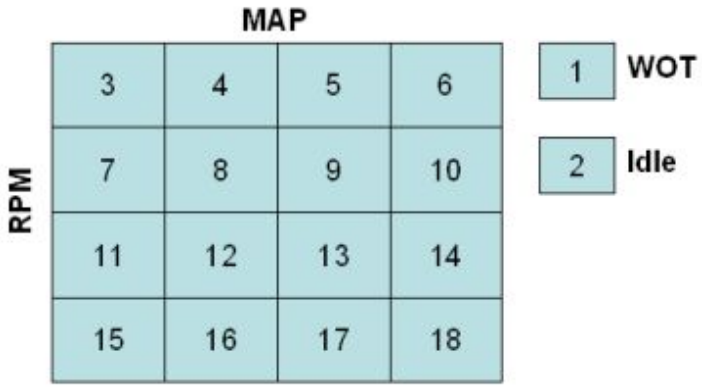
Airflow and Cylinder Airmass Calculations
The PCM has a number of airflow calculations it performs based primarily on input from the Mass Airflow sensor (MAF), Manifold Absolute Pressure (MAP) sensor, Inlet Air Temperature (IAT) sensor and other inputs. The PCM relies very heavily on its ability to accurately estimate the mass of air entering each cylinder during the intake stroke. It uses this information to accurately meter the correct mass of fuel into the cylinder to achieve the desired (commanded) air/fuel ratio (AFR).

The dynamic airmass calculations include various filters and strategies to predict the cylinder airmass from MAF, MAP, TPS, RPM, IAT and VE table inputs. The system is divided into various "zones" of operation (very similar to fuel trim cells). The zones are shown in the diagram below:



As engine operating conditions change the current zone changes and this selects the appropriate filter equation to be used in the dynamic airmass calculation.

Dynamic Airflow

- WOT Entry Max Airflow: If yes then set predicted airmass to ideal (maximum) cylinder airmass when entering WOT (Zone #1).
- MAP/TPS Airflow Filter: This filter is used to filter the MAF airmass in response to a MAP or TPS failure. It is also used to filter the MAF airmass when the engine RPM is greater than the High RPM Disable limit.
- High RPM Disable: Above this RPM use filtered MAF airmass for airmass prediction calculations.
- High RPM Re-Enable: If enabled, RPM must drop below this to re-enable airmass prediction calculation.
- High RPM Hysteresis: Hysteresis subtracted from High RPM Disable to re-enable dynamic airmass calculation.
- Initial Zone: Zone is initialized to this value when engine is started.
- WOT Zone - TPS %: Throttle position greater than or equal to this value is regarded as WOT and sets zone to #1 (WOT Zone).
- Idle Zone - VSS: Vehicle speed must be below this to set Idle Zone (zone #2).
- Idle Zone - TPS %: Throttle position speed must be below this to set Idle Zone (zone #2).
- Zone RPM Boundaries: RPM boundaries that define different zones (horizontal boundaries).
- Zone RPM Hysteresis: Hystersis applied to RPM zone transitions to prevent oscillation between zones.
- Zone MAP Boundaries: MAP boundaries that define different zones (vertical boundaries).
- Zone MAP Hysteresis: Hystersis applied to MAP zone transitions to prevent oscillation between zones.
- Maximum Limit Factor:
- Deep Decel - MAP: Below this MAP activates deep decel strategy and enables steady state.
- Dynamic Air Filter: Filters the current airmass value before prediction filtering. If in steady state the current airmass value is MAF based, if in unsteady state the current airmass is VE based (using an offset based on the last calculated VE Correction Factor).
- EGR Test Disable Time: Time to disable dynamic airmass calculation after an EGR test.
- Cranking to Run Time: Time to transition and ramp from cranking airmass to dynamic airmass calculations.

Prediction Coefficients

- Dynamic Airflow Corrected Gain: Dynamic airflow gain used to calculate the corrected airmass.

- Dynamic Airflow Base Gain: Dynamic airflow gain for calculated corrected airmass component.
- Dynamic Airflow Current Gain: Dynamic airflow gain for current airflow from MAF or VE component.
- Dynamic Airflow Old Gain: Dynamic airflow gain for previous airflow from MAF or VE component.
- Dynamic Airflow MAP Current Gain: Dynamic airflow gain for current MAP component.
- Dynamic Airflow MAP Old Gain: Dynamic airflow gain for for previous MAP component.
- Dynamic Airflow MAP Old2 Gain: Dynamic airflow gain for second previous MAP component.
- Dynamic Airflow TPS Current Gain: Dynamic airflow gain for current TPS component.
- Dynamic Airflow TPS Old Gain: Dynamic airflow gain for previous TPS component.
- Dynamic Airflow TPS Old2 Gain: Dynamic airflow gain for second previous TPS component.

Steady State
A critical part of the dynamic airmass calculation is determination of when the engine is operating at a steady state condition or unsteady (transient) state. During steady state the PCM uses a filtered MAF signal as the basis for airmass calculations, the PCM also calculates a "VE Correction Factor" during steady state. The VE correction factor is simply the ratio of the MAF airmass to the VE airmass and is used to "offset" the VE calculated airmass when a transient is encountered.

During unsteady state, the PCM uses the VE table to calculate airmass and it is offset (multiplied) by the last calculated VE Correction factor. As long as the VE Correction factor is within limits it will accurately offset any differences between MAF and VE table airmasses and the transition between steady and unsteady (transient) prediction will be smooth.

- Hi/Lo RPM Threshold: This RPM threshold determines if High or Low steady state determination will be used. If MAP is greater than Hi/Lo MAP Threshold or RPM is greater than Hi/Lo RPM Threshold the High mode settings are used otherwise Low mode settings are used.
- Hi/Lo MAP Threshold: This MAP threshold determines if High or Low steady state determination will be used. If MAP is greater than Hi/Lo MAP Threshold or RPM is greater than Hi/Lo RPM Threshold the High mode settings are used otherwise Low mode settings are used.
- Lo - MAP Delta: Low mode, MAP change below this will enable steady state.
- Hi - MAP Delta: High mode, MAP change below this will enable steady state.
- Lo - TPS Delta: Low mode, TPS change above this will disable steady state.
- Hi - TPS Delta: High mode, TPS change above this will disable steady state.
- Idle - MAP Integ Time: Time that the steady state MAP integrator will run during the idle steady state routine before value is compared to Integrator Threshold to disable steady state.
- Idle - MAP Integ Threshold: If steady state MAP Integrator exceeds this threshold during idle steady state then steady state will be disabled.
- Idle - VSS Max: Vehicle speed must be below this to enable idle steady state determination.
- Idle - TPS% Max: Throttle position must be below this to enable idle steady state determination.
- Idle - MAP Int Time En: Time that the steady state MAP integrator will run during the idle steady state routine before value is compared to Integrator Threshold to enable steady state.
- Idle - MAP Int Thresh En: If steady state MAP Integrator is below this threshold during idle unsteady state then steady state will be enabled.

VE Correction Factor
The VE Correction Factor is used to maintain a relative offset between the VE calculated airmass and the MAF measured airmass to ensure smooth transition between steady state and unsteady state behavior. To protect against unstable behavior the VE correction factor has limits in place and a reset condition.

- VE Initial Correction Factor: Initial value of the VE correction factor, the ratio of the MAF airmass to the VE airmass.
- VE Correction Factor - Filter: This filter coefficient is used to filter the VE correction factor. Values closer to 1.0 mean the filtered value reacts faster to changes at the increased risk of instability.
- VE Correction Factor - Min: Minimum limit for the VE Correction Factor.
- VE Correction Factor - Max: Maximum limit for the VE Correction Factor.
- VE Correction Factor - Reset: VE Correction factor will reset to 1.0 if VE correction factor is less than this value during deep deceleration.

- Initial ECT Boundaries: Engine coolant temperature zone boundaries used to select initial VE correction factor value.
- Initial vs. ECT Zone: VE Correction Factor is initialized to this value based on barometric pressure and coolant temperature zone.