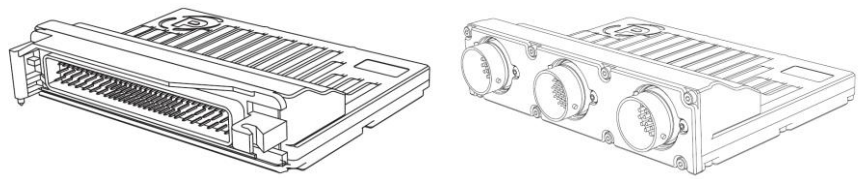




Technical Bulletin



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Abstract: Release of strategy for SQ6/M traction control. This document will give basic outline of the traction control system.

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1. TRACTION CONTROL

1.1 Slip Control Settings

STANDARD MAPPING > TRACTION CONTROL

These maps (1.1) all apply to both the Difference Based and Percentage Based strategies.

1.1.1 User Rev Limit

This map allows individual rev limits to be set for each position on the TCS pot. An entry of zero tells the ECU to use normal rev limit.

1.1.2 Slip Control Enable

The Traction Control System is only Enabled or Disabled at initialisation, so the map file MUST be re-programmed into the ECU if this setting is altered.

1.1.3 Slip Calculation Mode Threshold

This value is the speed (in Km) at which the calculation strategy changes from difference based to percentage based. If you want to use percentage based all the time (recommended) then set this value to zero.

1.1.4 Slip Control Gain

Slip Control Gain is a torque reduction (TCS_trq) multiplier that is configurable against RPM. The Slip Error is multiplied by this gain to calculate the Traction Control System Torque Reduction (TCS_trq). Therefore if you changed gain from 1.0 to 2.0 you would get twice the torque reduction for any given Slip Error.

NB a value of zero in this map will result in no torque reduction.

1.1.5 Slip Control Scale

This map applies another multiplier to the TCS_trq value (same as Slip Control Gain) but this gain is configurable against gear position.

If this feature is NOT required, set all values to 1.000.

1.1.6 Slip Control Clamp

This map sets a maximum limit on the calculated value of the Traction Control System Torque Reduction ("TCS_trq") and is configurable against RPM. TCS_trq is a percentage so the maximum possible entry is 100.

1.1.7 The Slip Control Demands

The following group of maps (1.1.7.1 – 1.1.7.5) allow you to reduce the amount of Torque Reduction specified in slip clamp. These multipliers are applied in order (see DIAGRAM 1). For example if the relevant entries in these maps were as follows:

MAP	Relevant Value	Cumulative TCS_trq
Slip Control Clamp	80	80
Slip Control Throttle Demand	100	80
Slip Control Steering Demand	50	40
Slip Control I_Accel_Vert Demand	100	40
Slip Control X_Damper Demand	80	32
Slip Control User Demand	95	30.4

So the end TCS_trq for this example would be 30.4%.

NB. If any of these values are zero then there will be no torque reduction. It should also be consider that if a lot of reductions are being made due to input conditions then the total TCS_trq can become too small. If this happens and you don't wish to alter the slip control demand tables you can use Slip Control Gain (1.1.4) to bring TCS_trq back to a desirable level. Always log TCS_trq whilst setting up the traction control.

1.1.7.1 Slip Control Throttle Demand

This map scales down the clamped "TCS_trq" value, as a function of the Throttle Position.

In some cases drivers/riders like to be able to induce slip at larger throttle openings so at large throttle angles you would put in a smaller percentage demand.

If this feature is NOT required, set all values to 100%.

1.1.7.2 Slip Control Steering Demand

This map scales down the clamped "TCS_trq" value, as a function of the Steering Angle.

This can be used to allow more torque reduction at larger steering angles (particularly useful in front wheel drive cars). To achieve this you would have a relatively small demand percentage at 0° and have it increasing with more steering lock (in both directions) to somewhere near 100% at full lock. Note that if you make the demand at 0° too small then the TCS will have little effect when the vehicle is in a straight line.

If this feature is NOT required, set all values to 100%.

1.1.7.3 Slip Control I_Accel_Vert Demand

This map scales down the clamped "TCS_trq" value, as a function of vertical acceleration.

This can be used to approximate lean angle on a bike with an increase in measured vertical G corresponding to an increase in lean angle.

If this feature is NOT required, set all values to 100%.

1.1.7.4 Slip Control X_Damper Demand

This map scales down the clamped "TCS_trq" value, as a function of front damper travel.

This map can be used to create an anti-wheelie strategy by having larger percentage demands as the damper approaches full extension.

If this feature is NOT required, set all values to 100%.

1.1.7.5 Slip Control User Demand

This map scales down the clamped "TCS_trq" value, as a function of the Traction Control Switch (TCS Pot) setting.

Be careful with this one as there are several other map that are affected by the position of the TCS_Pot (User Rev Limit; Goal Slip User Correction; Goal Slip User Multiplier; Slip Control User Demand). Make sure that you don't have these setup such that they conflict with each other (pull in opposite directions). It is always a good idea to check all of these maps before you alter one of them. Also make sure you're driver/rider knows what effect the position of this switch will have.

If this feature is NOT required, set all values to 100%.

1.1.8 Torque Decay Rate

This map entry controls how quickly the power is reinstated once the slip falls within the target threshold. The value entered specifies a maximum change in Torque Reduction (TCS_trq) over a 10ms period. 255 allows 100% change over the period and 0 allows no change.

Example – If this value is set to 85 then the torque reduction will decay at a maximum rate of 33.3% every 10ms so it will take 0.03s to reinstate full power after a 100% cut.

NB. This map should never be set to zero (and avoid very small numbers) otherwise the torque reduction will never decay.

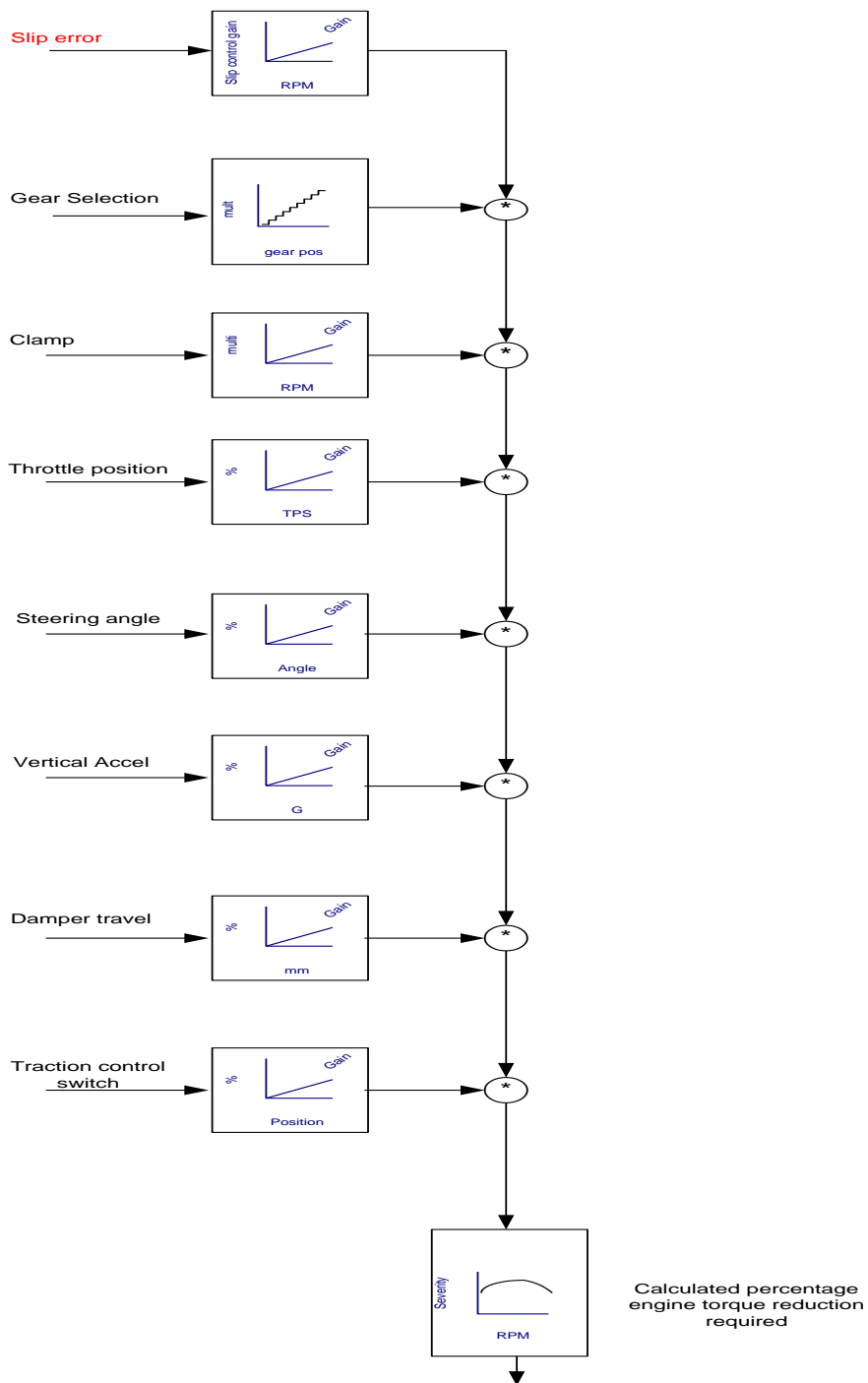


DIAGRAM 1

1.2 DIFFERENCE-BASED

The Maps in this section are only used by the ECU if speed is below the 'Slip Control Mode Threshold'. To use just the Difference Based maps set the threshold at a value that the vehicle will never achieve, conversely to disable these maps (and use only Percentage Based) set the threshold to zero.

1.2.1 Difference Based Slip calculation

Actual Slip = Speed of **Driven** Wheels - Speed of **Undriven** Wheels

Slip Error(tcsError) = Actual Slip - (Goal Slip + Goal Slip Corrections)

$((\text{tcsError (kph)} \times 6.5) \times \text{Slip control gain} \times \text{Slip control scale}) \times \text{Clamp} \times \text{Demands} = \text{TCS_trq}\%$

Maximum slip before clamp is 15.3KPH =100% (9.6MPH=100%) slip. Therefore to get TCS_trq percentage, multiply slip error KPH by 6.5 (MPH by 10.41)

1.2.2 Goal Slip Map

This map is the maximum allowed speed difference, between the driven and undriven wheels, that is used to invoke the Traction Control. Note that it must be configured to allow for the speed differences which will always occur as a result of any tyre distortions, due to the normal acceleration, braking and cornering forces experienced. It should be noted that the maximum error possible is 15.3 KPH (9.5MPH), after this point the error will be clamped.

Traction Control is invoked whenever Slip Error becomes positive.

1.2.3 Goal Slip Gear Correction

This is an adder to the Goal Slip Map, to allow adjustments to the slip target as a function of the Gear selected.

If this feature is NOT required, set all values to 0.0.

1.2.4 Goal Slip User Correction

This is an adder to the Goal Slip Map, to allow adjustments to the slip target as a function of the Traction Control Pot setting. Note that there are several maps that are affected by the position of the TCS Pot (User Rev Limit; Goal Slip User Correction; Goal Slip User Multiplier; Slip Control User Demand). Make sure that you don't have these setup such that they conflict with each other (pull in opposite directions). It is always a good idea to check all of these maps before you alter one of them. Also make sure you're driver/rider knows what effect the position of this switch will have.

If this feature is NOT required, set all values to 0.0.

Note that position "0" on the Pot always disables Traction Control.

1.3 PERCENTAGE-BASED

This group of maps applies only when the speed (in km) is over the 'Slip Calibration Mode Threshold'. To use the Percentage Based strategy at all times (recommended), set the threshold to zero.

1.3.1 Base Goal Slip Percentage

This map specifies the desired amount of slip of the driven wheels at varying speeds and throttle angles. There will be no torque reduction until the goal slip value has been exceeded. A value of 100% in this map means that the driven wheels are turning at twice the speed of the un-driven ones.

It is generally desirable to have more slip at lower road speeds and larger throttle openings. It should be noted that some vehicles running long gearing will require a lot of slip at low road speed to stop the TCS from pulling the engine below stall point. It is also worth bearing in mind that special launch torque reduction parameters can be setup to get the vehicle moving from a stand still in INPUT FUNCTIONS > START LINE LIMIT.

1.3.2 Goal Slip Gear Multiplier

Values entered here are multipliers applied to Goal Slip value depending on which gear you are in. You could for example have 1.5 as the first gear value so that the TCS does not reduce the torque until the slip is 50% more than specified in the Goal Base Slip Percentage map.

If this map is NOT required set all values to 1.0.

1.3.3 Goal Slip User Multiplier

This multiplier is applied after the goal slip multiplier and is dependent upon TCS_POT position. Note that there are several maps that are affected by the position of the TCS Pot (User Rev Limit; Goal Slip User Correction; Goal Slip User Multiplier; Slip Control User Demand). Make sure that you don't have these setup such that they conflict with each other (pull in opposite directions). It is always a good idea to check all of these maps before you alter one of them. Also make sure you're driver/rider knows what effect the position of this switch will have.

If this map is NOT required set all values to 1.0.

1.3.4 Slip Control Derivative Multiplier

This map allows you to apply a multiplier to the Goal Slip based on the rate of change of slip (%/s). The determination of the rate of change is described below in Slip Derivative Period.

If this map is NOT required set all values to 1.0.

1.3.5 Slip Derivative Period

This value tells the ECU over what period to look at the rate of change. The slip is always updated every 10ms but to see significant rates of change a slightly longer period needs to be observed. 50ms is a sensible starting point and compares the current slip with the slip 50ms ago to give a rate of change. This rate of change is then updated every 10ms.

Overly small values will give poor resolution and overly large ones will cause lag.

1.4 Torque transfer functions

Found in standard mapping

1.4.1.1 Cylinder Cut

This map determines the Traction Control Cylinder Cut Rate, as a function of the calculated "TCS_trq" value. A value of 50 in the 80% column would mean half of the cylinders are cut when the calculated TCS_trq is 80%. See also 1.5.1 where the type of cut is specified (ie fuel or ignition).

1.4.1.2 Ignition Retard

This map determines the Traction Control Ignition Retard, as a function of the calculated "TCS_trq" value. This is a figure in degrees. Retarding the ignition will give smoother torque reduction than cuts, but could cause excessive exhaust temperatures so it is advisable to consult your engine tuner as to what strategy to employ.

1.4.1.3 Injection Multiplier

This map determines the Traction Control Injection Multiplier, as a function of the calculated "TCS_trq" value. So a value of 0.5 would give you 50% of the injector time. Again there are obviously dangers in running too lean for too long so consulting you engine tuner is advisable.

1.4.1.4 Lambda Target Reduction

This map is used to correct the lambda target, to prevent the closed loop lambda control from removing the effect of the Traction Control Injection Multiplier.

1.5 Torque reduction

Found in software setup

1.5.1 Traction Control Torque Reduction Mode

This map selects which technique (fuel or ignition) is used to cut cylinders during traction control and will be used for the **Cylinder Cut**. See also 1.4.1.1

1.6 Wheel speed inputs

Found in INPUT FUNCTIONS > WHEEL SPEED INPUTS

For more information on wheel speed sensor setup, consult document: SQ6_SQ6M_TB001 Dynamic Wheelspeed Algorithm Configuration.

1.6.1 Vehicle Speed Wheel Select

This map selects which wheel speed input is used to determine the vehicle speed. This speed is used in the **Pit Lane Speed Limit** function, Speed dependant multiplier maps, ect, as well as Traction Control. If all four wheels have speed sensors, then FRONT_SPEED is the average of both front Speeds.

1.6.2 Driven Wheels Select

This map is used to determine which wheels are driven by the engine.

1.6.3 Driven Wheels Slip Filter

A recursive filter value which is used to calculate the driven wheel speed, after the Driven Wheel Diff Scaling has been applied. This filter is used to filter out drive line shunt and noise on the wheel speed signal.

This is a recursive filter, which is applied to the signal. Values of 0 to 100% can be entered in 0.1% increments. The following formula is used: $V_c = V_p - (V_p - V_c - 1) \times \frac{\text{Filter}}{100}$. Described in %

1.6.4 Undriven Wheels Slip Filter

A recursive filter value which is used to calculate the undriven wheel speed from the maximum of the individual undriven wheel speeds. This filter is used to filter out noise on the wheel speed signal.

This is a recursive filter, which is applied to the signal. Values of 0 to 100% can be entered in 0.1% increments. The following formula is used: $V_c = V_p - (V_p - V_c - 1) \times \frac{\text{Filter}}{100}$. Described in %

1.6.5 Driven Wheel Diff Scaling

This map determines how the Driven Wheel Speed is calculated:

- 0% = Maximum of the individual driven wheel speeds
- 50% = Average of the individual driven wheel speeds
- 100% = Minimum of the individual driven wheel speeds

1.6.6 Wheel Stop Timeout

If no teeth are seen by the wheel speed sensor for this period the wheel speed is sets to 0.

1.6.7 Wheel Speed Signal Error Timeout

If there is no signal from a wheel speed sensor while other wheels continue to turn an error timer is started. If this timer elapses an error is flagged and the sensor disabled. Traction control will also be disabled.

1.6.8 Wheel speed sensor setup

1.6.8.1 Sample count

This sets the number of teeth counter before the interrupt. This will affect the resolution of the wheel speed. If the number of teeth is 20 and the sample count is 20 then the ECU will review the wheel speed once every revolution.

1.6.8.2 Number of teeth

This map sets the number of teeth on the wheel speed trigger

1.6.9 Front Tyre Diameter

This map sets the tyre diameter of the front wheels. This must be set correctly to enable correct measurement of car speed.

1.6.10 Rear Tyre Diameter

This map sets the tyre diameter of the rear wheels. This must be set correctly to enable correct measurement of car speed.

1.7 Setting-Up Traction Control

When trying to set up the Traction Control you should always Log TCS-trq and also the associated channel of any map which you have not flattened out. For example if you configured Slip Control User Demand so that there is more torque reduction with more steering angle, then you should log 'tscDemandSteer'. The channels that relate to the TCS maps are all found in the TRACTION CONTROL section of the logable channel list in Offload Tool.

Some additional help may be available in the map by pressing 'F1' on the keyboard.

For further help and for all other enquires please contact Pectel Customer Support.

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