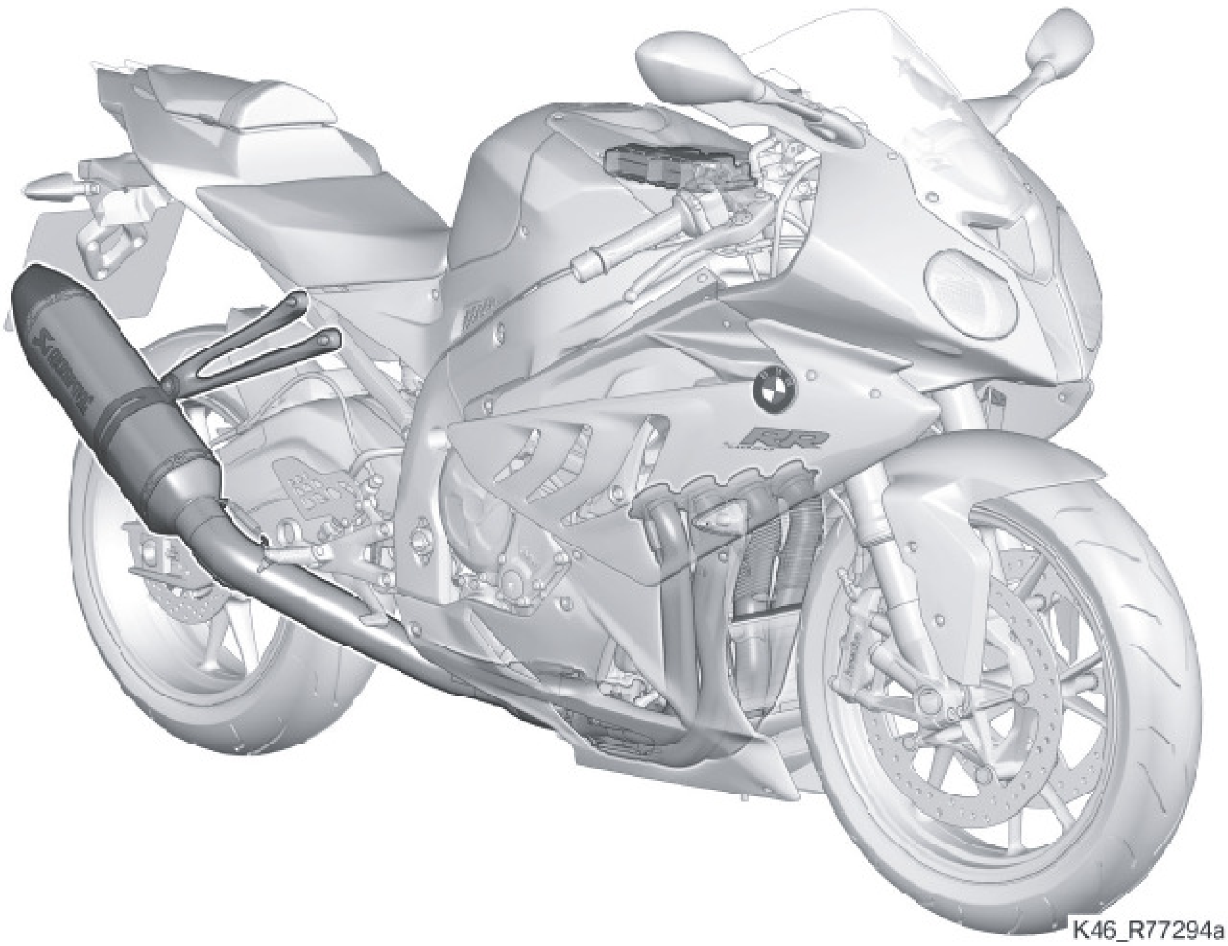
BMW Motorrad – HP Race Calibration

(Help version: 20100621)



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Warnings

Attention:

With this BMW product you influence your motorcycle's on-board electronic systems to a very significant extent. Changing parameters to settings other than standard can lead to critical riding situations for which BMW Motorrad cannot provide safeguards.

Warning:

The use of this product can change the motorcycle's handling in such ways that injury to life and limb and/or damage to equipment can occur.

Notes:

- Do not use this product if you lack the requisite experience and training.
- Influencing the electronic engine management system with this product can have serious results for rider and machine. The durability of the engine can be significantly reduced. Engine damage can occur. Always be sure to read and comply with the notes in the Rider's Manual.
- The BMW HP Race Calibration software can be used only with the corresponding electronic engine management unit and BMW adapter cables. The software is not suitable for use with other parts.
- Do not attempt to use a motorcycle modified by BMW HP Race Calibration anywhere other than on closed racing circuits; do not use the machine on public roads.

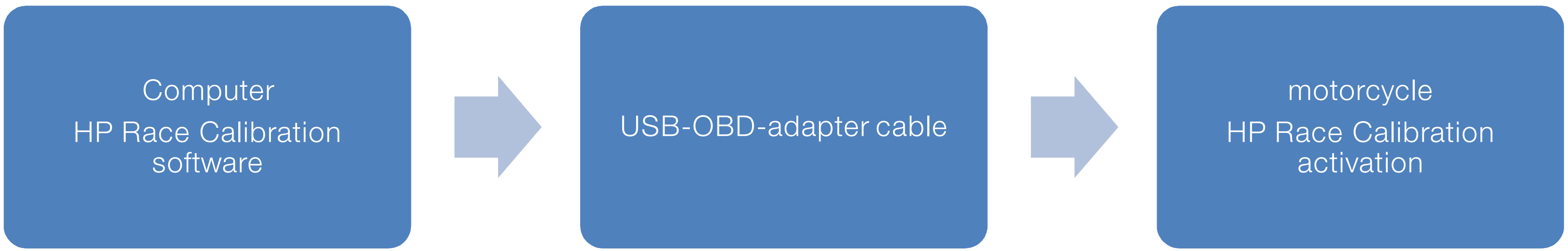
Introduction

The BMW Motorrad HP Race Calibration software makes it possible to adapt various functions of the electronic engine management system and the suspension and running-gear control systems. This means that modifications to the motorcycle (e.g. exhaust system, tyres) or rider preferences can be taken into account in the setup.

The following functions can be adapted:

- Injection
- Ignition
- DTC ^{OE}
- Shift assistant
- Pit-lane rpm limiter
- Adaptation

Components



Installation

See the installation guide.

Working with HP Race Calibration

This software enables you to create and edit data records that contain adaptations for the various functionalities.

User interface

The user interface of the HP Race Calibration software is made up of several sections.

Menu bar

The menu bar provides access to all the functions, help and settings. The keyboard shortcuts, if any, also appear here.

Toolbar

The toolbar provides quick access to the frequently used functions. You can hide this bar by selecting Options → Toolbars from the menu.

HP Race Calibration bar

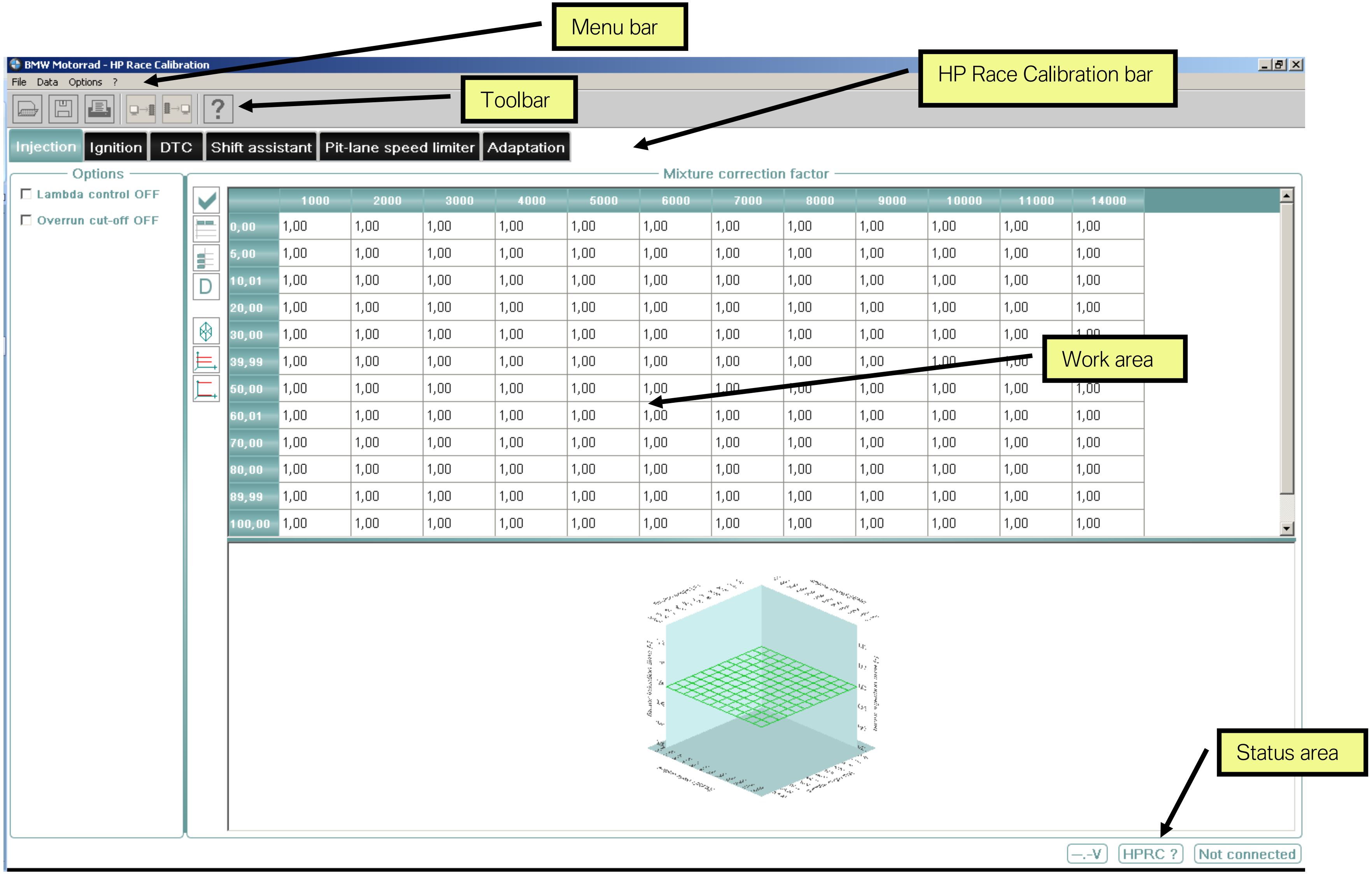
You can hide this bar by selecting Options → Toolbars from the menu.

Work area

The work area varies, depending on the subject area you select. The tabs above the work area enable you to select the work area you want.

Status area

The status area shows information about communication with the motorcycle.


Menu bar
HP Race Calibration bar
Toolbar
Work area
Status area
BMW Motorrad - HP Race Calibration
File Data Options ?
Injection
Ignition
DTC
Shift assistant
Pit-lane speed limiter
Adaptation
Options
Lambda control OFF
Overrun cut-off OFF
Mixture correction factor

	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	14000
0,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
5,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
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20,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
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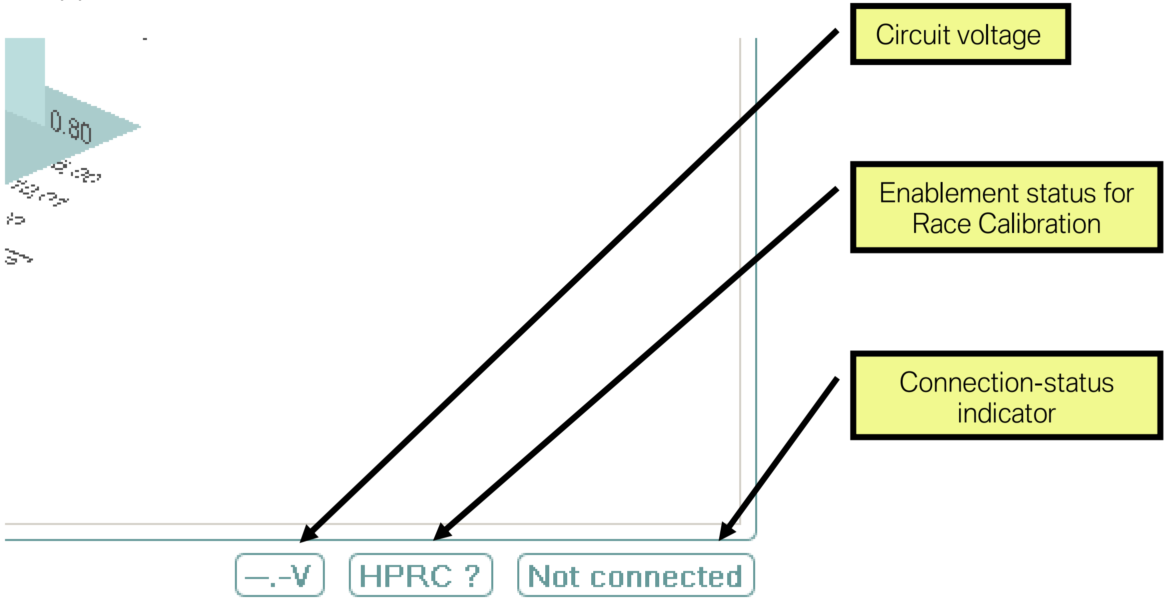
39,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
50,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
60,01	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
70,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
80,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
89,99	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
100,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

--.-V
HPRC ?
Not connected

Connection to the motorcycle

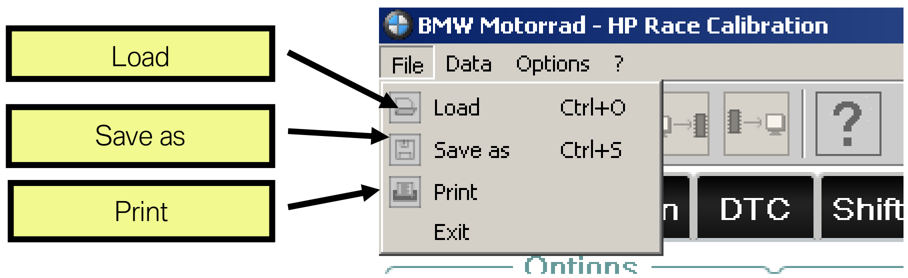
You can work on the settings in the data records without actually connecting to the motorcycle. The connection does not have to be established until you are ready to transfer the data to the motorcycle's ECU or want to download data from the motorcycle to the computer. You establish the connection by plugging the USB-OBD adapter cable into the computer and into the motorcycle's diagnosis connection. Communication does not commence until the ignition has been switched on. Communication status, status of enablement in the engine's electronic management system for the Race Calibration software and the circuit voltage in the motorcycle's on-board electrical system all appear on screen in the status area.

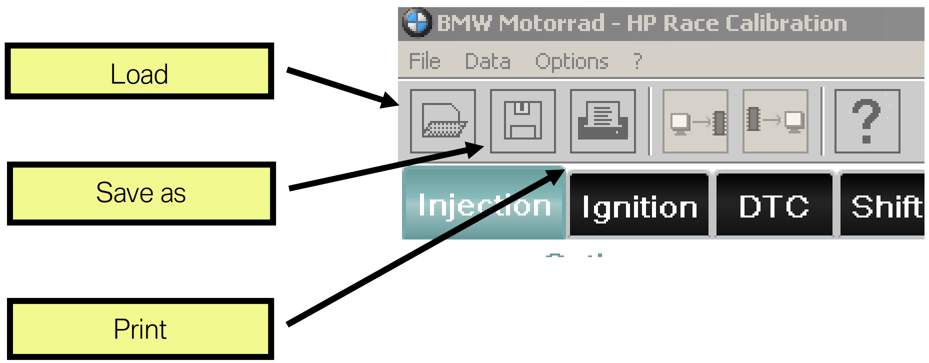


You can configure the connection by selecting Options → Communication in the menu bar. In this example the COM port is selected.

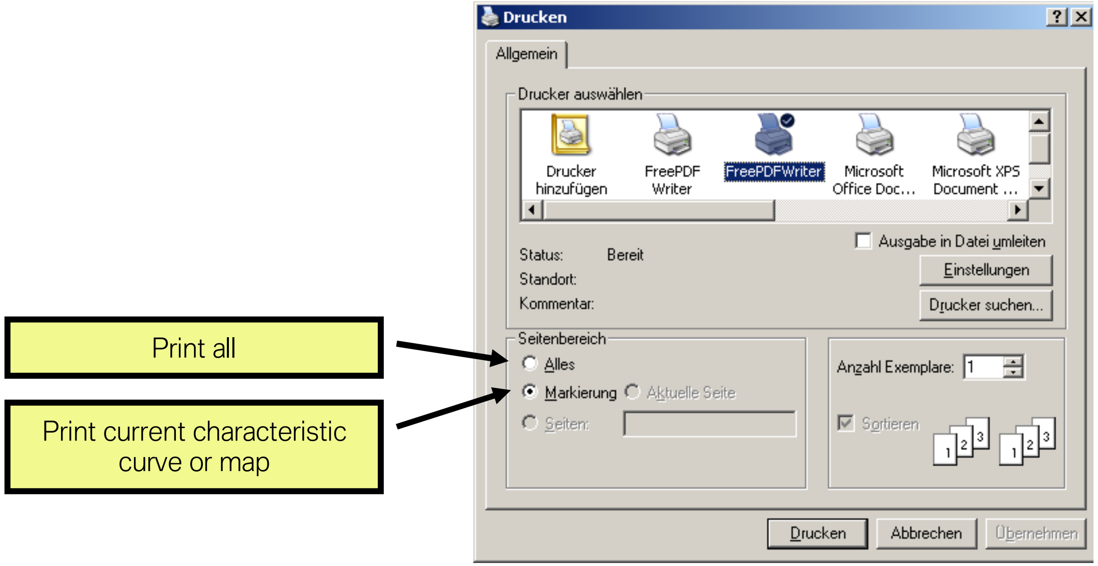
Loading/saving/printing data

You can save a data record in a file or load a record from a file. This enables you to administrate a library of data records and exchange records with other users. Access to the data-administration functions is via the menu or the toolbar. Note that you always load or save an entire data record.





You have the option of printing data. You can print out either the current characteristic curve/characteristic map or all data.



Writing data to the ECU / reading from the ECU

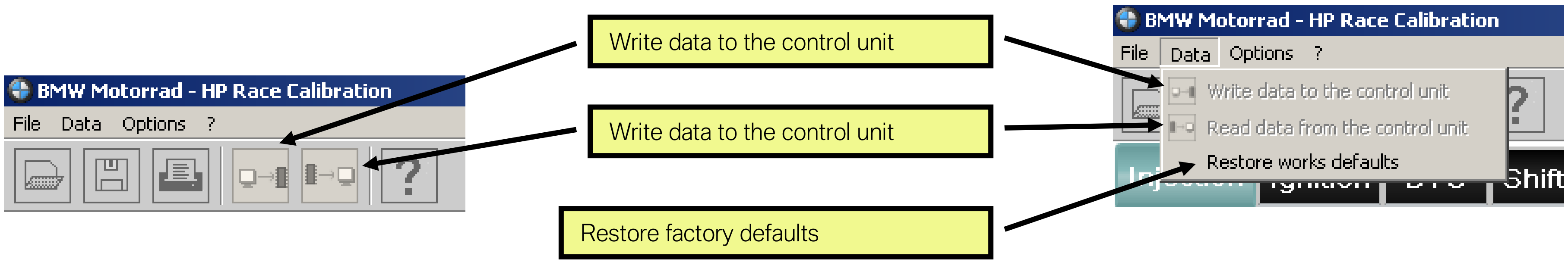
You can transmit the current data record from the HP Race Calibration software to the motorcycle's electronic control unit (ECU). Once it has been transmitted in this way the data record is active in the ECU and remains so until subsequently overwritten. If the ECU already contains a data record this original record is overwritten when you transmit a new data record. You cannot transmit data records to an ECU unless the ECU has been enabled accordingly by an authorised BMW dealer. Changes you make in the HP Race Calibration software are not active in the motorcycle until you have written them into the ECU. Note that the data record is always transmitted in its entirety.

Conversely, you can also read the current data record from the motorcycle's ECU. When you do this the data record imported from the motorcycle overwrites the data record in the HP Race Calibration software. Note that under these circumstances too, the data record is always transmitted in its entirety.

Access to the functions for reading and writing data records is via the menu or the toolbar. Reading and writing are possible only when the motorcycle is connected to the computer by the USB-OBD adapter cable, the ignition is ON and the engine is NOT RUNNING. The corresponding buttons are greyed and inactive unless all these preconditions are satisfied.

Restoring factory defaults

The menu also enables you to restore the factory default settings for parameters changed beforehand with the HP Race Calibration software. Note that all the changes in the entire data record are cancelled in this way. In this case too, the factory defaults are not actually restored in the motorcycle's ECU until you write the data to the control unit as described above.

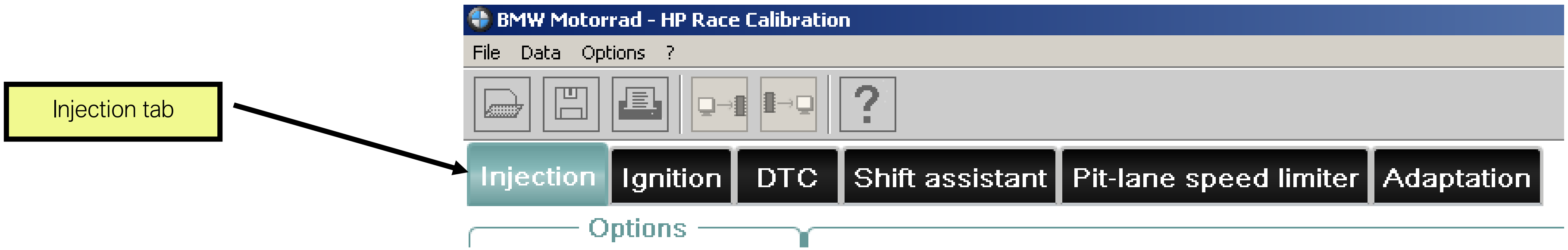


Editing data

A data record consists of a fixed number of editable parameters. These parameters represent a subset of the engine-management and suspension and running-gear control functions implemented in the motorcycle. The functions you can influence in this way are grouped in the following subject areas.

- Injection
- Ignition
- DTC [OE]
- Shift assistant
- Pit-lane rpm limiter
- Adaptation

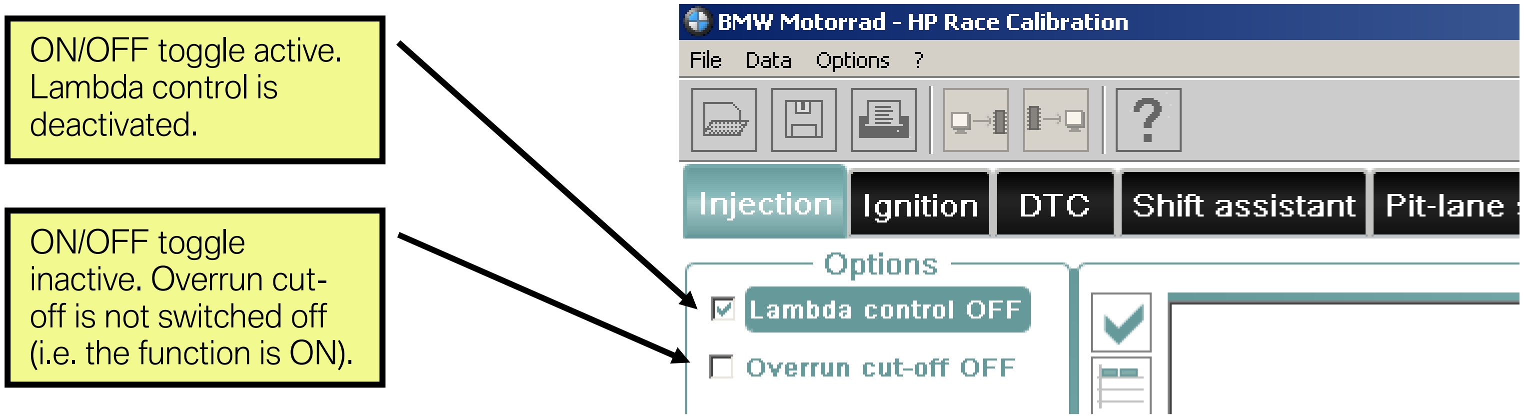
Each of these subject areas has its own tab below the toolbar and clicking on a tab will show you the parameters you can change for the given subject area. Click on a tab of your choice to take you to the corresponding subject area.



There are 4 kinds of parameter that you can change. Your changes show up right away in the HP Race Calibration software. The changes are not actually implemented in the motorcycle's systems until you transfer the data from the computer to the electronic control unit.

1. Option ON/OFF toggle

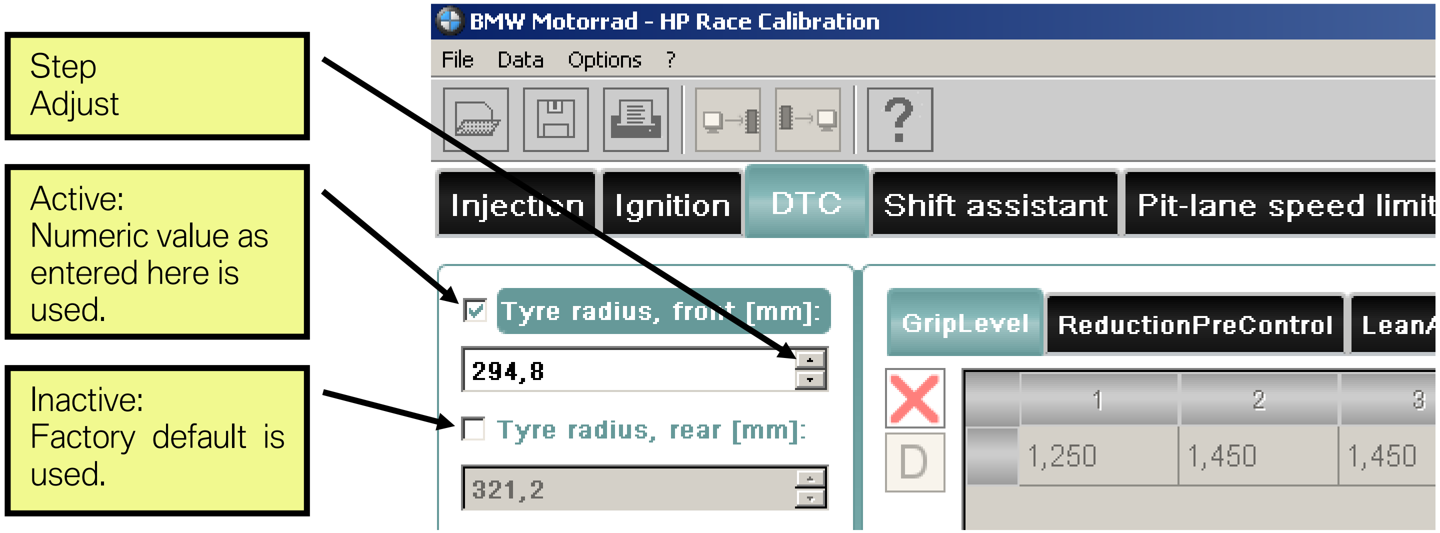
Each ON/OFF toggle has a checkbox, which you can activate or deactivate, with an explanatory text to the right. An ON/OFF toggle can only be either active or inactive. The active state is indicated by a tick in the checkbox: you toggle between the active and inactive states by clicking on the checkbox. The text beside the checkbox explains the significance of the option you switch on by activating its checkbox.



2. Characteristic values

Each characteristic value has a checkbox, which you can activate or deactivate, with an explanatory text to the right and, below the checkbox, a field that will accept a numeric entry and has 2 arrow buttons.
Characteristic values have to be activated. Ticking the checkbox activates the characteristic value and you can then change the value in the field for the numeric entry. You can use the computer keyboard to enter digits. The system automatically substitutes a comma for a period to avoid confusion with the decimal separator. You can increment or decrement the number in the field by clicking on the up/down arrows beside it. You also have the option of using the computer's Clipboard to copy and paste. There is also a popup menu

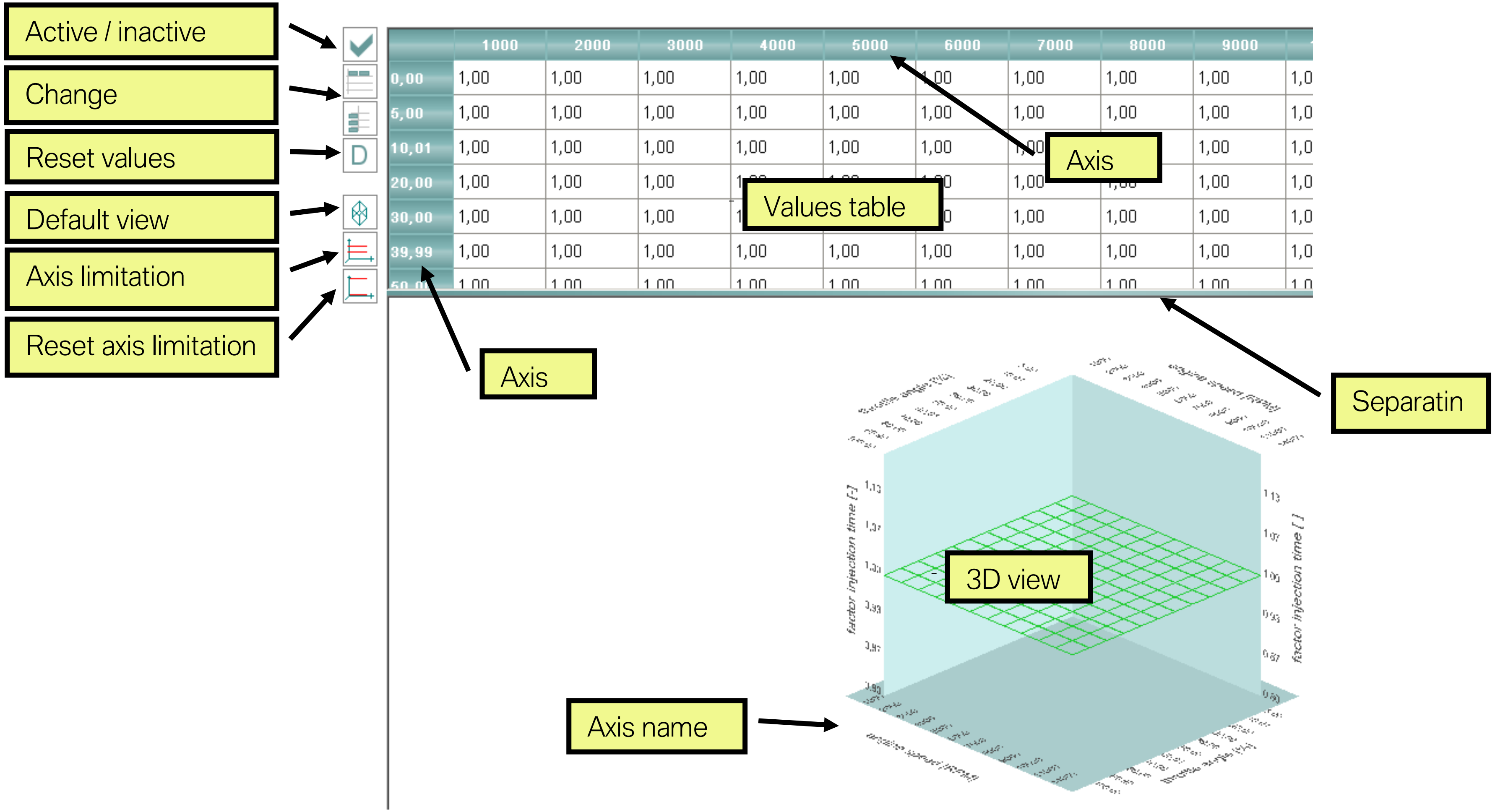
for accessing some of the options that can be entered here. All your entries have to be within a permissible range and permissible step size.
If a characteristic value is not activated its numeric-entry field is greyed and changes cannot be made. Note that under these circumstances the motorcycle uses the factory defaults for the parameter in question, not the value in the greyed field.



3. Characteristic maps

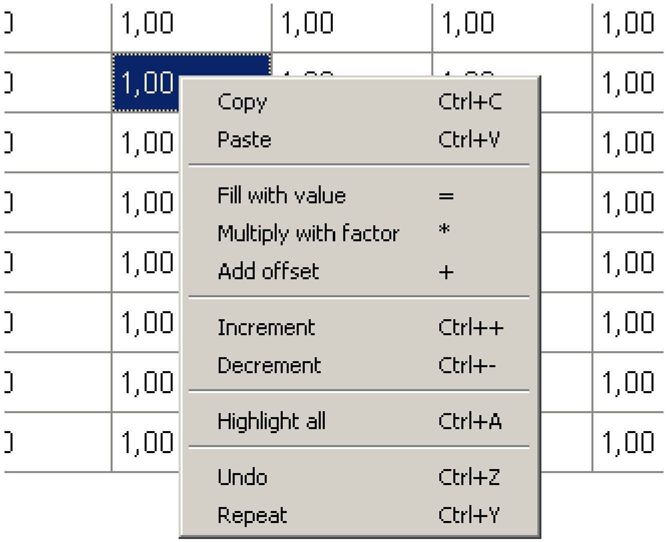
Each characteristic map has a checkbox, which you can activate or deactivate, a values table, a three-dimensional graphic and various buttons.
Characteristic maps have to be activated. Toggling the red X to a tick activates the characteristic map and the numeric-entry fields then accept entries. If a characteristic map is not activated its numeric-entry fields are greyed and changes cannot be made. Note that under these circumstances the motorcycle uses the factory defaults for the parameters in question, not the values in the greyed field.
A characteristic map consists of 2 axes and a values table. Each axis has an input value that corresponds to a variable you can influence in the motorcycle's ECU. The current values of the two input variables are used to calculate the point on the characteristic map at which the current operating point is located and this value is used to select the applicable value from the values table. Linear interpolation is applied if an input value does not correspond exactly to a value on the corresponding axis. The 3D view shows you

which input variables are represented by the axes of the characteristic map. For example, the map might show momentaneous values such as engine rpm.



The axes and the values table can be changed when the characteristic map is active. You can change the axes by opening an interpolation point editor by clicking the button to the left of the values table. You can make changes directly in the values table.

Use the mouse or the keyboard to highlight one or more cells and then make your changes. You can use the computer keyboard directly to enter digits. The system automatically substitutes a comma for a period to avoid confusion with the decimal separator. There are also a number of options for adjustment that you can access by opening the pop-up menu. The pop-up also lists the corresponding keyboard shortcuts.



You can increment or decrement the number in the field by clicking on the up/down arrows. Once you have highlighted cells, moreover, you can apply common functions such as filling the fields with values, multiplying or adding.
You also have the option of using the computer's Clipboard to copy and paste. This enables you to use other programs as editors to work with the data.
You can click on the button to the left of the values table to reset the values table and the axes to the default settings. This reset has no effect on the rest of the data record.
All your entries have to be within a permissible range and permissible step size.

The characteristic map is shown in graphic form in the 3D view. You can move the separating line between the map and the values table if you want to zoom the view. Use the left mouse button if you want to rotate the view. Clicking the right mouse button or clicking on the button to the left of the values table restores the default view. If you want to optimise the 3D view you can click on the **Axis limitation** button (to the left of the values table) to change the minimum/maximum values of the Z axis. This change affects only the 3D view; it has no effect on the data record as such. Click on the **Reset axis limitation** button (to the left of the values table) to undo axis limitation.

4. Characteristic curves

Characteristic curves are similar to characteristic maps in many ways. The difference is that they have only one input variable and consequently only one axis. This in turn means that the graphic view is two-dimensional.
There are some characteristic curves that do not admit changes to the axis, because the input variable accepts only fixed values that are all defined on the default axis (DTC mode, for example).

Notes on DTC retrofit

If the motorcycle to which the HP Race Calibration software is connected does not have DTC, the options for the DTC variables are greyed. When you transmit a data set to the motorcycle these variables are included in the transmission but they are inactive. This is to ensure that if DTC is retrofitted, the DTC factory default settings are active.

Notes on use

The procedures for making adjustments are detailed below, with each individual subject area dealt with in turn. To begin with however there are a few notes that apply regardless of the subject area, and since they relate to your safety and will facilitate your work you should read them carefully and bear them in mind.

- ***Keep parameters smooth***
  When making changes to characteristic maps and characteristic curves, make sure that the transients are always smooth and harmonious. "Steps" or "corners" are discontinuities in the data that will produce unexpected and potentially dangerous sudden changes in the way your motorcycle behaves. Always check the 3D or 2D view to make sure that the parameters are smooth.
- ***Proceed step-by-step***
  If you cannot immediately identify the optimum value, use a step-by-step approach and make gradual changes to the parameter. Tyre size, say, merely has to be measured and the appropriate size entered. If you are optimising the data for a DTC correction map, however, you have to implement a loop and make a succession of small changes with a test ride after each change to verify your progress. Always work step by step until you arrive at the optimum setup, instead of trying to make a single big change.
- ***Save and document the intermediate stages***
  Regularly save your data records in files and note down with as much precision as possible what you have achieved with each data record and where there is still scope for improvement. If you take this precaution you will always be able to return to a known set of circumstances and make comparisons that will help you draw useful conclusions.

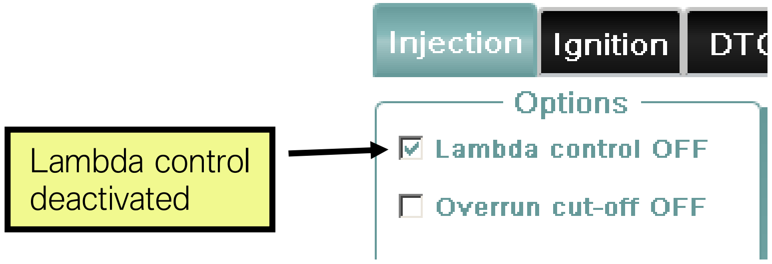
Injection

The "Injection" tab enables you to adjust a number of parameters that influence fuel injection.

Lambda control OFF

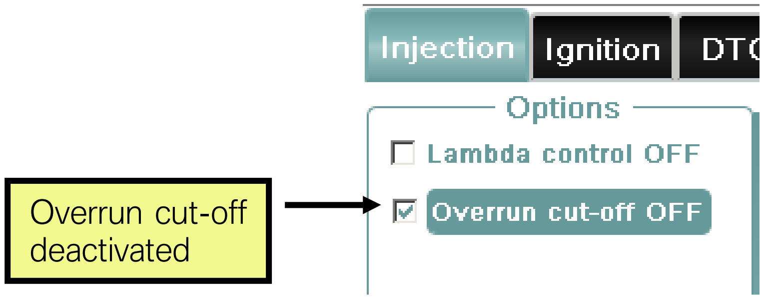
The lambda control system analyses the signals from the oxygen sensors fitted as standard in the exhaust system and corrects fuel injection timing in order to achieve a stoichiometric fuel/air ratio for combustion.

You have the option of deactivating lambda control, assuming that it is active in the motorcycle's ex-works condition. The absence of a tick for not active in the checkbox for ex-works condition does not necessarily mean that lambda control is active. It merely means that the ex-works condition has not been changed. Whether or not lambda control is active depends on the exhaust system mounted on the motorcycle. If the exhaust system includes the standard oxygen sensors, lambda control is active ex-works. Only in this case can you deactivate it.
Deactivating lambda control is of practical assistance if you want to vary the fuel/air ratio in a way that changes it from the stoichiometric default. You can then change the injection timing without lambda control intervening and cancelling out your changes.
You can deactivate lambda control by ticking the box in front of **Lambda control OFF**.



Overrun cut-off OFF

When the throttle twistgrip is snapped closed with the engine at high revs, the overrun cut-off function completely stops the supply of fuel to the engine to save fuel and reduce exhaust emissions.
Under these conditions combustion ceases and the inertia of the entire drivetrain serves to slow the motorcycle.
Deactivating overrun cut-off is practical if you want to reduce this deceleration of the motorcycle when you snap the throttle closed. With the overrun cut-off function deactivated fuel injection continues, with the engine receiving the amount of fuel that corresponds to the flow of inducted air. Under these circumstances you can vary mixture control and firing angle to influence combustion and consequently the way in which the motorcycle is slowed.
You can deactivate overrun cut-off by ticking the box in front of **Overrun cut-off OFF**.



Mixture correction factor

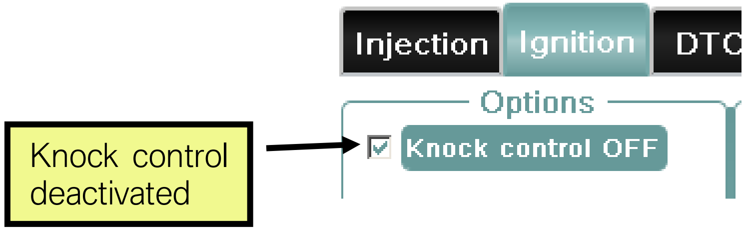
The **Mixture correction factor** characteristic map enables you to correct the injection times computed by the electronic engine management system. The electronic engine management system computes injection times that produce optimum combustion for the motorcycle's standard ex-works setup. Various fuel/air ratios (lambda) for combustion are achieved in this way; these ratios depend on the engine's operating point.
If you have modified the motorcycle in a way that changes the volume of air inducted to the engine (e.g. exhaust system) or if you want to use a fuel/air ratio other than this ex-works optimum, this characteristic map enables you to apply a multiplication factor to the computed injection times. Values greater than 1 prolong injection time and increase the volume of fuel injected, making the fuel/air mixture richer. Values less than 1 have the opposite effect. A value of 1 means no change to the injection times computed by the engine's electronic management system.
The correction factor can be stored in the characteristic map as a function of engine rpm and throttle-valve angle. Bear in mind that the fuel/air ratio has a very significant effect on engine behaviour (misfiring) and the temperatures of various components (e.g. pistons, exhaust valves). Particularly at high engine rpm and wide throttle-valve angles, it is advisable to make only such changes as compensate for changes to the volume of air inducted. You are advised to use suitable means of measuring lambda (excess oxygen) so that when you make changes to the data of the characteristic map you will achieve the optimum fuel/air ratio.
The correction factor is applied equally to all injection valves.

Ignition

The "Ignition" tab enables you to adjust a number of parameters that influence ignition output.

Knock control OFF

Knock control analyses the signals from the knock sensors and corrects the firing angle to avoid engine knock in the combustion process (see below).
You can deactivate knock control if you want to suppress these interventions in firing angle. Knock control intervenes only in circumstances in which knocking combustion occurs, so it is advisable not to deactivate it. It is not necessary to deactivate knock control in order to influence ignition output.
You can deactivate knock control by ticking the box in front of **Knock control OFF**.



Ignition correction offset

The **Ignition correction offset** characteristic map enables you to correct the ignition times computed by the electronic engine management system.
The fuel/air mixture inducted into the cylinders is ignited by the spark plugs to initiate combustion. The time of ignition is selected in such a way as to optimise as effectively as possible the conversion of the energy in the fuel into torque. The firing angle is stated in crankshaft degrees before top dead centre (TDC). Drift away from the optimum leads to non-optimised combustion and thus to a reduction in torque, can lead to major engine failure and can reduce the lifespan of the engine.
If you have modified the motorcycle in a way that changes the optimum ignition timing (e.g. exhaust system) or if you want to reduce optimum torque, this characteristic map enables you to apply an offset to correct the computed firing angles depending on engine rpm and throttle-valve angle. Like the firing angle itself, the offset is stated in crankshaft degrees before top dead centre. The correction offset is applied equally to the firing angles of all cylinders. Values greater than 0 advance ignition timing and thus increase the risk of

engine knock. Values less than 0 retard ignition timing and have the effect of reducing torque from the optimum. A value of 0 means no change to the firing angles computed by the engine's electronic management system.

Advancing the ignition too far can lead to the phenomenon known as engine knock at many operating points. Under these circumstances self-ignition occurs inside the combustion chamber in zones of the mixture not yet reached by the combustion triggered in the regular way by the spark plug. Extremely high pressures are produced, leading very rapidly to irreparable damage to engine components on account of excess temperatures and pressure surges. Retarding the ignition too far increases the risk of the exhaust valves and other components in the exhaust system overheating, which again can result in severe damage to the engine. Particularly at high engine rpm and wide throttle-valve angles, it is advisable to exercise great caution and proceed only very gradually when making changes. Do not deactivate knock control. It intervenes only in circumstances of knocking combustion that it is absolutely essential to avoid.

Use ignition correction primarily to influence engine operation at the low end of the throttle-valve angle range.

DTC

DTC sensors

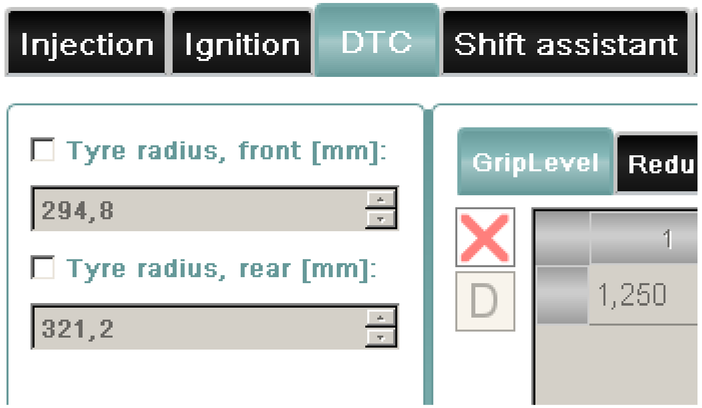
The wheel-speed signals from the ABS control unit and the sensor box signals for calculating the lean angle are used for the DTC function. In order for the function to operate correctly it is important that the sensor box is correctly positioned and that the sensor-to-ring spacing is correct and that the sensor rings are free of damage. Damage to the sensor ring or radial or axial out-of-round can lead to signal disruptions. The front and rear sensor rings must each have 48 uniformly distributed flanks / teeth made of magnetic material and the same number of inter-tooth gaps. The sensor box installs with the connector pointing vertically down and the black baseplate facing to the rear as viewed in the forward direction of travel. Nonconformances with the details above will result in errors in measurement and even implausible lean angles.

Procedure for application

The first step is to determine the correct tyre radii (**tyre radius front [mm]** and **tyre radius rear [mm]**). The next step is to determine the limit of grip (**GripLevel**). Later on distinctions can be drawn as to how traction control works and a more aggressive setting used. Later, too, the wheel speed transients can be used to decide whether control intervention is the result of a wheelie or a slipping wheel. The lean angle threshold (**LeanAngleDTCon**) can be adapted as necessary for each mode on the basis of the measured angle of lean, so that a wheelie does not reduce engine power to a troublesome extent. Fine-tuning for the specifics of a given racing circuit is possible in the **SlipCor** characteristic maps, using the information about lean angle and the speeds stored for the track sectors.

Tyre radii

In order for the process to compute wheel speed correctly, the radii of the front and rear tyres for riding in a straight line have to be entered (**Tyre radius front [mm]** and **Tyre radius rear [mm]**).



Tyre pressure has to be factored into application and into evaluation of slip. It has an effect on tyre stiffness and consequently on actual rolling radius. You can check and, if necessary, correct the tyre-radius entries by letting the motorcycle roll forward in a straight line with the clutch lever pulled and without heeling the motorcycle away from the upright position. If the entries for radius are correct the speed will be the same for the front wheel and the rear wheel (measured variables **V_FW** and **V_RW**). Speed-related differences have to be allowed for or corrected in the **SlipCor Mod 1-4** characteristic maps. A rear wheel radius entry that is smaller by 1% produces 1% more slip across all ride modes.

Grip limit – GripLevel

Grip can be entered separately for each mode in the **GripLevel** characteristic curve. At this time only the first 4 modes can be actuated. These 4 values are used exclusively for the next characteristic map, **ReductionPreControl**.

The recommended procedure to ascertain the grip limit is to start with an oversize rear-wheel radius (control intervenes earlier, because more slip is computed) and work gradually toward the limit of grip from the safe side. This entails gradually stepping down the value for the current mode in the **GripLevel** characteristic curve until the motorcycle starts to break away. Similarly, the lean angles should be reduced to low values in the **LeanAngleDTCon** characteristic curve.

Torque precontrol - ReductionPreControl

Torque precontrol calculates how close the motorcycle approaches to the limit dictated by the Kamm braking circle. In the **ReductionPreControl** characteristic map you can influence torque reduction as a function of engine speed and utilisation of the applied coefficient of friction. The applied values are fully effective in 1st gear only. In 2nd gear 20 is added to the characteristic map, 34 in 3rd gear and then 50 for the other gears. The system interprets any value in excess of 100 as 100% (maximum).

The factory defaults are applied in such a way that with the BMW Akrapovič exhaust from the HP Race Power Kit, acceleration for the full-load line is constant in 1st gear as of about 4000 rpm and with a maximum coefficient of friction. The advantage of precontrol is that slip control does not produce any unsteadiness in the suspension and running gear.

GripLevel | ReductionPreControl | LeanAngleDTCon | SlipCor Mod 1 | SlipCor Mod 2 | SlipCor Mod 3 | SlipCo

	70,00	75,00	80,00	85,00	90,00	95,00	98,00	100,00
2000	100,1	100,1	100,1	100,1	100,1	100,1	100,1	100,1
4000	100,1	100,1	100,1	100,1	100,1	98,9	98,0	94,9
5000	100,1	100,1	100,1	100,1	98,0	94,9	93,1	91,9
6000	100,1	100,1	100,1	98,9	96,1	91,9	89,1	87,0
7000	100,1	100,1	98,0	94,9	90,9	89,1	87,0	85,1
8000	100,1	98,0	98,0	91,9	89,1	87,0	85,1	83,9
10000	100,1	98,0	94,9	90,9	87,9	86,1	83,9	83,0
11500	100,1	98,0	94,9	90,9	87,9	86,1	83,9	83,0
12000	100,1	98,9	96,1	91,9	89,1	87,9	86,1	85,1
13500	100,1	100,1	98,0	94,0	91,9	90,0	87,9	87,9

Precontrol can be deactivated as follows: In the **GripLevel** characteristic curve set all values to 1.95 (maximum) and use 100 for the entire **ReductionPreControl** characteristic map.

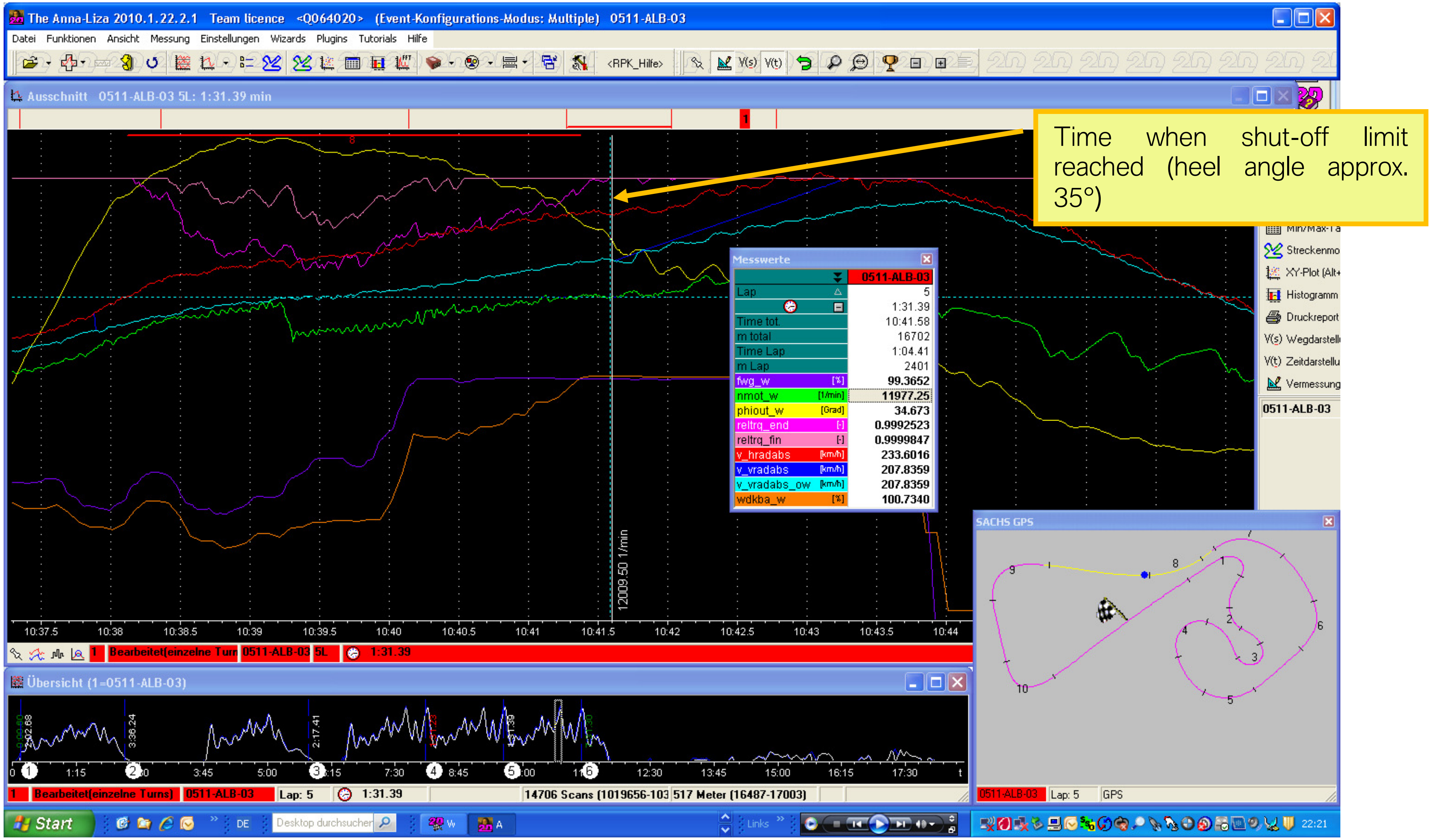
Angle of lean for power reduction - LeanAngleDTCon

On a race circuit, traction control is needed only when the motorcycle is heeled over to an extreme lean angle. As the motorcycle is lifted back toward the upright only the front wheel tends to lift off the ground (wheelie). The ECU is deceived into computing circumferential slip that hinders forward propulsion. Consequently, on a mode-specific basis you can apply a limit for the lean angle below which traction control is deactivated. This limit is applied in the **LeanAngleDTCon** characteristic curve to suit the individual mode. A new reference speed (measured variable **V_REF_FW**) is calculated, differing from the true front wheel speed (measured variable **V_FW**). The measured variable **V_REF_FW** is limited to a maximum that cannot exceed the rear wheel speed (measured variable **V_RW**).

These variables are shown below:

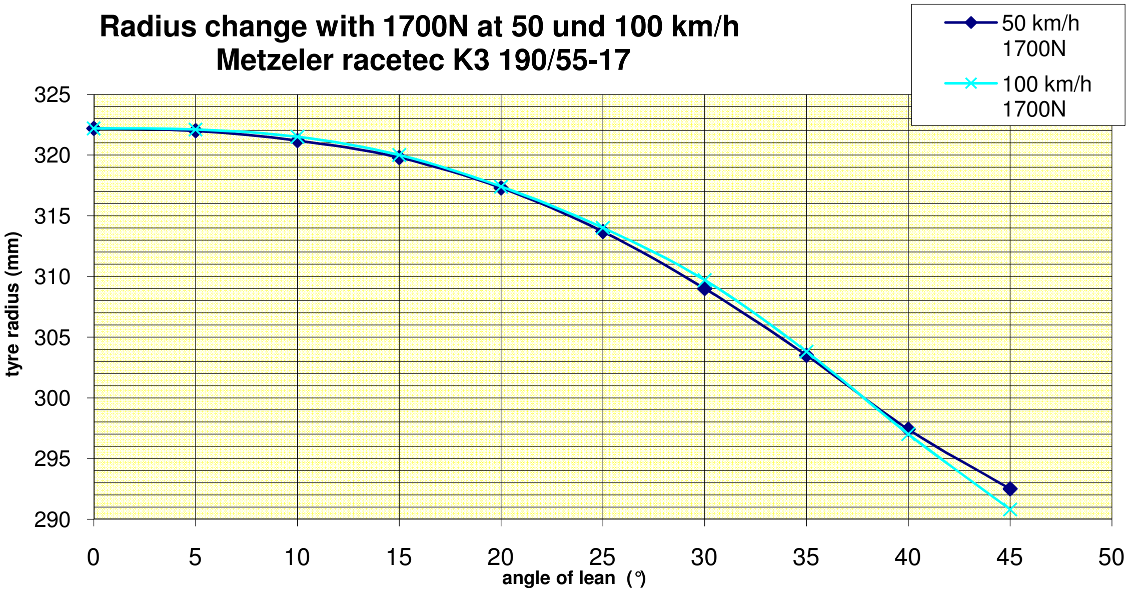
Front wheel speed	light blue
Rear wheel speed	red
Reference speed for the front wheel	dark blue
Lean Angle	yellow
Throttle twistgrip angle	violet
Throttle valve angle	brown
Engine rpm	green
Reduction from slip	pink
Reduction from slip and precontrol	dark pink

At the start of measurement, traction control and precontrol are both active at the apex of the corner. The rider opens the throttle again coming off the apex of the corner. Just past the cursor position, the lean angle undershoots the shut-off limit for traction control. A reference speed is then computed, approaching the rear wheel speed with the specified rate of acceleration. => Slip can no longer be detected. This is soon followed by phases in which the front wheel does not accelerate. This is where it is briefly out of contact with the ground. When the front wheel comes away from the ground the motorcycle already has so much grip again that traction control is no longer needed.


Time when shut-off limit reached (heel angle approx. 35°)

Slip correction - SlipCor Mod 1-4

Wheel slip is calculated as follows: Initially the difference is calculated between front wheel speed (measured value is **V_REF_FW**) and rear wheel speed (measured value is **V_RW**). Then a correction is applied, taking into account the difference in tyre rolling radii over lean angle (measured variable is **PHI_LEAN**). Each mode (RAIN =1, SPORT=2, RACE=3 and SLICK=4) has its own characteristic map (**SlipCor Mod 1-4**). These characteristic maps allow for tyre contour as a function of lean angle and speed. The value obtained from the "current" **SlipCor Mod** characteristic map is subtracted from the difference in wheel speed. When this corrected difference is divided by the speed of the front wheel, the result is the wheel slip used in the system. The system starts engine intervention when wheel slip reaches approximately 10 % of the computed value. The basic application is based on Metzeler Racetec K3 and Pirelli Super Corsa SC2 tyres, tyre sizes front and rear 120/70-17 and 190/55-17.
The diagram below shows that the tyre radius of the front and rear wheels becomes smaller as the lean angle increases. Acceptable guideline values are a reduction of approximately 5 % in front-wheel tyre radius and a reduction of approximately 10 % in rear-wheel tyre radius when the motorcycle is heeled over to a 45 ° angle of lean. Consequently, there is a difference of approximately 5 % between the speeds of the front and rear wheels.



This difference between tyre radius for the front and rear wheels has to be subtracted from the target slip. This is achieved with characteristic maps **SlipCor Mod 1-4**. The unit of measure for these maps is km/h and they can be applied depending on front wheel speed and lean angle.
This means that for the example above, 5 km/h has to be entered for a front wheel speed of 100 km/h and 2.5 km/h has to be entered for a front wheel speed of 50 km/h. The other **SlipCor** characteristic maps can be used to create different settings for the corresponding ride modes. This means that you can use different settings for slip or react to changes in tyre grip as wear increases in the course of a session. You can step through the settings while the motorcycle is on the move (see the Rider's Manual for the S 1000 RR).
For example, if you want 1 % more slip with a **SlipCor** characteristic map than with the preceding map, add 1% of the value of the speed interpolation point to the original value in each value in the line (for all lean angles).
The diagram below shows an example for a Metzeler Racetec K3 tyre with regard to the change in tyre radius in different modes and for different SlipCor characteristic maps. The map on the right produces 1% more slip than its counterpart on the left.

Angle of lean [°]

GripLevel | ReductionPreControl | LeanAngleDTCon | SlipCor Mod 1 | SlipCor Mod 2

	30,96	38,31	45,00	50,19	55,41	59,53
25,0	6,883	1,867	1,461	0,719	0,234	0,000
60,0	2,328	2,688	2,547	1,250	0,516	0,000
100,0	3,328	3,945	3,531	2,281	1,414	0,422
140,0	4,531	4,625	4,203	3,648	2,594	1,430
180,0	4,383	4,727	4,508	3,883	2,664	1,453
220,0	3,633	4,180	4,695	3,594	2,141	0,695
260,0	2,516	3,422	3,602	2,711	1,219	0,000

GripLevel | ReductionPreControl | LeanAngleDTCon | SlipCor Mod 1 | SlipCor Mod 2

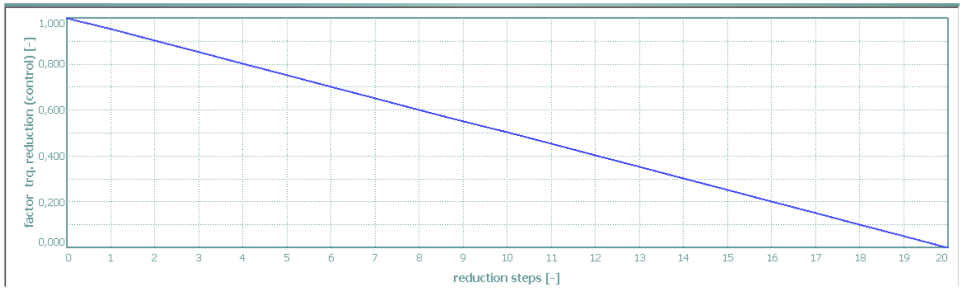
	30,96	38,31	45,00	50,19	55,41	59,53
25,0	7,000	1,992	1,586	0,844	0,359	0,000
60,0	2,625	2,984	2,844	1,547	0,812	0,070
100,0	3,828	4,445	4,031	2,781	1,914	0,922
140,0	5,234	5,328	4,906	4,352	3,297	2,133
180,0	5,281	5,625	5,406	4,781	3,562	2,352
220,0	4,734	5,281	5,797	4,695	3,242	1,797
260,0	3,812	4,719	4,898	4,008	2,516	1,016

Speed [km/h]

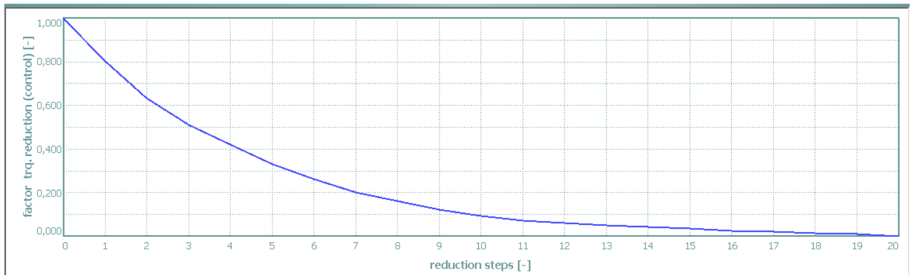
Torque reduction - TrqControl

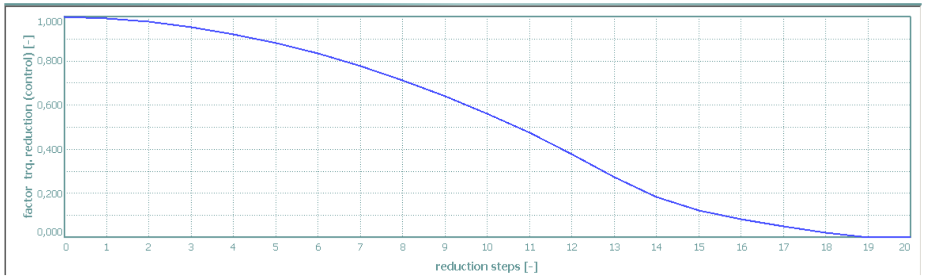
DTC intervention starts at a calculated wheel slip of approximately 10 %. You can use the tyre radii to correct, increasing or decreasing the level of slip for the various ride modes.

The **RED_SLIP** measured variable shows the percentage engine torque reduction and is taken from the **TrqControl** characteristic curve for torque reduction. A value of 1.0 corresponds to no reduction and a value of 0.0 corresponds to 100% reduction (engine off). The characteristic curve for torque reduction enables you to influence torque reduction to suit track conditions and tyre conditions. In the basic data set, **TrqControl** is linear (see diagram).



The downward gradient of the characteristic curve must be strictly monotonous. A tyre with a hard-wearing compound needs more torque reduction even at low reduction levels (falling degressively, see the diagram on the left). A tyre with a soft/wide limit zone, by contrast, needs less torque reduction at low reduction levels (falling progressively, see the diagram on the right).





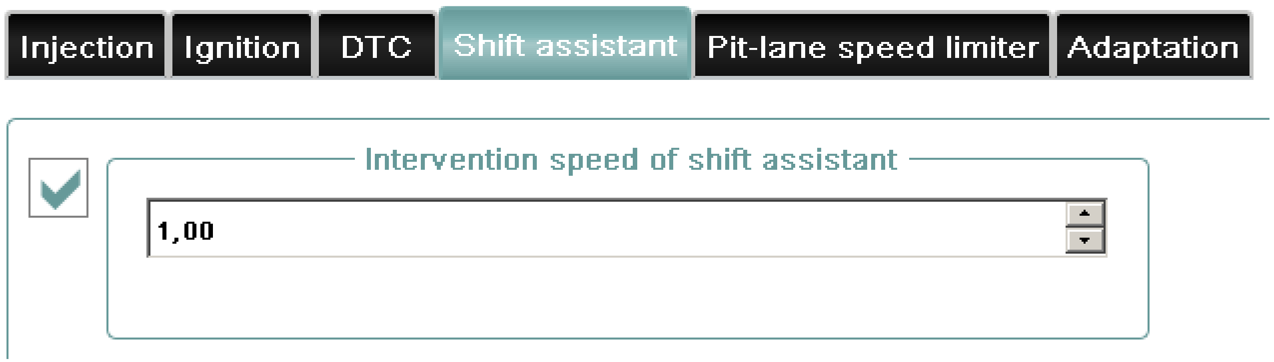
Torque increase - TrqIncrease

When rear wheel slip drops below the values applied in the **SlipCor** characteristic maps, engine torque is again increased. The presets can be changed to match rpm by means of the **TrqIncrease** characteristic curve. A value greater than 1.0 accelerates torque increase, a value below 1.0 retards torque increase.

Depending on the spring/shock-absorber settings, torque increase can excite a varying degree of vibration in the motorcycle. To separate the vibration frequencies of traction control from those of the spring/shock-absorber/tyre system, it is advisable for example to reduce torque increase (values less than 1.0). Entering an extremely low value for torque increase will make the motorcycle sluggish and slow to accelerate.

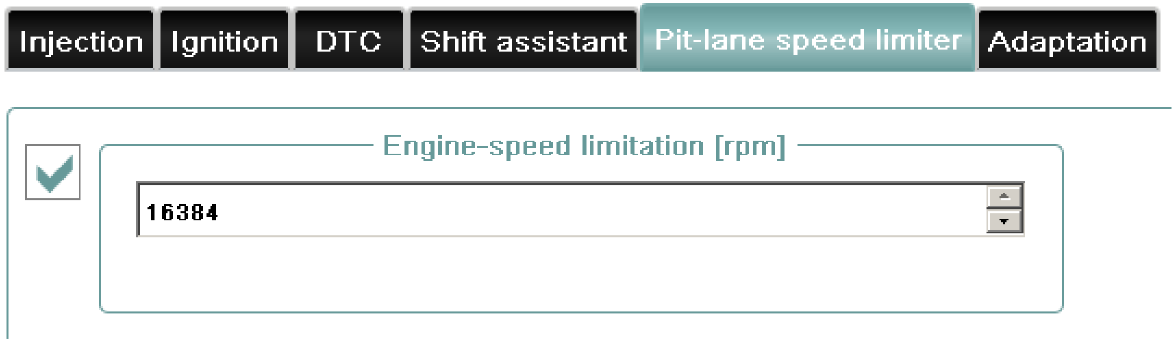
Shift assistant

The shift assistant (optional extra) enables upshifts without the clutch being disengaged. Modification of the shift assistant is possible only if the motorcycle is equipped with this optional extra. The engine-torque reduction for initiating upshift with the shift assistant cannot be changed, but you can influence the way in which engine torque is built up after the upshift by changing the applicable factor (**Intervention speed of shift assistant**). Values greater than 1 mean that torque is built up more quickly, values less than 1 slow down the build-up of engine torque. A value of 1 means that torque build-up is in accordance with the factory defaults.
Bear in mind that the rate of torque build up also has an effect on the drivetrain's reaction to load change, and this in turn can result in unexpected reactions on the part of the motorcycle.



Pit-lane speed limiter

This function enables you to use an rpm limiter that is active only in 1st gear and only when the starter button is pressed. Use can set **Engine speed limitation [rpm]** so that, for example, the motorcycle cannot be accelerated past the permissible limit in the pit lane as long as you stay in first gear. Bear in mind that changes to the transmission ratios or different tyres can produce different speed limits even though the setting is not changed; be sure to check your setup every time you make changes of this nature. This setting cannot be exceeded by the ex-works setting for maximum engine speed.



Adaptation

The electronic engine management system "learns" various settings that are conditional to the components fitted on your motorcycle. These settings are saved in the ECU and are retained even if the battery is disconnected.

This applies to the following components:

- Throttle-valve assembly
- Exhaust system
- Airbox, air filter
- Basic motor (modifications relevant to the gas-change cycle)
- Gearbox selector drum potentiometer, shift lever sensor

If you make alterations to your motorcycle that affect these components you must delete the adaptation values so that the electronic engine management system can learn the values for the modified parts or new components. You can ride away immediately after deleting the adaptation values; the ECU learns the new values while you are riding.

The shift assistant is the exception to the above. The function of the shift assistant is not activated until you have ridden enough in all years and the engine has idled for a sufficient length of time with the gearbox in neutral. Consequently, you have the option of deleting the adaptation values in 2 stages. If the modifications do not affect the gearbox selector potentiometer and the shift lever sensor, use the **Delete adaptation data without gearbox adaptation** function. This means that the function of the shift assistant is immediately available again afterward. If the modifications affect the gearbox selector potentiometer or the shift lever sensor, use the **Delete all adaptation data** function.