTION CONTROL PROPORTIONAL TERM MINIMUM

Specifies the minimum allowable value for the Traction Control Proportional Term. This value will be used as the proportional term if the calculated value for the proportional term is a larger negative value (further away from zero).

Range: -100 to 0%

TRACTION CONTROL SLIP CORRECTION MAXIMUM

Specifies the maximum amount of slip correction that can be applied. This value will be used for Traction Control Slip Correction if the calculated value for slip correction is higher.

Range: 0 to 100%

TRACTION CONTROL SLIP CORRECTION MINIMUM

Specifies the minimum amount of slip correction that can be applied. This value will be used for Traction Control Slip Correction if the calculated value for slip correction is a larger negative value (further away from zero).

Range: -100 to 0%

TRACTION CONTROL THROTTLE POSITION CUT

When traction control is active, cut the throttle position setpoint by this percentage of Traction Control Slip Correction.

For example: If Traction Control Slip Correction is 70% and Traction Control Throttle Position Cut is 25% then, Traction Control Throttle Position Cut Requested = (25 * 70)/100 = 17.5%

Range: 0 to 100%

MEASUREMENTS

TRACTION CONTROL ACTIVE

If TRUE, traction control is active.

TRACTION CONTROL FEED FORWARD TERM

Traction control feed forward term (%).

TRACTION CONTROL IGNITION CUT REQUESTED

When traction control is active, this indicates the actual amount of ignition cut requested by this feature.

TRACTION CONTROL INJECTION CUT REQUESTED

When traction control is active, this indicates the actual amount of injection cut requested by this feature.

TRACTION CONTROL INTEGRAL TERM

One of three component values that are used to calculate Traction Control Slip Requested, which is the slip value required to bring slip under control.

> **NOTE:** Traction Control Slip Requested = Traction Control Feed Forward Term - Traction Control Proportional Term - Traction Control Integral Term.

The integral term is based on of the cumulative slip error over time. Each time slip error is calculated:

1. The error is multiplied by Traction Control Integral Gain, which is then multiplied by the time since the integral term was last calculated (0.005 seconds).

2. The result is added to the previous Traction Control Integral Term, resulting in a new value for the integral term.

TRACTION CONTROL PROPORTIONAL TERM

One of three component values that are used to calculate Traction Control Slip Requested, which is the slip value required to bring slip under control.

> **NOTE:** Traction Control Slip Requested = Traction Control Feed Forward Term - Traction Control Proportional Term - Traction Control Integral Term.

The proportional term is directly proportional to the amount of slip error.

TRACTION CONTROL SLIP CORRECTION

Indicates the amount (%) that the current slip must be reduced in order to bring it under control.

For example: If Slip Setpoint is 10%, the currently calculated amount of slip is 20%, and the Traction Control Slip Requested is 5% then,

Traction control slip correction = (20 - 5) / 20 = 75%

In othere words, the slip must be reduced by 75% to bring it under control.

TRACTION CONTROL SLIP REQUESTED

This amount of slip that the traction control module thinks is required in order for slip to be under control. This is calculated as:

Traction Control Slip Requested = Traction Control Feed Forward Term - Traction Control Proportional Term - Traction Control Integral Term

TRACTION CONTROL THROTTLE POSITION CUT REQUESTED

The amount of throttle cut requested by the traction control module.

For example: if Traction Control Slip Correction is 75% and Traction Control Throttle Position Cut is 50%, then,

Traction Control Throttle Position Cut Requested = 75 * (50 / 100) = 37.5 %,

In other words, reduce the current throttle position by 37.5%

NOTE: Only applicable to drive by wire configurations.

TRANSMISSION

Parameters for configuration of the transmission / gearbox.

GEAR SELECTOR

Parameters for the gear selector.

TUNABLE PARAMETERS (CHARACTERISTICS)

GEAR SELECTOR #1 SENSOR INPUT

Specifies the pin on the ECU connector that gear selector sensor 1 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is gear selector sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GEAR SELECTOR #2 SENSOR INPUT

Specifies the pin on the ECU connector that gear selector sensor 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is gear selector sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GEAR SELECTOR #3 SENSOR INPUT

Specifies the pin on the ECU connector that gear selector sensor 3 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is gear selector sensor 3.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

GEAR SELECTOR 1 SENSOR STATUS

Possible statuses for sensor 1 include:

- **False** = Inactive
- **True** = Active

GEAR SELECTOR 2 SENSOR STATUS

Possible statuses for sensor 2 include:

- **False** = Inactive
- **True** = Active

GEAR SELECTOR 3 SENSOR STATUS

Possible statuses for sensor 1 include:

- **False** = Inactive
- **True** = Active

GEAR SELECTOR POSITION

Indicates the gear selector position (P/N-R-D).

GEAR SELECTION DEMAND

Parameters for gear selection demand.

TUNABLE PARAMETERS (CHARACTERISTICS)

DRIVE GEAR 1 ACTUATOR #1 STATUS

Drive gear #1 actuator #1 (PWM #1) status.

- **On** = 100% Duty Cycle.
- **Off** = 0% Duty Cycle.

DRIVE GEAR 1 ACTUATOR #2 STATUS

Drive gear #1 actuator #2 (PWM #2) status.

- **On** = 100% Duty Cycle.
- **Off** = 0% Duty Cycle.

DRIVE GEAR 2 ACTUATOR #1 STATUS

Drive gear #2 actuator #1 (PWM #1) status.

- **On** = 100% Duty Cycle.
- **Off** = 0% Duty Cycle.

DRIVE GEAR 2 ACTUATOR #2 STATUS

Drive gear #2 actuator #2 (PWM #2) status.

- **On** = 100% Duty Cycle.
- **Off** = 0% Duty Cycle.

DRIVE GEAR 3 ACTUATOR #1 STATUS

Drive gear #3 actuator #1 (PWM #1) status.

- **On** = 100% Duty Cycle.

- **Off** = 0% Duty Cycle.

DRIVE GEAR 3 ACTUATOR #2 STATUS

Drive gear #3 actuator #2 (PWM #2) status.

- **On** = 100% Duty Cycle.
- **Off** = 0% Duty Cycle.

DRIVE GEAR 4 ACTUATOR #1 STATUS

Drive gear #4 actuator #1 (PWM #1) status.

- **On** = 100% Duty Cycle.
- **Off** = 0% Duty Cycle.

DRIVE GEAR 4 ACTUATOR #2 STATUS

Drive gear #4 actuator #2 (PWM #2) status.

- **On** = 100% Duty Cycle.
- **Off** = 0% Duty Cycle.

DRIVE GEAR DOWNSHIFT 3 TO 2 ACTUATOR OUTPUT

Specifies the pin on the ECU connector that the drive gear downshift 3 to 2 actuator is wired to.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "low side driver outputs." Selecting one of these outputs tells the ECU which output is the drive gear downshift 3 to 2 actuator.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

DRIVE GEAR DOWNSHIFT 3 TO 2 ACTUATOR OUTPUT FREQUENCY

Drive gear downshift 3 to 2 PWM channel output frequency.

Range: 0 to 2000 Hz

DRIVE GEAR SELECTION DEMAND #1 ACTUATOR OUTPUT

Specifies the pin on the ECU connector that drive gear selection demand actuator 1 is wired to.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "low side driver outputs." Selecting one of these outputs tells the ECU which output is drive gear selection demand actuator 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

DRIVE GEAR SELECTION DEMAND #1 ACTUATOR OUTPUT FREQUENCY

Gear selection demand #1 PWM channel output frequency.

Range: 0 to 2000 Hz.

DRIVE GEAR SELECTION DEMAND #2 ACTUATOR OUTPUT

Specifies the pin on the ECU connector that drive gear selection demand actuator 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "low side driver outputs." Selecting one of these outputs tells the ECU which output is drive gear selection demand actuator 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

DRIVE GEAR SELECTION DEMAND #2 ACTUATOR OUTPUT FREQUENCY

Gear selection demand #2 PWM channel output frequency.

Range: 0 to 2000 Hz.

MEASUREMENTS

DRIVE GEAR DOWNSHIFT 3 TO 2 ACTUATOR DUTY CYCLE

Drive gear downshift 3 to 2 actuator duty cycle (%).

DRIVE GEAR DOWNSHIFT 3 TO 2 ACTUATOR OUTPUT STATUS

Drive gear downshift 3 to 2 actuator output status.

DRIVE GEAR SELECTION ACTUATOR #1 DUTY CYCLE

Gear selection actuator #1 duty cycle (%).

DRIVE GEAR SELECTION ACTUATOR #1 SOURCE STATUS

Gear selection actuator #1 source status.

DRIVE GEAR SELECTION ACTUATOR #2 DUTY CYCLE

Gear selection actuator #2 duty cycle (%).

DRIVE GEAR SELECTION ACTUATOR #2 OUTPUT STATUS

Gear selection actuator #2 output status.

LINE PRESSURE DEMAND

Parameters for transmission line pressure demand.

TUNABLE PARAMETERS (CHARACTERISTICS)

LINE PRESSURE ACTUATOR DUTY CYCLE

This table specifies line pressure actuator duty cycle as a function of transmission oil temperature and line pressure setpoint.

Cell data range: 0 to 100%

LINE PRESSURE (TRANS RX) ACTUATOR OUTPUT

Specifies which output pin on the ECU is connected to the line pressure actuator.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "High Side Drivers." Selecting a high side driver tells the ECU which of these outputs is assigned to the transmission line pressure actuator.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

LINE PRESSURE (TRANS RX) ACTUATOR OUTPUT FREQUENCY

Specifies the frequency of the signal output to the transmission line pressure actuator.

Range: 0 to 2000 Hz

MEASUREMENTS

LINE PRESSURE ACTUATOR DUTY CYCLE

Line pressure actuator duty cycle (%).

LINE PRESSURE ACTUATOR OUTPUT STATUS

Line pressure actuator output status.

MANUAL TRANSMISSION DRIVE GEAR

Parameters for configuring the manual transmission drive gear.

TUNABLE PARAMETERS (CHARACTERISTICS)

GEAR RATIO DELTA THRESHOLD

Specifies the minimum rate of change in gear ratio required to enable manual transmission gear detection.

Range: 0 to 1000 (1/s)

GEAR RATIO DELTA THRESHOLD HYSTERESIS

If the rate of change in gear ratio falls below Gear Ratio Delta Threshold minus this value, manual transmission gear detection will be disabled.

Range: 0 to 1000 (1/s)

MANUAL TRANSMISSION GEAR RATIO #1

Specifies the gear ratio for 1st gear.

Range: 0 to 10

MANUAL TRANSMISSION GEAR RATIO #2

Specifies the gear ratio for 2nd gear.

Range: 0 to 10

MANUAL TRANSMISSION GEAR RATIO #3

Specifies the gear ratio for 3rd gear.

Range: 0 to 10

MANUAL TRANSMISSION GEAR RATIO #4

Specifies the gear ratio for 4th gear.

Range: 0 to 10

MANUAL TRANSMISSION GEAR RATIO #5

Specifies the gear ratio for 5th gear.

Range: 0 to 10

MANUAL TRANSMISSION GEAR RATIO #6

Specifies the gear ratio for 6th gear.

Range: 0 to 10

MANUAL TRANSMISSION GEAR RATIO REVERSE

Specifies the gear ratio for reverse gear.

Range: 0 to 10

NEUTRAL POSITION SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the neutral position sensor switch is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the neutral position switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

NEUTRAL POSITION SWITCH SENSOR INVERTED

Set this to YES if the neutral position switch sensor signal is inverted (when voltage from the sensor decreases, the value indicated increases).

MEASUREMENTS

GEAR RATIO DELTA

The rate of change of the gear ratio (per second).

MANUAL TRANS GEAR DETECTION ACTIVE

If TRUE, manual transmission gear detection is active.

MANUAL TRANSMISSION ACTIVE GEAR

Indicates the currently active drive gear.

MANUAL TRANSMISSION GEAR RATIO

The rate of change of the gear ratio (per second).

NEUTRAL POSITION SWITCH SENSOR STATUS

Neutral position switch sensor status:

- **0** = Inactive.
- **1** = Active.

NEUTRAL POSITION SWITCH SENSOR VOLTAGE

Indicates the voltage generated by the neutral position switch in the vehicles transmission.

SHIFT PARAMETERS

Parameters for transmission shift.

TUNABLE PARAMETERS (CHARACTERISTICS)

NORMAL MODE DOWN SHIFT VEHICLE SPEED 2 TO 1

This table defines normal mode drive gear 2 to 1 down shift vehicle speed as a function of throttle position. Vehicle speed must be below this table value in order to down shift from 2nd gear to 1st gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

NORMAL MODE DOWN SHIFT VEHICLE SPEED 3 TO 2

This table defines normal mode drive gear 3 to 2 down shift vehicle speed as a function of throttle position. Vehicle speed must be below this table value in order to down shift from 3rd gear to 2nd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

NORMAL MODE DOWN SHIFT VEHICLE SPEED 4 TO 3

This table defines normal mode drive gear 4 to 3 down shift vehicle speed as a function of throttle position. Vehicle speed must be below this table value in order to down shift from 4th gear to 3rd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

NORMAL MODE UP SHIFT VEHICLE SPEED 1 TO 2

This table defines normal mode drive gear 1 to 2 up shift vehicle speed as a function of throttle position. Vehicle speed must be above this table value in order to up shift from 1st gear to 2nd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

NORMAL MODE UP SHIFT VEHICLE SPEED 2 TO 3

This table defines normal mode drive gear 2 to 3 up shift vehicle speed as a function of throttle position. Vehicle speed must be above this table value in order to up shift from 2nd gear to 3rd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

NORMAL MODE UP SHIFT VEHICLE SPEED 3 TO 4

This table defines normal mode drive gear 3 to 4 up shift vehicle speed as a function of throttle position. Vehicle speed must be above this table value in order to up shift from 3rd gear to 4th gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

NORMAL MODE WIDE OPEN THROTTLE DOWN 1 TO 2 SHIFT ENGINE SPEED THRESHOLD

Specifies the normal mode wide open throttle drive gear 1 to 2 up or 2 to 1 down shift engine speed. Engine speed must be above this value in order to shift up from 1st gear to 2nd gear or down from to 2nd gear to 1st gear. This value is applicable when wide open throttle is active.

Range: 0 to 10000 rpm

NORMAL MODE WIDE OPEN THROTTLE DOWN 2 TO 3 SHIFT ENGINE SPEED THRESHOLD

Specifies the normal mode wide open throttle drive gear 2 to 3 up or 3 to 2 down shift engine speed. Engine speed must be above this value in order to shift up from 2nd gear to 3rd gear or down from to 3rd gear to 2nd gear. This value is applicable when wide open throttle is active.

Range: 0 to 10000 rpm

NORMAL MODE WIDE OPEN THROTTLE DOWN 3 TO 4 SHIFT ENGINE SPEED THRESHOLD

Specifies the normal mode wide open throttle drive gear 3 to 4 up or 4 to 3 down shift engine speed. Engine speed must be above this value in order to shift up from 3rd gear to 4th gear or down from to 4th gear to 3rd gear. This value is applicable when wide open throttle is active.

Range: 0 to 10000 rpm

NORMAL MODE WIDE OPEN THROTTLE DOWN SHIFT VEHICLE SPEED 2 TO 1

Specifies the normal mode wide open throttle drive gear 2 to 1 down shift vehicle speed. Vehicle speed must be below this value in order to down shift from 2nd gear to 1st gear. This value is applicable when wide open throttle is active.

Range: 0 to 100 mph

NORMAL MODE WIDE OPEN THROTTLE DOWN SHIFT VEHICLE SPEED 3 TO 2

Specifies the normal mode wide open throttle drive gear 3 to 2 down shift vehicle speed. Vehicle speed must be below this value in order to down shift from 3rd gear to 2nd gear. This value is applicable when wide open throttle is active.

Range: 0 to 100 mph

NORMAL MODE WIDE OPEN THROTTLE DOWN SHIFT VEHICLE SPEED 4 TO 3

Specifies the normal mode wide open throttle drive gear 4 to 3 down shift vehicle speed. Vehicle speed must be below this value in order to down shift from 4th gear to 3rd gear. This value is applicable when wide open throttle is active.

Range: 0 to 100 mph

NORMAL MODE WIDE OPEN THROTTLE UP SHIFT VEHICLE SPEED 1 TO 2

Specifies the normal mode wide open throttle drive gear 1 to 2 up shift vehicle speed. Vehicle speed must be above this value in order to up shift from gear 1st gear to 2nd gear. This value is applicable when wide open throttle is active.

Range: 0 to 100 mph

NORMAL MODE WIDE OPEN THROTTLE UP SHIFT VEHICLE SPEED 2 TO 3

Specifies the normal mode wide open throttle drive gear 2 to 3 up shift vehicle speed. Vehicle speed must be above this value in order to up shift from gear 2nd gear to 3rd gear. This value is applicable when wide open throttle is active.

Range: 0 to 100 mph

NORMAL MODE WIDE OPEN THROTTLE UP SHIFT VEHICLE SPEED 3 TO 4

Specifies the normal mode wide open throttle drive gear 3 to 4 up shift vehicle speed. Vehicle speed must be above this value in order to up shift from gear 3rd gear to 4th gear. This value is applicable when wide open throttle is active.

Range: 0 to 100 mph

PERFORMANCE MODE DOWN SHIFT VEHICLE SPEED 2 TO 1

This table defines performance mode drive gear 2 to 1 down shift vehicle speed as a function of throttle position. Vehicle speed must be below this table value in order to down shift from 2nd to 1st gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

PERFORMANCE MODE DOWN SHIFT VEHICLE SPEED 3 TO 2

This table defines performance mode drive gear 3 to 2 down shift vehicle speed as a function of throttle position. Vehicle speed must be below this table value in order to down shift from 3rd to 2nd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

PERFORMANCE MODE DOWN SHIFT VEHICLE SPEED 4 TO 3

This table defines performance mode drive gear 4 to 3 down shift vehicle speed as a function of throttle position. Vehicle speed must be below this table value in order to down shift from 4th to 3rd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

PERFORMANCE MODE UP SHIFT VEHICLE SPEED 1 TO 2

This table defines performance mode drive gear 1 to 2 up shift vehicle speed as a function of throttle position. Vehicle speed must be above this table value in order to up shift from 1st to 2nd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

PERFORMANCE MODE UP SHIFT VEHICLE SPEED 2 TO 3

This table defines performance mode drive gear 2 to 3 up shift vehicle speed as a function of throttle position. Vehicle speed must be above this table value in order to up shift from 2nd to 3rd gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

PERFORMANCE MODE UP SHIFT VEHICLE SPEED 3 TO 4

This table defines performance mode drive gear 3 to 4 up shift vehicle speed as a function of throttle position. Vehicle speed must be above this table value in order to up shift from 3rd to 4th gear. This table is applicable when wide open throttle is NOT active.

Range: 0 to 100 mph

PERFORMANCE MODE WIDE OPEN THROTTLE 1 TO 2 SHIFT ENGINE SPEED THRESHOLD

Specifies performance mode wide open throttle drive gear 1 to 2 up or 2 to 1 down shift engine speed. Engine speed must be above this value in order to up shift from 1st to 2nd gear or down shift from 2nd to 1st gear. This value is applicable when wide open throttle is active.

Range: 0 to 10000 rpm

PERFORMANCE MODE WIDE OPEN THROTTLE 2 TO 3 SHIFT ENGINE SPEED THRESHOLD

Specifies performance mode wide open throttle drive gear 2 to 3 up or 3 to 2 down shift engine speed. Engine speed must be above this value in order to up shift from 2nd to 3rd gear or down shift from 3rd to 2nd gear. This value is applicable when wide open throttle is active.

Range: 0 to 10000 rpm

PERFORMANCE MODE WIDE OPEN THROTTLE 3 TO 4 SHIFT ENGINE SPEED THRESHOLD

Specifies performance mode wide open throttle drive gear 3 to 4 up or 4 to 3 down shift engine speed. Engine speed must be above this value in order to up shift from 3rd to 4th gear or down shift from 4th to 3rd gear. This value is applicable when wide open throttle is active.

Range: 0 to 10000 rpm

PERFORMANCE MODE WIDE OPEN THROTTLE DOWN SHIFT VEHICLE SPEED 2 TO 1

Specifies performance mode wide open throttle drive gear 2 to 1 down shift vehicle speed Vehicle speed must be below this value in order to down shift from 2nd to 1st gear. This value is applicable when wide open throttle is active.

Range: 0 to 1000 mph

PERFORMANCE MODE WIDE OPEN THROTTLE DOWN SHIFT VEHICLE SPEED 3 TO 2

Specifies performance mode wide open throttle drive gear 3 to 2 down shift vehicle speed Vehicle speed must be below this value in order to down shift from 3rd to 2nd gear. This value is applicable when wide open throttle is active.

Range: 0 to 1000 mph

PERFORMANCE MODE WIDE OPEN THROTTLE DOWN SHIFT VEHICLE SPEED 4 TO 3

Specifies performance mode wide open throttle drive gear 4 to 3 down shift vehicle speed Vehicle speed must be below this value in order to down shift from 4th to 3rd gear. This value is applicable when wide open throttle is active.

Range: 0 to 1000 mph

PERFORMANCE MODE WIDE OPEN THROTTLE UP SHIFT VEHICLE SPEED 1 TO 2

Specifies performance mode wide open throttle drive gear 1 to 2 up shift vehicle speed. Vehicle speed must be above this value in order to up shift from 1st to 2nd gear. This value is applicable when wide open throttle is active.

Range: 0 to 1000 mph

PERFORMANCE MODE WIDE OPEN THROTTLE UP SHIFT VEHICLE SPEED 2 TO 3

Specifies performance mode wide open throttle drive gear 2 to 3 up shift vehicle speed. Vehicle speed must be above this value in order to up shift from 2nd to 3rd gear. This value is applicable when wide open throttle is active.

Range: 0 to 1000 mph

PERFORMANCE MODE WIDE OPEN THROTTLE UP SHIFT VEHICLE SPEED 3 TO 4

Specifies performance mode wide open throttle drive gear 3 to 4 up shift vehicle speed. Vehicle speed must be above this value in order to up shift from 3rd to 4th gear. This value is applicable when wide open throttle is active.

Range: 0 to 1000 mph

TRANSMISSION SHIFT MODE

Selects the transmission shift mode:

- Normal mode
- Performance mode

TRANSMISSION TYPE

Indicates the type of transmission being used in the vehicle. For LS engines, the transmission types supported by CORE include the following:

- 4L60E Automatic Transmission
- 4L80E Automatic Transmission
- Manual Transmission

MEASUREMENTS

AUTO TRANS ACTIVE DRIVE GEAR

Indicates which drive gear is active.

TRANSMISSION SHIFT MODE SELECTED

Indicates which transmission shift mode is currently selected.

SHIFT PRESSURES

Parameters for transmission shift pressures.

TUNABLE PARAMETERS (CHARACTERISTICS)

LINE PRESSURE SETPOINT MAXIMUM

Specifies the maximum allowable value for Line Pressure Setpoint. This value will be used if the calculated Line Pressure Setpoint is higher.

Range: 0 to 2000 kPa / 0 to 290 psi

LINE PRESSURE SETPOINT MINIMUM

Specifies the minimum allowable value for Line Pressure Setpoint. This value will be used if the calculated Line Pressure Setpoint is lower.

Range: 0 to 2000 kPa / 0 to 290 psi

NORMAL MODE DOWN SHIFT LINE PRESSURE 2 TO 1

This table specifies normal mode drive gear 2 to 1 down shift line pressure setpoint as a function of throttle position. This is only applicable when drive gear 2 to 1 shifting is in progress.

Range: 0 to 1000 kPa

NORMAL MODE DOWN SHIFT LINE PRESSURE 3 TO 2

This table specifies normal mode drive gear 3 to 2 down shift line pressure setpoint as a function of throttle position. This is only applicable when drive gear 3 to 2 shifting is in progress.

Range: 0 to 1000 kPa

NORMAL MODE DOWN SHIFT LINE PRESSURE 4 TO 3

This table specifies normal mode drive gear 4 to 3 down shift line pressure setpoint as a function of throttle position. This is only applicable when drive gear 4 to 3 shifting is in progress.

Range: 0 to 1000 kPa

NORMAL MODE LINE PRESSURE GEAR #1

This table defines normal mode in drive gear# 1 line pressure setpoint as a function of throttle position. This is only applicable when in gear# 1.

Range: 0 to 1000 kPa

NORMAL MODE LINE PRESSURE GEAR #2

This table specifies normal mode in drive gear #2 line pressure setpoint as a function of throttle position. This is only applicable when in gear #2.

Range: 0 to 1000 kPa

NORMAL MODE LINE PRESSURE GEAR #3

This table specifies normal mode in drive gear #3 line pressure setpoint as a function of throttle position. This is only applicable when in gear #3.

Range: 0 to 1000 kPa

NORMAL MODE LINE PRESSURE GEAR #4

This table specifies normal mode in drive gear #4 line pressure setpoint as a function of throttle position. This is only applicable when in gear #4.

Range: 0 to 1000 kPa

NORMAL MODE LINE PRESSURE GEAR #PARK

This table specifies normal mode line pressure in parking gear setpoint as a function of throttle position. This is only applicable when in parking gear.

Range: 0 to 1000 kPa

NORMAL MODE LINE PRESSURE GEAR #REVERSE

This table specifies normal mode line pressure in reverse gear setpoint as a function of throttle position. This is only applicable when in reverse gear.

Range: 0 to 1000 kPa

NORMAL MODE UP SHIFT LINE PRESSURE 1 TO 2

This table specifies normal mode drive gear 1 to 2 up shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 1 to gear 2 is in progress.

Range: 0 to 1000 kPa

NORMAL MODE UP SHIFT LINE PRESSURE 2 TO 3

This table specifies normal mode drive gear 2 to 3 up shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 2 to gear 3 is in progress.

Range: 0 to 1000 kPa

NORMAL MODE UP SHIFT LINE PRESSURE 3 TO 4

This table specifies normal mode drive gear 3 to 4 up shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 3 to gear 4 is in progress.

Range: 0 to 1000 kPa

PERFORMANCE MODE DOWN SHIFT LINE PRESSURE 2 TO 1

This table defines performance mode drive gear 2 to 1 down shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 2 to gear 1 is in progress.

Range: 0 to 1000 kPa

PERFORMANCE MODE DOWN SHIFT LINE PRESSURE 3 TO 2

This table defines performance mode drive gear 3 to 2 down shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 3 to gear 2 is in progress.

Range: 0 to 1000 kPa

PERFORMANCE MODE DOWN SHIFT LINE PRESSURE 4 TO 3

This table specifies performance mode drive gear 4 to 3 down shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 4 to gear 3 is in progress.

Range: 0 to 1000 kPa

PERFORMANCE MODE LINE PRESSURE GEAR #1

This table defines performance mode line pressure setpoint in drive gear #1 as a function of throttle position. This is only applicable in gear #1.

Range: 0 to 1000 kPa

PERFORMANCE MODE LINE PRESSURE GEAR #2

This table specifies performance mode line pressure setpoint in drive gear #2 as a function of throttle position. This is only applicable in gear #2.

Range: 0 to 1000 kPa

PERFORMANCE MODE LINE PRESSURE GEAR #3

This table specifies performance mode line pressure setpoint in drive gear #3 as a function of throttle position. This is only applicable in gear #3.

Range: 0 to 1000 kPa

PERFORMANCE MODE LINE PRESSURE GEAR #4

This table specifies performance mode line pressure setpoint in drive gear #4 as a function of throttle position. This is only applicable in gear #4.

Range: 0 to 1000 kPa

PERFORMANCE MODE LINE PRESSURE GEAR #PARK

This table specifies performance mode line pressure setpoint in parking gear as a function of throttle position. This is only applicable in parking gear.

Range: 0 to 1000 kPa

PERFORMANCE MODE LINE PRESSURE GEAR #REVERSE

This table specifies performance mode line pressure setpoint in reverse gear as a function of throttle position. This is only applicable in reverse gear.

Range: 0 to 1000 kPa

PERFORMANCE MODE UP SHIFT LINE PRESSURE 1 TO 2

This table defines performance mode drive gear 1 to 2 up shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 1 to gear 2 is in progress.

Range: 0 to 1000 kPa

PERFORMANCE MODE UP SHIFT LINE PRESSURE 2 TO 3

This table specifies performance mode drive gear 2 to 3 up shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 2 to gear 3 is in progress.

Range: 0 to 1000 kPa

PERFORMANCE MODE UP SHIFT LINE PRESSURE 3 TO 4

This table specifies performance mode drive gear 3 to 4 up shift line pressure setpoint as a function of throttle position. This is only applicable when a shift from gear 3 to gear 4 is in progress.

Range: 0 to 1000 kPa

MEASUREMENTS

DRIVE GEAR DOWN SHIFT 2 TO 1 ACTIVE

If TRUE, the transmission is in the process of shifting from drive gear 2 to drive gear 1.

DRIVE GEAR DOWN SHIFT 3 TO 2 ACTIVE

If TRUE, the transmission is in the process of shifting from drive gear 3 to drive gear 2.

DRIVE GEAR DOWN SHIFT 4 TO 3 ACTIVE

If TRUE, the transmission is in the process of shifting from drive gear 4 to drive gear 3.

DRIVE GEAR UP SHIFT 1 TO 2 ACTIVE

If TRUE, the transmission is in the process of shifting from drive gear 1 to drive gear 2.

DRIVE GEAR UP SHIFT 2 TO 3 ACTIVE

If TRUE, the transmission is in the process of shifting from drive gear 2 to drive gear 3.

DRIVE GEAR UP SHIFT 3 TO 4 ACTIVE

If TRUE, the transmission is in the process of shifting from drive gear 3 to drive gear 4.

GEAR SHIFT ACTIVE

If TRUE, a gear shift is in progress (from any gear to any other gear).

LINE PRESSURE SETPOINT

The line pressure that the ECU is trying to maintain.

NORMAL MODE GEAR SHIFT LINE PRESSURE

When shifting gears in normal mode, this indicates the current line pressure.

NORMAL MODE IN GEAR LINE PRESSURE

When in gear in normal mode, this indicates the current line pressure.

PERFORMANCE MODE GEAR SHIFT LINE PRESSURE

When shifting gears in performance mode, this indicates the current line pressure.

PERFORMANCE MODE IN GEAR LINE PRESSURE

When in gear in performance mode, this indicates the current line pressure.

PERFORMANCE MODE LINE PRESSURE

Indicates the current line pressure in performance mode.

SHIFT TIME

Parameters for transmission shift time.

TUNABLE PARAMETERS (CHARACTERISTICS)

GEAR SHIFT TIME MAXIMUM

Specifies the maximum time for gear shifts.

Range: 0 to 2000 seconds

GEAR SHIFT TIME MINIMUM

Specifies the minimum time for gear shifts.

Range: 0 to 2000 seconds

NORMAL MODE DOWN SHIFT TIME 2 TO 1

This table specifies drive gear 2 to 1 down shift time in normal mode as a function of throttle position (drive gear 2 to 1 down shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

NORMAL MODE DOWN SHIFT TIME 3 TO 2

This table specifies drive gear 3 to 2 down shift time in normal mode as a function of throttle position (drive gear 3 to 2 down shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

NORMAL MODE DOWN SHIFT TIME 4 TO 3

This table specifies drive gear 4 to 3 down shift time in normal mode as a function of throttle position (drive gear 4 to 3 down shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

NORMAL MODE UP SHIFT TIME 1 TO 2

This table specifies drive gear 1 to 2 up shift time in normal mode as a function of throttle position (drive gear 1 to 2 up shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

NORMAL MODE UP SHIFT TIME 2 TO 3

This table specifies drive gear 2 to 3 up shift time in normal mode as a function of throttle position (drive gear 2 to 3 up shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

NORMAL MODE UP SHIFT TIME 3 TO 4

This table specifies drive gear 3 to 4 up shift time in normal mode as a function of throttle position (drive gear 3 to 4 up shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

PERFORMANCE DOWN SHIFT TIME 2 TO 1

This table specifies drive gear 2 to 1 down shift time in performance mode as a function of throttle position (drive gear 2 to 1 down shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

PERFORMANCE DOWN SHIFT TIME 3 TO 2

This table specifies drive gear 3 to 2 down shift time in performance mode as a function of throttle position (drive gear 3 to 2 down shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

PERFORMANCE DOWN SHIFT TIME 4 TO 3

This table specifies drive gear 4 to 3 down shift time in performance mode as a function of throttle position (drive gear 4 to 3 down shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

PERFORMANCE MODE UP SHIFT TIME 1 TO 2

This table specifies drive gear 1 to 2 up shift time in performance mode as a function of throttle position (drive gear 1 to 2 up shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

PERFORMANCE MODE UP SHIFT TIME 2 TO 3

This table specifies drive gear 2 to 3 up shift time in performance mode as a function of throttle position (drive gear 2 to 3 up shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

PERFORMANCE MODE UP SHIFT TIME 3 TO 4

This table specifies drive gear 3 to 4 up shift time in performance mode as a function of throttle position (drive gear 3 to 4 up shifting will be active for this amount of time).

Cell data range: 0 to 420 seconds

MEASUREMENTS

DRIVE GEAR DOWN SHIFT 2 TO 1 TIME

The time (in seconds) to shift from second to first gear.

DRIVE GEAR DOWN SHIFT 3 TO 2 TIME

The time (in seconds) to shift from third to second gear.

DRIVE GEAR DOWN SHIFT 4 TO 3 TIME

The time (in seconds) to shift from fourth to third gear.

DRIVE GEAR UP SHIFT 1 TO 2 TIME

The time (in seconds) to shift from first to second gear.

DRIVE GEAR UP SHIFT 2 TO 3 TIME

The time (in seconds) to shift from second to third gear.

DRIVE GEAR UP SHIFT 3 TO 4 TIME

The time (in seconds) to shift from third to fourth gear.

TORQUE CONVERTER

Parameters for torque converter.

TUNABLE PARAMETERS (CHARACTERISTICS)

NORMAL MODE TORQUE CONVERTER APPLY VEHICLE SPEED GEAR #2

In normal mode, this table defines torque converter control apply (lock) vehicle speed for second gear as a function of throttle position (vehicle speed must be above this table value in order to apply TCC PWM).

Cell data range: 0 to 1000 mph

NORMAL MODE TORQUE CONVERTER APPLY VEHICLE SPEED GEAR #3

In normal mode, this table defines torque converter control apply (lock) vehicle speed for third gear as a function of throttle position (vehicle speed must be above this table value in order to apply TCC PWM).

Cell data range: 0 to 1000 mph

NORMAL MODE TORQUE CONVERTER APPLY VEHICLE SPEED GEAR #4

In normal mode, this table defines torque converter control apply (lock) vehicle speed for fourth gear as a function of throttle position (vehicle speed must be above this table value in order to apply TCC PWM).

Cell data range: 0 to 1000 mph

NORMAL MODE TORQUE CONVERTER RELEASE TPS THRESHOLD GEAR #2

In normal mode, this table defines torque converter control release (unlock) throttle position threshold for second gear as a function of throttle position (if throttle position is above this table value, TCC PWM will release).

Cell data range: 0 to 100%

NORMAL MODE TORQUE CONVERTER RELEASE TPS THRESHOLD GEAR #3

In normal mode, this table defines torque converter control release (unlock) throttle position threshold for third gear as a function of throttle position (if throttle position is above this table value, TCC PWM will release).

Cell data range: 0 to 100%

NORMAL MODE TORQUE CONVERTER RELEASE TPS THRESHOLD GEAR #4

In normal mode, this table defines torque converter control release (unlock) throttle position threshold for fourth gear as a function of throttle position (if throttle position is above this table value, TCC PWM will release).

Cell data range: 0 to 100%

NORMAL MODE TORQUE CONVERTER RELEASE VEHICLE SPEED GEAR #2

In normal mode, this table defines torque converter control release (unlock) vehicle speed for second gear as a function of throttle position (vehicle speed must be below this table value in order to release TCC PWM).

Cell data range: 0 to 1000 mph

NORMAL MODE TORQUE CONVERTER RELEASE VEHICLE SPEED GEAR #3

In normal mode, this table defines torque converter control release (unlock) vehicle speed for third gear as a function of throttle position (vehicle speed must be below this table value in order to release TCC PWM).

Cell data range: 0 to 1000 mph

NORMAL MODE TORQUE CONVERTER RELEASE VEHICLE SPEED GEAR #4

In normal mode, this table defines torque converter control release (unlock) vehicle speed for fourth gear as a function of throttle position (vehicle speed must be below this table value in order to release TCC PWM).

Cell data range: 0 to 1000 mph

PERFORMANCE MODE TORQUE CONVERTER APPLY VEHICLE SPEED GEAR #2

In performance mode, this table defines torque converter control apply (lock) vehicle speed for second gear as a function of throttle position (vehicle speed must be above this table value in order to apply TCC PWM).

Cell data range: 0 to 1000 mph

PERFORMANCE MODE TORQUE CONVERTER APPLY VEHICLE SPEED GEAR #3

In performance mode, this table defines torque converter control apply (lock) vehicle speed for third gear as a function of throttle position (vehicle speed must be above this table value in order to apply TCC PWM).

Cell data range: 0 to 1000 mph

PERFORMANCE MODE TORQUE CONVERTER APPLY VEHICLE SPEED GEAR #4

In performance mode, this table defines torque converter control apply (lock) vehicle speed for fourth gear as a function of throttle position (vehicle speed must be above this table value in order to apply TCC PWM).

Cell data range: 0 to 1000 mph

PERFORMANCE MODE TORQUE CONVERTER RELEASE TPS THRESHOLD GEAR #2

In performance mode, this table defines torque converter control release (unlock) throttle position threshold for second gear as a function of throttle position (if throttle position is above this table value, TCC PWM will release).

Cell data range: 0 to 100%

PERFORMANCE MODE TORQUE CONVERTER RELEASE TPS THRESHOLD GEAR #3

In performance mode, this table defines torque converter control release (unlock) throttle position threshold for third gear as a function of throttle position (if throttle position is above this table value, TCC PWM will release).

Cell data range: 0 to 100%

PERFORMANCE MODE TORQUE CONVERTER RELEASE TPS THRESHOLD GEAR #4

In performance mode, this table defines torque converter control release (unlock) throttle position threshold for fourth gear as a function of throttle position (if throttle position is above this table value, TCC PWM will release).

Cell data range: 0 to 100%

PERFORMANCE MODE TORQUE CONVERTER RELEASE VEHICLE SPEED GEAR #2

In performance mode, this table defines torque converter control release (unlock) vehicle speed for second gear as a function of throttle position (vehicle speed must be below this table value in order to release TCC PWM).

Cell data range: 0 to 1000 mph

PERFORMANCE MODE TORQUE CONVERTER RELEASE VEHICLE SPEED GEAR #3

In performance mode, this table defines torque converter control release (unlock) vehicle speed for third gear as a function of throttle position (vehicle speed must be below this table value in order to release TCC PWM).

Cell data range: 0 to 1000 mph

PERFORMANCE MODE TORQUE CONVERTER RELEASE VEHICLE SPEED GEAR #4

In performance mode, this table defines torque converter control release (unlock) vehicle speed for fourth gear as a function of throttle position (vehicle speed must be below this table value in order to release TCC PWM).

Cell data range: 0 to 1000 mph

TORQUE CONVERTER (TCC) APPLY DURING SHIFT ENABLED

Torque converter apply (lock) during drive gear shifting enabled.

- **Yes** = apply TCC PWM if apply conditions are true.
- **No** = release TCC PWM, even if apply conditions are true.

TORQUE CONVERTER (TCC) APPLY ENABLE DRIVE GEAR MINIMUM

Specifies the minimum gear number to allow torque converter to be applied/locked.

TORQUE CONVERTER (TCC) APPLY ENABLE ENGINE COOLANT TEMPERATURE MINIMUM

Specifies the minimum engine coolant temperature to allow torque converter to be applied/locked.

Range: 40° to 150° C

TORQUE CONVERTER (TCC) APPLY ENABLE THROTTLE POSITION MINIMUM

Specifies the minimum throttle position to allow torque converter to be applied/-locked.

Range: 0 to 100%

TORQUE CONVERTER (TCC) APPLY ENABLE THROTTLE POSITION MAXIMUM

Specifies the maximum throttle position to allow torque converter to be applied/-locked.

Range: 0 to 100%

MEASUREMENTS

TORQUE CONVERTER (TCC) APPLY ENABLED

If TRUE, torque converter apply has been enabled.

TORQUE CONVERTER (TCC) APPLY TIME

Torque converter apply time (ms).

TORQUE CONVERTER (TCC) STATE

Indicates the torque converter state. This will be one of the following:

- Disabled
- Release
- Apply

TORQUE CONVERTER DEMAND

Parameters for torque converter demand.

TUNABLE PARAMETERS (CHARACTERISTICS)

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE ACTUATOR MAXIMUM DUTY CYCLE

This table specifies the torque converter PWM solenoid valve actuator maximum duty cycle as a function of transmission oil temperature and line pressure setpoint.

Cell data range: 0 to 100%

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE ACTUATOR MINIMUM DUTY CYCLE

This table specifies the torque converter PWM solenoid valve actuator minimum duty cycle as a function of transmission oil temperature and line pressure setpoint.

Cell data range: 0 to 100%

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE ACTUATOR OUTPUT

Specifies the pin on the ECU connector that the torque converter PWM solenoid actuator is wired to.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "Low Side Drivers." Selecting a low side driver tells the ECU which of these outputs is assigned to the torque converter PWM solenoid actuator.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE ACTUATOR OUTPUT FREQUENCY

Specifies the frequency of the output to the torque converter PWM solenoid valve actuator.

Range: 0 to 2000 Hz

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE APPLY DUTY CYCLE

This table specifies the torque converter PWM solenoid valve apply duty cycle as a function of torque converter apply time.

Cell data range: 0 to 100%

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE RELEASE DUTY CYCLE

Specifies the release duty cycle for torque converter PWM solenoid valve.

Range: 0 to 100%

TORQUE CONVERTER (PWM) SOLENOID VALVE ACTUATOR OUTPUT

Specifies the pin on the ECU connector that the torque converter solenoid valve actuator is wired to.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "Low Side Drivers." Selecting a low side driver tells the ECU which of these outputs is assigned to the torque converter solenoid valve actuator.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TORQUE CONVERTER (TCC) SOLENOID VALVE ACTUATOR OUTPUT FREQUENCY

Specifies the frequency of the output to the torque converter solenoid valve actuator.

Range: 0 to 2000 Hz.

MEASUREMENTS

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE ACTUATOR DUTY CYCLE

Torque converter PWM solenoid valve actuator duty cycle (%).

TORQUE CONVERTER (TCC) PWM SOLENOID VALVE ACTUATOR OUTPUT STATUS

Torque converter PWM solenoid valve actuator output status.

TORQUE CONVERTER (TCC) SOLENOID VALVE ACTUATOR DUTY CYCLE

Torque converter solenoid actuator duty cycle (%).

TORQUE CONVERTER (TCC) SOLENOID VALVE ACTUATOR OUTPUT STATUS

Torque converter solenoid actuator output status.

TRANSMISSION LINE PRESSURE SENSOR

Parameters for the transmission line pressure sensor.

TUNABLE PARAMETERS (CHARACTERISTICS)

TRANSMISSION LINE PRESSURE (TRANS PR) FILTER COEFFICIENT

A filter can be applied to the signal from the transmission line pressure sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR DEFAULT

The default value for the transmission line pressure sensor. This is that line pressure that will be reported when the diagnostic for the transmission line pressure sensor returns any result other than OK.

Range: 0 to 662 kPa

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR DTC MAXIMUM

Specifies the maximum allowable pressure reading for the transmission line pressure sensor. Pressure readings above this threshold will set a DTC.

Range: 0 to 300 kPa

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum allowable voltage for the transmission line pressure sensor signal (short to ground threshold). Voltages above this threshold will set a DTC.

Range: 3.5 to 5 volts

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR DTC MINIMUM

Specifies the minimum allowable pressure reading for the transmission line pressure sensor. Pressure readings below this threshold will set a DTC.

Range: 0 to 300 kPa

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum allowable voltage for the transmission line pressure sensor signal (short to ground threshold). Voltages below this threshold will set a DTC.

Range: 0 to 2 volts

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR GAIN

This is part of the calibration for the transmission line pressure sensor. It specifies how much pressure each volt of signal from the transmission line pressure sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

Range: 1 to 100 kPa/V

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR INVERTED

Set to TRUE if the transmission line pressure sensor signal is inverted (when pressure increases, sensor signal voltage decreases).

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR OFFSET

Offset calibration of the transmission line pressure sensor. Set this to the amount of pressure indicated when the senor signal equals 0 volts.

Range: -99 to 99 kPa

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR INPUT

Specifies the pin on the ECU connector that transmission line pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the transmission line pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

TRANSMISSION LINE PRESSURE (TRANS PR)

Indicates the transmission line pressure, after filtering is applied.

TRANSMISSION LINE PRESSURE (TRANS PR) DTC ACTIVE

If YES, a DTC has been set for the transmission line pressure sensor.

TRANSMISSION LINE PRESSURE (TRANS PR) RAW

Indicates the transmission line pressure, before filtering is applied.

TRANSMISSION LINE PRESSURE (TRANS PR) SENSOR VOLTAGE

Indicates the voltage received from the transmission line pressure sensor.

TRANSMISSION OIL TEMPERATURE

Parameters for the transmission oil temperature sensor.

TUNABLE PARAMETERS (CHARACTERISTICS)

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SENSOR DEFAULT

Specifies the transmission oil temperature failsafe to use when the transmission oil temperature sensor error flag is on.

Range: -40° to 150° C

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) FILTER COEFFICIENT

A filter can be applied to the signal from the transmission oil temperature sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SCALED ENDPOINTS

The transmission oil temperature sensor changes its electrical resistance as the temperature increases. This table is used to convert the resistance of the sensor to the temperature represented by that resistance.

The values on the table's axis represent amounts of resistance (in Ohms) of the sensor. Enter the corresponding temperatures in the cells below.

Cell data range: -40° to 150° C

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SENSOR DTC MAXIMUM

Specifies the maximum allowed temperature reading for the transmission oil temperature sensor. Temperatures above this threshold will set a DTC.

Range: -40° to 150° C

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SENSOR DTC MAXIMUM VOLTAGE

Specifies the maximum allowed voltage for the transmission oil temperature sensor signal (open circuit threshold). Voltages above this threshold will set a DTC.

Range: 0 to 5 volts

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SENSOR DTC MINIMUM

Specifies the minimum allowed temperature reading for the transmission oil temperature sensor. Temperatures below this threshold will set a DTC.

Range: -40° to 150° C

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum allowed voltage for the transmission oil temperature sensor signal (short to ground threshold). Voltages below this threshold will set a DTC.

Range: 0 to 5 volts.

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SENSOR INPUT

Specifies the pin on the ECU connector that the transmission oil temperature is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "NTC temperature inputs." Selecting a temperature input tells the ECU which of these inputs is the transmission oil temperature sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

TRANSMISSION OIL TEMPERATURE (TRANS TEMP)

The transmission oil temperature, after filtering is applied.

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) DTC ACTIVE

If YES, a DTC has been set for the transmission oil temperature sensor.

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) RAW

Transmission oil temperature, before filtering is applied.

TRANSMISSION OIL TEMPERATURE (TRANS TEMP) SENSOR VOLTAGE

The voltage of the signal from the transmission oil temperature sensor.

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Buffalo Grove, IL 60089, USA

VEHICLE INPUTS AND OUTPUTS

Miscellaneous input from and output to the vehicle.

AIR CONDITIONER

Parameters for the a/c system.

TUNABLE PARAMETERS (CHARACTERISTICS)

AIR CONDITIONER ACTIVE DELAY

After all the required conditions for activating the air conditioner are met, wait this long before activation.

Range: 0 to 600 seconds

AIR CONDITIONER ENABLED

Set to YES to enable air conditioning. Set to NO to disable.

AIR CONDITIONER ENGINE FAN MODE

The value selected for the air conditioner engine fan mode controls how the engine cooling fans operate when the A/C is on:

- Both Off
- Fan 1 Active
- Fan 2 Active

AIR CONDITIONER ENGINE SPEED MAXIMUM THRESHOLD

Specifies the engine speed above which the air conditioner will be deactivated.

Range: 0 to 10,000 rpm

AIR CONDITIONER ENGINE SPEED MAXIMUM THRESHOLD HYSTERESIS

If engine speed falls below Air Conditioner Engine Speed Maximum Threshold minus this value, the air conditioner can be reactivated.

Higher values help prevent the air conditioner from being repeatedly activated and deactivated when engine speed hovers near the threshold.

Range: 0 to 1,000 rpm

AIR CONDITIONER ENGINE SPEED MINIMUM THRESHOLD

Specifies the engine speed above which the air conditioner can be activated.

Range: 0 to 10,000 rpm

AIR CONDITIONER ENGINE SPEED MINIMUM THRESHOLD HYSTERESIS

If engine speed falls below Air Conditioner Engine Speed Minimum Threshold minus this value, the air conditioner will be deactivated.

Larger values help prevent rapid on and off cycling when engine speed hovers near the threshold.

Range: 0 to 1,000 rpm

AIR CONDITIONER IDLE SPEED SETPOINT ADDER

This table specifies air conditioner idle speed setpoint adder as a function of engine coolant temperature. This parameter increases the engines idle speed to compensate for the additional load from the A/C compressor.

Range: 0 to 1,000 rpm

AIR CONDITIONER REFRIGERANT PRESSURE THRESHOLD

Specifies the minimum air conditioner refrigerant pressure required to activate the air conditioner.

> **NOTE:** This parameter applies only if an air conditioner refrigerant pressure sensor is fitted.

Range: 0 to 125 kPa

AIR CONDITIONER REFRIGERANT PRESSURE THRESHOLD HYSTERESIS

If air conditioner refrigerant pressure falls below Air Conditioner Refrigerant Temperature Threshold minus this value, the air conditioner will be deactivated.

Higher values help prevent repeated activation and deactivation when refrigerant pressure hovers near the threshold.

> **NOTE:** This parameter applies only if an air conditioner refrigerant pressure sensor is fitted.

Range: 0 to 125 kPa

AIR CONDITIONER REFRIGERANT TEMPERATURE THRESHOLD

Specifies the minimum air conditioner refrigerant temperature required to activate the air conditioner.

> **NOTE:** This parameter applies only if an air conditioner refrigerant temperature sensor is fitted.

Range: -40° to 150° C

AIR CONDITIONER REFRIGERANT TEMPERATURE THRESHOLD HYSTERESIS

If air conditioner refrigerant temperature falls below Air Conditioner Refrigerant Temperature Threshold minus this value, the air conditioner will be deactivated.

Higher values help prevent repeated activation and deactivation when refrigerant temperature hovers near the threshold.

> **NOTE:** This parameter applies only if an air conditioner refrigerant temperature sensor is fitted.

Range: -40° to 150° C

AIR CONDITIONER THROTTLE POSITION THRESHOLD

Specifies a throttle position threshold above which the A/C compressor will be deactivated.

Range: 0 to 100%

AIR CONDITIONER THROTTLE POSITION THRESHOLD HYSTERESIS

If throttle position falls below Air Conditioner Throttle Position Threshold minus this value, the air conditioner can be reactivated.

Range: 0 to 100%

MINIMUM AIR CONDITIONER ENGINE RUN TIME

Specifies the minimum duration that the engine must run before the A/C can be activated.

Range: 0 to 600 seconds

MEASUREMENTS

AIR CONDITIONER ACTIVE

If TRUE, the air conditioner is active.

AIR CONDITIONER ENGINE FAN MODE REQUESTED

When A/C is running, this indicates the current fan mode requested.

AIR CONDITIONER IDLE SPEED SETPOINT ADDER

Air conditioner idle speed setpoint adder measures the increase of the engines speed at idle from the additional load coming from the compressor.

AIR CONDITIONER DEMAND

Parameters for air conditioner demand.

TUNABLE PARAMETERS (CHARACTERISTICS)

AIR CONDITIONER (AC) ACTUATOR OUTPUT

Specifies the pin on the ECU connector that the air conditioner actuator is wired to.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

AIR CONDITIONER (AC) ACTUATOR OUTPUT STATUS

Air conditioner actuator output status.

AIR CONDITIONER REFRIGERANT PRESSURE

Parameters for air conditioner refrigerant pressure.

TUNABLE PARAMETERS (CHARACTERISTICS)

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR DTC MAXIMUM

Specifies the maximum allowable reading from the air conditioner refrigerant pressure sensor. Air conditioner refrigerant pressure sensor values above this threshold will set a DTC.

Range: 0 to 300 kPa

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR DTC MAXIMUM VOLTS

Specifies the maximum allowable voltage for the signal from the refrigerant pressure sensor. (open circuit threshold). Voltages above this threshold will set a DTC.

If the voltage is above this threshold, the ECU will consider the refrigerant pressure sensor to be operating abnormally, potentially indicating a problem with the refrigerant pressure sensor or its wiring.

Range: 3.5 to 5V

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR DTC MINIMUM

Specifies the minimum allowable reading from the air conditioner refrigerant pressure sensor. Air conditioner refrigerant pressure sensor values below this threshold will set a DTC.

Range: 0 to 300 kPa

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR DTC MINIMUM VOLTAGE

Specifies the minimum allowable voltage for the signal from the refrigerant pressure sensor. (short to ground threshold). Voltages below this threshold will set a DTC.

If the voltage is below this threshold, the ECU will consider the refrigerant pressure sensor to be operating abnormally, potentially indicating a problem with the refrigerant pressure sensor or its wiring.

Range: 0 to 2V

AIR CONDITIONER (AC) REFRIGERANT PRESSURE FILTER COEFFICIENT

A filter can be applied to the signal from the AC refrigerant pressure sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output unfiltered signal (output signal is equal to input signal).
- **0** = output null signal. Not recommended.

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR DEFAULT

Indicates the baseline default value for the air conditioner refrigerant pressure sensor. This is the pressure reading that will be used when the air conditioner refrigerant pressure sensor diagnostic indicates that the sensor is not OK.

Range: 0 to 662 kPa

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR GAIN

This is part of the calibration for the refrigerant pressure sensor. It specifies how much pressure each volt of signal from the refrigerant pressure sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 100 kPa/V

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR INVERTED

Set to TRUE if the air conditioner refrigerant pressure sensor signal is inverted (the signal transitions from a higher voltage to a lower voltage with respect to increasing pressure).

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR OFFSET

This is part of the calibration for the refrigerant pressure sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

Range: -99 to 99 kPa

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR INPUT

Specifies the pin on the ECU connector that the air conditioner refrigerant pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the air conditioner refrigerant pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

AIR CONDITIONER (AC) REFRIGERANT PRESSURE

Air conditioner refrigerant pressure measures the refrigerant pressure.

AIR CONDITIONER (AC) REFRIGERANT PRESSURE DTC ACTIVE

If YES, a DTC has been set for air conditioner refrigerant pressure.

AIR CONDITIONER (AC) REFRIGERANT PRESSURE RAW

Raw air conditioner refrigerant pressure.

AIR CONDITIONER (AC) REFRIGERANT PRESSURE SENSOR VOLTAGE

This parameter measures the air conditioner refrigerant pressure sensor voltage.

Range: 0 to 5V

AIR CONDITIONER REFRIGERANT TEMPERATURE

Parameters for air conditioner refrigerant temperature.

TUNABLE PARAMETERS (CHARACTERISTICS)

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE SENSOR DTC MAXIMUM

This parameter specifies the maximum acceptable value received from the air conditioner refrigerant temperature sensor. Adjust this parameter if you wish to set a boundary beyond which the ECU will recognize a significant deviation and generate a DTC.

Range: -40° to 150° C

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE SENSOR DTC MAXIMUM VOLTAGE

This parameter specifies the maximum acceptable voltage for the signal received from the air conditioner refrigerant temperature sensor (open circuit threshold). Voltages above this threshold will set a DTC.

Range: 0 to 5V

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE SENSOR DTC MINIMUM

This parameter specifies the minimum acceptable value received from the air conditioner refrigerant temperature sensor. Values above this threshold will trigger a DTC. Adjust this parameter if you wish to set a boundary beyond which the ECU will recognize a significant deviation.

Range: -40° to 150° C

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE SENSOR DTC MINIMUM VOLTAGE

This parameter establishes the minimum acceptable voltage for the signal received from the air conditioner refrigerant temperature sensor (short to ground threshold). Voltages below this threshold will set a DTC.

You may want to adjust this value to an appropriate minimum for the specific sensor you are using. This prevents false error codes when the sensor voltage range significantly differs from the default range expected by the ECU.

Range: 0 to 5V

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE ENDPOINTS

The air conditioner refrigerant temperature sensor changes its electrical resistance as the temperature increases. This table is used to convert the resistance of the sensor to the temperature represented by that resistance.

The values on the table's axis represent amounts of resistance (in Ohms) of the sensor. Enter the corresponding temperatures in the cells below.

Range: -40° to 150° C

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE FILTER COEFFICIENT

A filter can be applied to the signal from the AC refrigerant temperature sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output unfiltered signal (output signal is equal to input signal).
- **0** = output null signal. Not recommended.

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE SENSOR DEFAULT

Air conditioner refrigerant temperature failsafe value used when air conditioner refrigerant temperature error flag is set. The ECU will use this default reading when the A/C refrigerant temperature pressure sensor appears to be malfunctioning.

Range: -40° to 150° C

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE SENSOR INPUT

Specifies the pin on the ECU connector that the air conditioner refrigerant temperature sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "NTC temperature inputs." Selecting a temperature input tells the ECU which of these inputs is the air conditioner refrigerant temperature sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE

The air conditioner refrigerant temperature, after filtering.

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE DTC ACTIVE

If YES, a DTC has been for air conditioner refrigerant temperature.

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE RAW

Raw air conditioner refrigerant temperature.

AIR CONDITIONER (AC) REFRIGERANT TEMPERATURE SENSOR VOLTAGE

This parameter measures the voltage produced by the air conditioner refrigerant temperature sensor (in volts).

BASE

Base parameters.

TUNABLE PARAMETERS (CHARACTERISTICS)

VEHICLE TIRE DIAMETER

Specifies the diameter of the vehicle's tires.

BRAKE PEDAL

Parameters for the brake pedal.

TUNABLE PARAMETERS (CHARACTERISTICS)

BRAKE SWITCH SENSOR DEFAULT

Specifies a fallback value to use as the brake switch sensor reading if the ECU detects that the brake switch sensor has failed.

BRAKE SWITCH SENSOR INVERTED

Set to TRUE if the brake switch sensor signal is inverted.

REAR BRAKE PRESSURE SENSOR DTC MAXIMUM

Specifies the minimum allowable pressure reading for the rear brake pressure sensor. Pressure readings above this threshold will set a DTC.

REAR BRAKE PRESSURE SENSOR DTC MAXIMUM VOLTAGE

This parameter establishes the maximum acceptable voltage (open circuit threshold) for the signal received from the rear brake pressure sensor. Voltages above this threshold will set an error code. Voltages above this threshold will set a DTC.

You may want to adjust this value to an appropriate maximum for the specific sensor you are using. This prevents false error codes when the sensor voltage range significantly differs from the default range expected by the ECU.

REAR BRAKE PRESSURE SENSOR DTC MINIMUM

Specifies the minimum allowable pressure reading for the rear brake pressure sensor. Pressure readings below this threshold will set a DTC.

REAR BRAKE PRESSURE SENSOR DTC MINIMUM VOLTAGE

This parameter establishes the minimum acceptable voltage (short to ground threshold) for the signal received from the rear brake pressure sensor DTC minimum. Voltages below this threshold will set a DTC.

You may want to adjust this value to an appropriate minimum for the specific sensor you are using. This prevents false error codes when the sensor voltage range significantly differs from the default range expected by the ECU.

REAR BRAKE PRESSURE SENSOR DEFAULT

Specifies a failsafe value for the reading from the rear brake pressure sensor. The ECU will use this default reading when the rear brake pressure sensor appears to be malfunctioning.

REAR BRAKE PRESSURE SENSOR GAIN

This is part of the calibration for the rear brake pressure sensor. It specifies how much pressure each volt of signal from the rear brake pressure sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

REAR BRAKE PRESSURE SENSOR INPUT

Specifies the pin on the ECU connector that the rear brake pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "generic analog inputs" Selecting an analog input tells the ECU which of these inputs is the rear brake pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

REAR BRAKE PRESSURE SENSOR INVERTED

Set to TRUE if the rear brake pressure sensor signal is inverted (when rear brake pressure increases, the voltage from the sensor decreases).

REAR BRAKE PRESSURE SENSOR OFFSET

This is part of the calibration for rear brake pressure sensors. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

MEASUREMENTS

FRONT BRAKE PRESSURE DTC FAULT ACTIVE

If YES, a fault has been set for the front brake pressure sensor.

REAR BRAKE PRESSURE

The pressure indicated by the rear brake pressure sensor, after filtering is applied.

REAR BRAKE PRESSURE DTC FAULT ACTIVE

If YES, a fault has been set for the rear brake pressure sensor.

REAR BRAKE PRESSURE RAW

The pressure indicated by the rear brake pressure sensor, before filtering is applied.

REAR BRAKE PRESSURE SENSOR VOLTAGE

The voltage of the signal from the rear brake pressure sensor.

BRAKES

Parameters for the brake system.

TUNABLE PARAMETERS (CHARACTERISTICS)

BRAKE PEDAL STRATEGY

Defines how the brake pedal will be used as a switch:

- **Pressure.** Brake pressure used as reference for a switch.
- **Switch 12v.** Switched 12 volt brake pedal.

BRAKE SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that brake switch sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is brake switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FRONT BRAKE PRESSURE DTC MAXIMUM

Specifies the maximum allowable pressure reading from the front brake pressure sensor. Pressures higher than this threshold will set a DTC.

FRONT BRAKE PRESSURE DTC MAXIMUM VOLTAGE

Specifies the maximum allowable voltage for the signal from the front brake pressure sensor (open circuit threshold). Voltages above this threshold will set a DTC.

FRONT BRAKE PRESSURE DTC MINIMUM

Specifies the minimum allowable pressure reading from the front brake pressure sensor. Pressures below this threshold will set a DTC.

FRONT BRAKE PRESSURE DTC MINIMUM VOLTAGE

Specifies the minimum allowable voltage for the signal from the front brake pressure sensor (short to ground threshold). Voltages below this threshold will set a DTC.

FRONT BRAKE PRESSURE FILTER FREQUENCY

The rate at which the signal from the front brake pressure sensor is filtered to reduce noise and fluctuations.

> **NOTE:** 0 = no filter.

FRONT BRAKE PRESSURE SENSOR DEFAULT

Specifies the a default (failsafe) value for the brake pressure reading. This value will be used when front brake pressure error flag is set.

FRONT BRAKE PRESSURE SENSOR GAIN

This is part of the calibration for the front brake pressure sensor. It specifies how much pressure each volt of signal from the front brake pressure sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

FRONT BRAKE PRESSURE SENSOR INVERTED

Set to TRUE if the front brake pressure sensor signal is inverted. In other words, the voltage increases when the pressure decreases.

FRONT BRAKE PRESSURE SENSOR OFFSET

This is part of the calibration for the front brake pressure sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

FRONT BRAKE PRESSURE SENSOR INPUT

Specifies the pin on the ECU connector that the front brake pressure sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the front brake pressure sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FRONT BRAKE PRESSURE THRESHOLD

Specifies the level of brake pressure applied to the front brakes that triggers certain braking-related systems or safety features.

MEASUREMENTS

BRAKES ACTIVE

If TRUE, the brakes are active. If FALSE, they are not.

FRONT BRAKE PRESSURE

Indicates the amount hydraulic force applied to the front brakes when the brake pedal is pressed.

FRONT BRAKE PRESSURE SENSOR VOLTAGE

The voltage of the signal from the front brake pressure sensor.

DRIVER SWITCHES

Parameters for driver switches.

TUNABLE PARAMETERS (CHARACTERISTICS)

AIR CONDITIONER ARMING SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the air conditioner arming switch sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital channels." Selecting a digital channel tells the ECU which of these inputs is the air conditioner arming switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FUEL TANK CAPACITY RESET SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the fuel tank capacity reset switch sensor is wired to. This is a digital or analog momentary switch.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital channels." Selecting a digital channel tells the ECU which of these inputs is the fuel tank capacity reset switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MAP SWITCHING ARMING SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the map switching arming switch sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital CAN bus inputs." Selecting a CAN bus input tells the ECU which of these inputs is the map switching arming switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MASTER ODOMETER RESET SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the master odometer reset switch sensor is wired to. This is a digital or analog momentary switch.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital channels." Selecting a digital channel tells the ECU which of these inputs is the master odometer reset switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

NITROUS (NOS) ARMING SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the nitrous arming switch sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital channels." Selecting a digital channel tells the ECU which of these inputs is the nitrous arming switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TRACTION CONTROL ARMING SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the traction control arming switch sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital channels." Selecting a digital channel tells the ECU which of these inputs is the traction control arming switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TRIP RESET SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the trip reset switch sensor is wired to. This is a digital or analog momentary switch.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital channels." Selecting a digital channel tells the ECU which of these inputs is the trip reset switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

VEHICLE SPEED LIMITER ARMING SWITCH SENSOR INPUT

Specifies the pin on the ECU connector that the vehicle speed limiter arming switch sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "digital channels." Selecting a digital channel tells the ECU which of these inputs is the air conditioner arming switch sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

AIR CONDITIONER ARMING SWITCH ACTIVE

If YES, the air conditioner arming switch is active. If NO, the air conditioner arming switch is NOT active.

FUEL TANK CAPACITY RESET SWITCH ACTIVE

If YES, the fuel tank capacity reset switch is active (ON).

MAP SWITCHING ARMING SWITCH POSITION

Map switching arming digital switch position.

MASTER ODOMETER RESET SWITCH ACTIVE

If YES, the master odometer reset switch is active (ON).

NITROUS ARMING SWITCH ACTIVE

If YES, the switch controlling the nitrous oxide system is active. If NO, the nitrous arming switch is NOT active.

TRACTION CONTROL ARMING SWITCH ACTIVE

If TRUE, the switch responsible for activating the traction control system is active (on). If FALSE, the switch is not active.

TRIP RESET SWITCH ACTIVE

If YES, the trip reset switch is active (ON).

VEHICLE SPEED LIMITER ARMING SWITCH ACTIVE

If YES, the vehicle speed limiter arming switch is active. If NO, it is not.

FANS

There are two modules for engine cooling fans:

- **Fans.** This module determines whether the engine coolant temperature is high enough to enable each of the fans (or low enough to disable them).
- **Fan Demand.** This module allows tuners to manually activate and deactivate each of the fans. It also indicates whether each of the fans is currently active.

TUNABLE PARAMETERS (CHARACTERISTICS)

ENGINE OFF FAN RUN TIME

Run the fan for this amount of time if engine coolant temperature is above the set threshold and the ignition switch is active, but the engine is not running.

This is meant to prevent the battery from running down.

FAN 1 ACTUATOR OUTPUT

Specifies the low side driver output on the ECU that fan 1 is connected to.

There are 14 low side driver output pins on the ECU connector.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FAN 1 ENGINE COOLANT TEMPERATURE THRESHOLD

First stage fan control will be enabled when engine coolant temperature is greater than this threshold.

Range: 0 to 120 °C

FAN 1 ENGINE COOLANT TEMPERATURE THRESHOLD HYSTERESIS

First stage fan control will be disabled when engine coolant temperature falls below Fan 1 Engine Coolant Temperature Threshold minus this value.

Higher values prevent frequent enabling and disabling of fan control when engine temperature remains near the threshold.

Range: 0° to 20° C

FAN 1 OVERRIDE DEMAND

If Fan 1 Override Enabled is ON, this parameter can be used to manually switch fan 1 on (TRUE) or off (FALSE).

FAN 1 OVERRIDE ENABLED

Set to ON to enable second stage fan manual override. When this is ON, the fan can be switched on an off using Fan 1 Override Demand.

FAN 2 ACTUATOR OUTPUT

Specifies the low side driver output on the ECU that fan 2 is connected to.

There are 14 low side driver output pins on the ECU connector.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

FAN 2 ENGINE COOLANT TEMPERATURE THRESHOLD

Second stage fan control will be enabled when engine coolant temperature is greater than this threshold.

Range: 0° to 120° C

FAN 2 ENGINE COOLANT TEMPERATURE THRESHOLD HYSTERESIS

Second stage fan control will be disabled when engine coolant temperature falls below Fan 2 Engine Coolant Temperature Threshold minus this value.

Higher values prevent frequent enabling and disabling of fan control when engine temperature remains near the threshold.

Range: 0° to 20° C

FAN 2 OVERRIDE DEMAND

If Fan 2 Override Enabled is ON, this parameter can be used to manually switch fan 2 on (TRUE) or off (FALSE).

FAN 2 OVERRIDE ENABLED

Set to ON to enable second stage fan manual override. When this is ON, the fan can be switched on an off using Fan 2 Override Demand.

MEASUREMENTS

FAN 1 ACTIVE

If TRUE, fan 1 is active (is running).

FAN 2 ACTIVE

If TRUE, fan 2 is active (is running).

FAN 1 REQUESTED

If TRUE, first stage fan control has been requested. This will happen when engine coolant temperature has exceeded Fan 1 Engine Coolant Temperature Threshold.

The parameter will remain TRUE until the coolant temperature falls below Fan 1 Engine Coolant Temperature Threshold minus Fan 1 Engine Coolant Temperature Threshold Hysteresis.

FAN 2 REQUESTED

If TRUE, second stage fan control has been requested. This will happen when engine coolant temperature has exceeded Fan 2 Engine Coolant Temperature Threshold.

The parameter will remain TRUE until the coolant temperature falls below Fan 2 Engine Coolant Temperature Threshold minus Fan 2 Engine Coolant Temperature Threshold Hysteresis.

GENERIC PRESSURE SENSORS

It's possible to connect up to six additional pressure sensors to the ECU. The ECU will not use the data from these sensors, but it can record this data for playback in VCM Live.

TUNABLE PARAMETERS (CHARACTERISTICS)

GENERIC PRESSURE 1 DEFAULT

Specifies the default value for generic pressure sensor 1.

GENERIC PRESSURE 1 FILTER COEFFICIENT

A filter can be applied to the signal from the generic pressure sensor 1. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC PRESSURE 1 SENSOR GAIN

This is part of the calibration for the generic pressure sensor 1. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 1000 kPa/V

GENERIC PRESSURE 1 SENSOR INPUT

Specifies the pin on the ECU connector that generic pressure sensor 1 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is the generic pressure sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC PRESSURE 1 SENSOR INVERTED

Set to TRUE if the generic pressure sensor 1 signal is inverted (when pressure increases, the voltage from the sensor decreases).

GENERIC PRESSURE 1 SENSOR OFFSET

This is part of the calibration for generic pressure sensor 1. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

GENERIC PRESSURE 2 DEFAULT

Specifies the default value for generic pressure sensor 2.

GENERIC PRESSURE 2 FILTER COEFFICIENT

A filter can be applied to the signal from generic pressure sensor 2. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC PRESSURE 2 SENSOR GAIN

This is part of the calibration for generic pressure sensor 2. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

NOTE: If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 1000 kPa/V

GENERIC PRESSURE 2 SENSOR INPUT

Specifies the pin on the ECU connector that generic pressure sensor 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is generic pressure sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC PRESSURE 2 SENSOR INVERTED

Set to TRUE if the generic pressure sensor 2 signal is inverted (when pressure increases, the voltage from the sensor decreases).

GENERIC PRESSURE 2 SENSOR OFFSET

This is part of the calibration for generic pressure sensor 2. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

GENERIC PRESSURE 3 DEFAULT

Specifies the default value for generic pressure sensor 3.

GENERIC PRESSURE 3 FILTER COEFFICIENT

A filter can be applied to the signal from generic pressure sensor 3. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC PRESSURE 3 SENSOR GAIN

This is part of the calibration for generic pressure sensor 3. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 1000 kPa/V

GENERIC PRESSURE 3 SENSOR INPUT

Specifies the pin on the ECU connector that generic pressure sensor 3 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is generic pressure sensor 3.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC PRESSURE 3 SENSOR INVERTED

Set to TRUE if the generic pressure sensor 3 signal is inverted (when pressure increases, the voltage from the sensor decreases).

GENERIC PRESSURE 3 SENSOR OFFSET

This is part of the calibration for generic pressure sensor 3. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

GENERIC PRESSURE 4 DEFAULT

Specifies the default value for generic pressure sensor 4.

GENERIC PRESSURE 4 FILTER COEFFICIENT

A filter can be applied to the signal from generic pressure sensor 4. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC PRESSURE 4 SENSOR GAIN

This is part of the calibration for generic pressure sensor 4. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 1000 kPa/V

GENERIC PRESSURE 4 SENSOR INPUT

Specifies the pin on the ECU connector that generic pressure sensor 4 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is generic pressure sensor 4.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC PRESSURE 4 SENSOR INVERTED

Set to TRUE if the generic pressure sensor 4 signal is inverted (when pressure increases, the voltage from the sensor decreases).

GENERIC PRESSURE 4 SENSOR OFFSET

This is part of the calibration for the generic pressure 4 sensor. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

GENERIC PRESSURE 5 DEFAULT

Specifies the default value for generic pressure sensor 5.

GENERIC PRESSURE 5 FILTER COEFFICIENT

A filter can be applied to the signal from generic pressure sensor 5. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC PRESSURE 5 SENSOR GAIN

This is part of the calibration for generic pressure sensor 5. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 1000 kPa/V

GENERIC PRESSURE 5 SENSOR INPUT

Specifies the pin on the ECU connector that generic pressure sensor 5 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is generic pressure sensor 5.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC PRESSURE 5 SENSOR INVERTED

Set to TRUE if the generic pressure sensor 5 signal is inverted (when pressure increases, the voltage from the sensor decreases).

GENERIC PRESSURE 5 SENSOR OFFSET

This is part of the calibration for generic pressure sensor 5. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

GENERIC PRESSURE 6 DEFAULT

Specifies the default value for generic pressure sensor 6.

GENERIC PRESSURE 6 FILTER COEFFICIENT

A filter can be applied to the signal from generic pressure sensor 6. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC PRESSURE 6 SENSOR GAIN

This is part of the calibration for generic pressure sensor 6. It specifies how much pressure each volt of signal from the sensor represents.

This can be easily calculated using two voltages for which you already know the corresponding pressures. The equation is:

Gain = (P2-P1)/(V2-V1)

> **NOTE:** If you were to graph these two points and then draw a line from one point to the other, gain is the SLOPE of that line.

Range: 1 to 1000 kPa/V

GENERIC PRESSURE 6 SENSOR INPUT

Specifies the pin on the ECU connector that generic pressure sensor 6 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "general purpose analog channels." Selecting an analog channel tells the ECU which of these inputs is generic pressure sensor 6.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC PRESSURE 6 SENSOR INVERTED

Set to TRUE if the generic pressure sensor 6 signal is inverted (when pressure increases, the voltage from the sensor decreases).

GENERIC PRESSURE 6 SENSOR OFFSET

This is part of the calibration for generic pressure sensor 6. It is the amount of pressure indicated when the signal from the sensor is at 0 volts.

MEASUREMENTS

GENERIC PRESSURE 1

The amount of pressure indicated by generic pressure sensor 1, after filtering is applied.

GENERIC PRESSURE 1 SENSOR VOLTAGE

The voltage of the signal from generic pressure sensor 1.

GENERIC PRESSURE 1 RAW

The amount of pressure indicated by generic pressure sensor 1, before filtering is applied.

GENERIC PRESSURE 2

The amount of pressure indicated by generic pressure sensor 2, after filtering is applied.

GENERIC PRESSURE 2 SENSOR VOLTAGE

The voltage of the signal from generic pressure sensor 2.

GENERIC PRESSURE 2 RAW

The amount of pressure indicated by generic pressure sensor 2, before filtering is applied.

GENERIC PRESSURE 3

The amount of pressure indicated by generic pressure sensor 3, after filtering is applied.

GENERIC PRESSURE 3 SENSOR VOLTAGE

The voltage of the signal from generic pressure sensor 3.

GENERIC PRESSURE 3 RAW

The amount of pressure indicated by generic pressure sensor 3, before filtering is applied.

GENERIC PRESSURE 4

The amount of pressure indicated by generic pressure sensor 4, after filtering is applied.

GENERIC PRESSURE 4 SENSOR VOLTAGE

The voltage of the signal from generic pressure sensor 4.

GENERIC PRESSURE 4 RAW

The amount of pressure indicated by generic pressure sensor 4, before filtering is applied.

GENERIC PRESSURE 5

The amount of pressure indicated by generic pressure sensor 5, after filtering is applied.

GENERIC PRESSURE 5 SENSOR VOLTAGE

The voltage of the signal from generic pressure sensor 5.

GENERIC PRESSURE 5 RAW

The amount of pressure indicated by generic pressure sensor 5, before filtering is applied.

GENERIC PRESSURE 6

The amount of pressure indicated by generic pressure sensor 6, after filtering is applied.

GENERIC PRESSURE 6 SENSOR VOLTAGE

The voltage of the signal from generic pressure sensor 6.

GENERIC PRESSURE 6 RAW

The amount of pressure indicated by generic pressure sensor 6, before filtering is applied.

GENERIC TEMPERATURE SENSORS

It's possible to connect up to three additional temperature sensors to the ECU. The ECU will not use the data from these sensors, but it can record this data for playback in VCM Live.

TUNABLE PARAMETERS (CHARACTERISTICS)

GENERIC TEMPERATURE 1 FILTER COEFFICIENT

A filter can be applied to the signal from generic temperature sensor 1. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC TEMPERATURE 1 SCALED ENDPOINTS

Temperature sensors change their electrical resistance as the temperature increases. This table is used to convert the resistance of the sensor to the temperature represented by that resistance.

The values on the table's axis represent amounts of resistance (in Ohms) of the sensor. Enter the corresponding temperatures in the cells below.

GENERIC TEMPERATURE 1 SENSOR INPUT

Specifies the pin on the ECU connector that generic temperature sensor 1 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "NTC temperature inputs." Selecting a temperature input tells the ECU which of these inputs is generic temperature sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC TEMPERATURE 2 FILTER COEFFICIENT

A filter can be applied to the signal from the generic temperature sensor 2. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC TEMPERATURE 2 SCALED ENDPOINTS

Temperature sensors change their electrical resistance as the temperature increases. This table is used to convert the resistance of the sensor to the temperature represented by that resistance.

The values on the table's axis represent amounts of resistance (in Ohms) of the sensor. Enter the corresponding temperatures in the cells below.

GENERIC TEMPERATURE 2 SENSOR INPUT

Specifies the pin on the ECU connector that generic temperature sensor 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "NTC temperature inputs." Selecting a temperature input tells the ECU which of these inputs is generic temperature sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

GENERIC TEMPERATURE 3 FILTER COEFFICIENT

A filter can be applied to the signal from the generic temperature sensor 3. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output no filtered signal i.e. output signal is equal to input signal.
- **0** = output null signal so it is strictly recommended not to use 0 value.

GENERIC TEMPERATURE 3 SCALED ENDPOINTS

Temperature sensors change their electrical resistance as the temperature increases. This tableis used to convert the resistance of the sensor to the temperature represented by that resistance.

The values on the table's axis represent amounts of resistance (in Ohms) of the sensor. Enter the corresponding temperatures in the cells below.

GENERIC TEMPERATURE 3 SENSOR INPUT

Specifies the pin on the ECU connector that generic temperature sensor 3 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "NTC temperature inputs." Selecting a temperature input tells the ECU which of these inputs is generic temperature sensor 3.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

GENERIC TEMPERATURE 1

The temperature indicated by generic temperature sensor 1, after filtering is applied.

GENERIC TEMPERATURE 1 RAW

The temperature indicated by generic temperature sensor 1, before filtering is applied.

GENERIC TEMPERATURE 1 SENSOR VOLTAGE

The voltage of the signal from generic temperature sensor 1.

GENERIC TEMPERATURE 2

The temperature indicated by generic temperature sensor 2, after filtering is applied.

GENERIC TEMPERATURE 2 RAW

The temperature indicated by generic temperature sensor 2, before filtering is applied.

GENERIC TEMPERATURE 2 SENSOR VOLTAGE

The voltage of the signal from generic temperature sensor 2.

GENERIC TEMPERATURE 3

The temperature indicated by generic temperature sensor 3, after filtering is applied.

GENERIC TEMPERATURE 3 RAW

The temperature indicated by generic temperature sensor 3, before filtering is applied.

GENERIC TEMPERATURE 3 SENSOR VOLTAGE

The voltage of the signal from generic temperature sensor 3.

IGNITION SWITCH

Parameters for the ignition switch.

TUNABLE PARAMETERS (CHARACTERISTICS)

IGNITION SWITCH SENSOR INPUT

Indicates the pin on the ECU connector that the ignition switch sensor is wired to.

> **NOTE:** Although this is technically a configurable parameter, there is only one input pin that supports the ignition switch sensor. So, it's pre-selected.

IGNITION SWITCH VOLTAGE FILTER COEFFICIENT

A filter can be applied to the voltage from the ignition switch. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

MEASUREMENTS

IGNITION SWITCH ACTIVE

Indicates the position of the ignition switch. In a conventional 4-position ignition system...

- TRUE corresponds to the key being in either the START position or in the ON/RUN position. In other words, the driver wants the engine to be on.

- FALSE corresponds to the key being in either the OFF or the ACC position (the driver wants the engine to be off).

IGNITION SWITCH SENSOR RAW VOLTAGE

The voltage of the signal from the ignition switch sensor, before filtering.

IGNITION SWITCH SENSOR VOLTAGE

The voltage of the signal from the ignition switch sensor, after filtering.

MALFUNCTION INDICATOR LAMP (MIL)

This module controls the malfunction indicator lamp, which illuminates to indicate that a fault has been detected.

MEASUREMENTS

MIL INDICATOR ACTIVE

If YES, the Malfunction Indicator Lamp is active (lit).

VEHICLE GAUGES

Parameters for vehicle gauges.

TUNABLE PARAMETERS (CHARACTERISTICS)

SPEEDOMETER ACTUATOR DUTY CYCLE

This parameter refers to how long and how frequently the actuator that drives the speedometer needle is ON (when OFF, duty cycle is 0%). A higher duty cycle means more frequent updates to the speed reading. A lower duty cycle means less frequent updates.

Range: 0 to 100%

SPEEDOMETER ACTUATOR FREQUENCY

This table indicates how often the speedometer updates its readings.

SPEEDOMETER ACTUATOR FREQUENCY OVERRIDE DEMAND

This parameter allows the normal frequency (in Hz) at which the speedometer updates its readings to be temporarily changed or overriden.

SPEEDOMETER ACTUATOR FREQUENCY OVERRIDE ENABLED

Set to YES to enable speedometer actuator override.

SPEEDOMETER ACTUATOR OUTPUT

Specifies which output pin on the ECU is connected to the speedometer actuator.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "Low Side Drivers." Selecting a low side driver tells the ECU which of these outputs is assigned to the speedometer.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

TACHOMETER ACTUATOR DUTY CYCLE

Specifies how long and how frequently the actuator that drives the tachometer needle is ON (when OFF, duty cycle is 0%). A higher duty cycle means more frequent updates to the tacho reading. A lower duty cycle means less frequent updates.

Range: 0 to 100%

TACHOMETER ACTUATOR FREQUENCY

This table indicates how often the tachometer updates its readings.

TACHOMETER ACTUATOR FREQUENCY OVERRIDE DEMAND

When Tachometer Actuator Frequency Override Enabled equals TRUE, this parameter specifies the tachometer actuator frequency to apply.

TACHOMETER ACTUATOR FREQUENCY OVERRIDE ENABLED

Set to YES to enable tachometer actuator override.

TACHOMETER ACTUATOR OUTPUT

Specifies which output pin on the ECU is connected to the tachometer actuator.

On the ECU connector, there are several pins that are reserved for such outputs. These are called "Low Side Drivers." Selecting a low side driver tells the ECU which of these outputs is assigned to the tachometer.

(Cannot be live tuned. Requires flashing modifications back to the ECU).

MEASUREMENTS

SPEEDOMETER ACTUATOR FREQUENCY

Indicates how often the speedometer updates its readings. A higher frequency means more frequent updates. A lower frequency means fewer updates, making the speedometer less responsive but possibly more stable.

TACHOMETER ACTUATOR FREQUENCY

Indicates how often the tachometer updates its readings. A higher frequency means more frequent updates. A lower frequency means fewer updates, making the tachometer less responsive but possibly more stable.

VEHICLE SPEED LIMITER

Parameters for the vehicle speed limiter.

TUNABLE PARAMETERS (CHARACTERISTICS)

VEHICLE SPEED ARMING DELAY

The amount of time delay after vehicle speed limiter arming switch is engaged before cutting the vehicle speed (by cutting TPS & retarding ignition).

VEHICLE SPEED LIMITER CLOSED LOOP MAXIMUM

Specifies the maximum allowable value for Vehicle Speed Limiter Throttle Position Requested. If the calculated request is higher than this value, this value will be used instead.

VEHICLE SPEED LIMITER CLOSED LOOP MINIMUM

Specifies the minimum allowable value for Vehicle Speed Limiter Throttle Position Requested. If the calculated request is lower than this value, this value will be used instead.

VEHICLE SPEED LIMITER FEED FORWARD (MAP #1)

This is one of four maps that specify vehicle speed limiter feed forward as a function of gear number index. This map will be used when Vehicle Speed Limiter Map Select equals 1.

VEHICLE SPEED LIMITER FEED FORWARD MAP #2

This is one of four maps that specify vehicle speed limiter feed forward as a function of gear number index. This map will be used when Vehicle Speed Limiter Map Select equals 2.

VEHICLE SPEED LIMITER FEED FORWARD MAP #3

This is one of four maps that specify vehicle speed limiter feed forward as a function of gear number index. This map will be used when Vehicle Speed Limiter Map Select equals 3.

VEHICLE SPEED LIMITER FEED FORWARD MAP #4

This is one of four maps that specify vehicle speed limiter feed forward as a function of gear number index. This map will be used when Vehicle Speed Limiter Map Select equals 4.

VEHICLE SPEED LIMITER IGNITION RETARD DECAY

This table specifies a multiplier to ignition as a function of the amount of time the vehicle speed limiter ignition retard has been active.

This allows the ignition retard to increase or decrease based on how long the vehicle speed limiter has been active.

- If values are ascending, the rate of ignition retard increases with vehicle speed limiter active time.
- If values are descending, the rate of ignition retard decreases with the vehicle speed limiter active time.

VEHICLE SPEED LIMITER IGNITION RETARD (MAP #1)

This is one of four maps that specify vehicle speed limiter ignition retard as a function of gear number index and vehicle speed limiter vehicle speed error. This map is used when Vehicle Speed Limiter Map Select is set to 1.

VEHICLE SPEED LIMITER IGNITION RETARD MAP #2

This is one of four maps that specify vehicle speed limiter ignition retard as a function of gear number index and vehicle speed limiter vehicle speed error. This map is used when Vehicle Speed Limiter Map Select is set to 2.

VEHICLE SPEED LIMITER IGNITION RETARD MAP #3

This is one of four maps that specify vehicle speed limiter ignition retard as a function of gear number index and vehicle speed limiter vehicle speed error. This map is used when Vehicle Speed Limiter Map Select is set to 3.

VEHICLE SPEED LIMITER IGNITION RETARD MAP #4

This is one of four maps that specify vehicle speed limiter ignition retard as a function of gear number index and vehicle speed limiter vehicle speed error. This map is used when Vehicle Speed Limiter Map Select is set to 4.

VEHICLE SPEED LIMITER INTEGRAL GAIN

This table defines vehicle speed limiter integral gain as a function of active drive gear and vehicle speed error.

VEHICLE SPEED LIMITER INTEGRAL TERM MAXIMUM

Specifies the maximum allowed value for the vehicle speed limiter integral term. If the calculated integral term exceeds this value, this value will be used instead.

VEHICLE SPEED LIMITER INTEGRAL TERM MINIMUM

Specifies the minimum allowed value for the vehicle speed limiter integral term. If the calculated integral term is below this value, this value will be used instead.

VEHICLE SPEED LIMITER MAP SELECT

Use this parameter to choose the map used for speed limiter functions that have multiple maps.

Range: 1 to 4

VEHICLE SPEED LIMITER PROPORTIONAL GAIN

This table defines vehicle speed limiter proportional gain as a function of active drive gear & vehicle speed error.

VEHICLE SPEED LIMITER PROPORTIONAL TERM MAXIMUM

Specifies the maximum allowable value for the Vehicle Speed Limiter Proportional Term. This value will be used as the Proportional Term if the calculated Proportional Term exceeds it.

VEHICLE SPEED LIMITER PROPORTIONAL TERM MINIMUM

Specifies the minimum allowed value for the Vehicle Speed Limiter Proportional Term. If the calculated proportional term is less than this value, this value will be used instead.

VEHICLE SPEED LIMITER THRESHOLD (MAP #1)

This is one of four maps that specify vehicle speed limiter threshold as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 1.

VEHICLE SPEED LIMITER THRESHOLD MAP #2

This is one of four maps that specify vehicle speed limiter threshold as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 2.

VEHICLE SPEED LIMITER THRESHOLD MAP #3

This is one of four maps that specify vehicle speed limiter threshold as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 3.

VEHICLE SPEED LIMITER THRESHOLD MAP #4

This is one of four maps that specify vehicle speed limiter threshold as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 4.

VEHICLE SPEED LIMITER THRESHOLD HYSTERESIS (MAP #1)

This is one of four maps that specify vehicle speed limiter threshold hysteresis as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 1.

VEHICLE SPEED LIMITER THRESHOLD HYSTERESIS MAP #2

This is one of four maps that specify vehicle speed limiter threshold hysteresis as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 2.

VEHICLE SPEED LIMITER THRESHOLD HYSTERESIS MAP #3

This is one of four maps that specify vehicle speed limiter threshold hysteresis as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 3.

VEHICLE SPEED LIMITER THRESHOLD HYSTERESIS MAP #4

This is one of four maps that specify vehicle speed limiter threshold hysteresis as a function of gear number index. This map is used when Vehicle Speed Limiter Map Select is set to 4.

VEHICLE SPEED LIMITER THROTTLE POSITION RATE LIMITER DOWN

Indicates how slowly the throttle blades can close when the speed limiter is being approached or is active. The larger the value, the more gradual the response and vice versa (values are negative).

Higher values are recommended in order to obtain smoother ramp out response when vehicle speed limiter gets deactivated.

VEHICLE SPEED LIMITER THROTTLE POSITION RATE LIMITER UP

Indicates how quickly the throttle blades can open when the speed limiter is being approached or is active. The larger the value, the steeper the cut and vice versa.

Higher values are recommended since rapid throttle response is needed when vehicle speed limiter is active, in order to get better control and safety.

MEASUREMENTS

GEAR NUMBER INDEX

Gear number index. Automatic Transmission:

- AGear1 = 1
- AGear2 = 2
- AGear3 = 3
- AGear4 = 4

Manual Transmission:

- MGearN = 0
- MGear1 = 1
- MGear2 = 2
- MGear3 = 3
- MGear4 = 4
- MGear5 = 5
- MGear6 = 6.

VEHICLE SPEED LIMITER ACTIVE

If TRUE, the vehicle speed limiter is active.

VEHICLE SPEED LIMITER FEED FORWARD TERM

One of three component values that are used to calculate Vehicle Speed Limiter Throttle Position Requested.

> **NOTE:** Throttle position requested is equal to Feed Forward Term + Proportional Term + Integral Term.

This term is taken from the currently-selected Vehicle Speed Limiter Feed Forward Map.

VEHICLE SPEED LIMITER IGNITION CUT PATTERN REQUESTED

Indicates the amount of ignition cut (in degrees or radians) requested by the speed limiter.

VEHICLE SPEED LIMITER IGNITION RETARD

Indicates how the ECU restricts the vehicles top speed by altering the ignition timing. The ECU detects the vehicle reaching a preset speed limit, it retards the ignition timing, causing the spark to fire at a later time.

VEHICLE SPEED LIMITER IGNITION RETARD ACTIVE

If TRUE, the vehicle speed limiter retard is actively using ignition retard to control the top speed.

VEHICLE SPEED LIMITER IGNITION RETARD DECAY

The multiplier being applied to the base amount ignition retard defined for vehicle speed limiter. Depending on how Vehicle Speed Limiter Ignition Retard Decay has been tuned, this may increase or decrease over time.

VEHICLE SPEED LIMITER INTEGRAL TERM

One of three component values that are used to calculate Vehicle Speed Limiter Throttle Position Requested.

> **NOTE:** Throttle position requested is equal to Feed Forward Term + Proportional Term + Integral Term.

The integral is multiplied by vehicle speed limiter vehicle speed error over time. Each time this error is calculated.

1. The error is multiplied by vehicle speed limiter integral gain, which is then multiplied by the task time (0.01 seconds).
2. The result is added to the previous vehicle speed limiter integral term, resulting in a new value for the integral term.

VEHICLE SPEED LIMITER MAP SELECTED

Indicates which of the four maps are selected for vehicle speed limiter parameters that include map switching.

VEHICLE SPEED LIMITER PROPORTIONAL TERM

One of three component values that are used to calculate Vehicle Speed Limiter Throttle Position Requested.

> **NOTE:** Throttle position requested is equal to Feed Forward Term + Proportional Term + Integral Term.

This term is directly proportional to Vehicle Speed Limiter Vehicle Speed Error.

VEHICLE SPEED LIMITER THRESHOLD

Indicates the specific speed which the vehicles speed limiting system activates.

VEHICLE SPEED LIMITER THROTTLE POSITION REQUESTED

When vehicle speed limiter is active, this indicates the final throttle (in %) requested by the speed limiter module.

VEHICLE SPEED LIMITER VEHICLE SPEED ERROR

The amount by which the current vehicle speed differs from the speed limiter threshold (Vehicle Speed Limiter Threshold - vehicle speed).

VEHICLE SPEED SENSOR

Parameters for the vehicle speed sensor.

TUNABLE PARAMETERS (CHARACTERISTICS)

NUMBER OF TEETH ON TRANSMISSION GEAR

Specifies the number of teeth on the transmission gear.

Range: 0 to 100

NUMBER OF WHEEL SPEED SENSORS

Specifies the number of wheel speed sensors fitted in the vehicle.

Range: 0 to 10

REAR END GEAR RATIO

Specifies the rear end gear ratio (final drive ratio).

Range: 0 to 5

VEHICLE SPEED CALCULATION MODE

Specifies how the vehicle speed is calculated:

- Transmission Based
- Wheel Based

VEHICLE SPEED FILTER (VSS) COEFFICIENT

A filter can be specified for the signal coming from the vehicle speed sensor. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

0 and 1 themselves have special meanings:

- **1** - output unfiltered signal (the output signal is equal to input signal).
- **0** - output null signal (not recommended).

VEHICLE SPEED SENSOR (VSS) INPUT

Specifies the pin on the ECU connector that the vehicle speed sensor is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "Speed Inputs." Selecting a speed input tells the ECU which of these inputs is the vehicle speed sensor.

(Cannot be live tuned. Requires flashing modifications back to the ECU.)

VEHICLE SPEED SENSOR TYPE

Specifies the type of vehicle speed sensor installed:

- VR (variable reluctance)
- DHE (digital hall effect)

(Cannot be live tuned. Requires flashing modifications back to the ECU.)

MEASUREMENTS

VEHICLE SPEED

Indicates the vehicle speed, after filtering is applied.

VEHICLE SPEED (VSS) DTC FAULT ACTIVE

If YES, a DTC has been set for the vehicle speed sensor. Applicable to transmission-based speed calculated mode.

VEHICLE SPEED RAW

Indicates the vehicle speed, before filtering is applied.

VEHICLE SPEED SENSOR FREQUENCY

The rate at which a vehicle speed sensor generates electrical signals (in Hz) in response to the rotational speed of a vehicle's wheels.

WHEEL SPEED

Wheel speed parameters.

TUNABLE PARAMETERS (CHARACTERISTICS)

FRONT WHEEL 1 SPEED FILTER COEFFICIENT

A filter can be applied to the signal from front wheel speed sensor 1. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

FRONT WHEEL 1 SPEED SENSOR INPUT

Specifies the pin on the ECU connector that front wheel speed sensor 1 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "Speed Inputs." Selecting a speed input tells the ECU which of these inputs is front wheel speed sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU.)

FRONT WHEEL 2 SPEED FILTER COEFFICIENT

A filter can be applied to the signal from front wheel speed sensor 2. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended.

FRONT WHEEL 2 SPEED SENSOR INPUT

Specifies the pin on the ECU connector that front wheel speed sensor 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "Speed Inputs." Selecting a speed input tells the ECU which of these inputs is front wheel speed sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU.)

NUMBER OF TEETH ON WHEEL

Specifies the number of teeth on the ring for the wheel speed sensor.

Range: 1 to 100

REAR WHEEL 1 SPEED FILTER COEFFICIENT

A filter can be applied to the signal from rear wheel speed sensor 1. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended

REAR WHEEL 1 SPEED SENSOR INPUT

Specifies the pin on the ECU connector that rear wheel speed sensor 1 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "Speed Inputs." Selecting a speed input tells the ECU which of these inputs is rear wheel speed sensor 1.

(Cannot be live tuned. Requires flashing modifications back to the ECU.)

REAR WHEEL 2 SPEED FILTER COEFFICIENT

A filter can be applied to the signal from rear wheel speed sensor 2. This is useful for smoothing a noisy signal and reducing the intensity (or amplitude) of sudden spikes and dips in the signal.

The number is a decimal between 0 and 1, which specifies the strength of the filter. Values near 1 would not filter out much (weak filtering). Values near 0 would filter out the whole signal (very strong filtering).

- **1** = output an unfiltered signal. That is, output signal is equal to input signal.
- **0** = output null signal. Not recommended

REAR WHEEL 2 SPEED SENSOR INPUT

Specifies the pin on the ECU connector that rear wheel speed sensor 2 is wired to.

On the ECU connector, there are several pins that are reserved for such inputs. These are called "Speed Inputs." Selecting a speed input tells the ECU which of these inputs is rear wheel speed sensor 2.

(Cannot be live tuned. Requires flashing modifications back to the ECU.)

MEASUREMENTS

FRONT WHEEL 1 SPEED

The wheel speed reported by front wheel speed sensor 1, after filtering is applied.

FRONT WHEEL 1 SPEED RAW

The wheel speed reported by front wheel speed sensor 1, before filtering is applied.

FRONT WHEEL 1 SPEED SENSOR FREQUENCY

Front wheel 2 speed sensor frequency (Hz).

FRONT WHEEL 2 SPEED

The wheel speed reported by front wheel speed sensor 2, after filtering is applied.

FRONT WHEEL 2 SPEED RAW

The wheel speed reported by front wheel speed sensor 2, before filtering is applied.

FRONT WHEEL 2 SPEED SENSOR FREQUENCY

Front wheel 2 speed sensor frequency (Hz).

REAR WHEEL 1 SPEED

The speed reported by rear wheel speed sensor 1, after filtering is applied.

REAR WHEEL 1 SPEED RAW

The speed reported by rear wheel speed sensor 1, before filtering is applied.

REAR WHEEL 1 SPEED SENSOR FREQUENCY

Rear wheel 1 speed sensor frequency (Hz).

REAR WHEEL 2 SPEED

The speed reported by rear wheel speed sensor 2, after filtering is applied.

REAR WHEEL 2 SPEED RAW

The speed reported by rear wheel speed sensor 2 in miles per hour, before filtering is applied.

REAR WHEEL 2 SPEED SENSOR FREQUENCY

Rear wheel 2 speed sensor frequency (Hz).