BOSCH

ECU MS 3 Sport

Users Manual

1.4 5/23/2014

Table of Contents

1 Getting started

Disclaimer**:**

Due to continuous enhancements we reserve the rights to change any illustrations, photos and technical data within this manual.

Please retain this manual for your records.

Before starting:

Before starting your engine for the first time, install the complete software from the installation CD. Bosch Motorsport software is developed for Windows 2000/XP. Connect the PC Link Adapter (MSA Box) or the Ethernet line (depending on calibration equipment) to your computer and install the driver. Read the manual carefully and follow the application hints step by step. Don't hesitate to contact us, contact data can be found on the backside of this document.

Important notes:

Caution

Risk of injury if using the inappropriately

Use the MS 3 Sport only as intended in this manual. Any maintenance or repair must be performed by authorized and qualified personnel approved by Bosch Motorsport.

Caution

Risk of injury if using the MS 3 Sport with uncertified combinations and accessories

Operation of the MS 3 Sport is only certified with the combinations and accessories that are specified in this manual. The use of variant combinations, accessories, and other devices outside the scope of this manual are only permitted when they have been determined to be compliant from a performance and safety standpoint by a representative from Bosch Motorsport.

Notice

Drive-by-wire systems

For systems with drive-by-wire additional safety provisions apply. For details please refer to the document "Safety Instructions for Drive-by-Wire Systems in Motorsport Applications".

2 Sport Systems - Overview

The Sport Systems support an easy to understand user concept. The ECUs are configured as so called alpha/n versions. This means that the engine characteristic map is based on engine speed, throttle position and engine temperature. The injected amount of fuel and the ignition point are derived from these values.

The drawing gives you an overview over the essential input and output channels of a MS Sport ECU that are necessary to run the engine. The MS 3 Sport offers even more input and output channels.
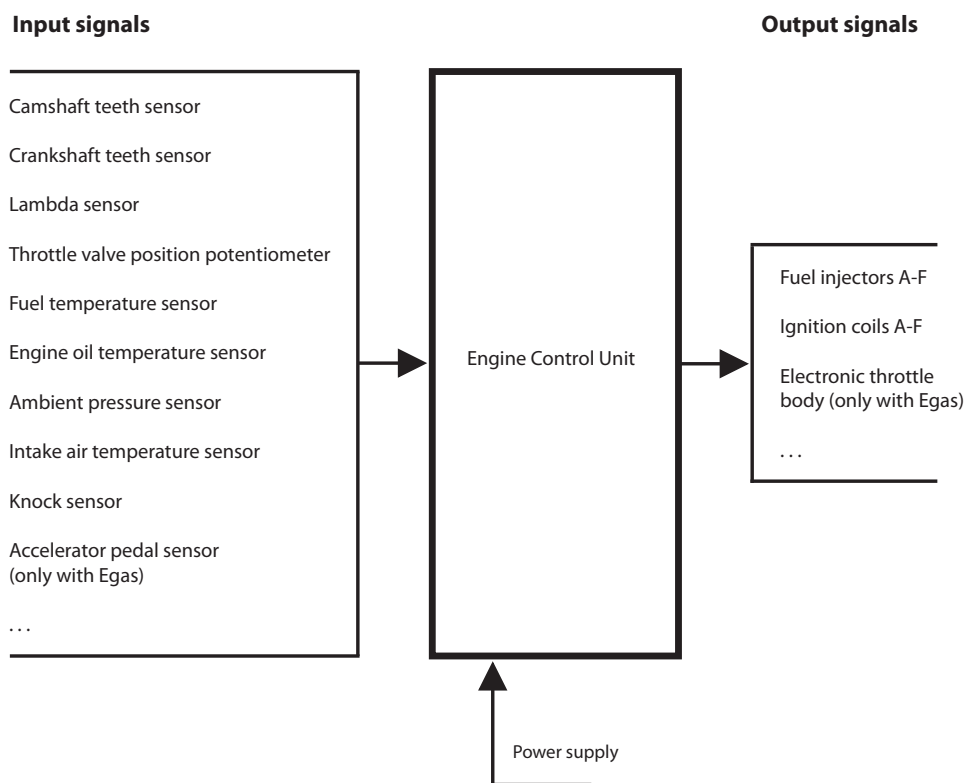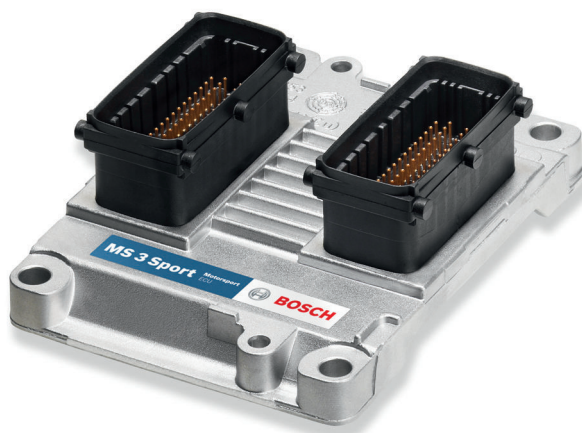
Input signals   **Output signals**

Camshaft teeth sensor

Crankshaft teeth sensor

Lambda sensor

Throttle valve position potentiometer

Fuel temperature sensor

Engine oil temperature sensor   Engine Control Unit   Fuel injectors A-F

Ambient pressure sensor   Ignition coils A-F

Intake air temperature sensor   Electronic throttle
                                                                               body (only with Egas)
Knock sensor
                                                                               . . .
Accelerator pedal sensor
(only with Egas)

. . .

Power supply

Fig. 1: Input and output channels

3 Technical Data

The MS 3 Sport is the first Bosch engine management system to be manufactured with full hybrid technology. Therefore it is very small, lightly and robust against vibrations. The MS 3 Sport is suitable for engines with up to 6 cylinders and has internal ignition output stages. Two sensor inputs are available for vibration knock detection and knock control. Various engine parameters can be measured with different input channels and transferred via CAN interface to an optional data logger or dash display.

Application	
Engine layout	Max. 6 cylinders, 2 bank
Control strategy	Alpha/n
Lambda control	Dual
Speed limiter	
Gear cut for sequential gear box	
Map switch corresponds to 3 different target lambda and spark maps.	
Fuel cut off	
Sequential fuel injection	
Asymmetric injection timing	
Asymmetric ignition timing	
Knock control	Optional
Electronic throttle control	Optional
Traction control	Optional
Interface to Bosch Motorsport ABS M4 kit	
Support of 60-2 and 36-2 ignition trigger wheels	
Max. vibration	Vibration Profile 3 (see www.bosch-motorsport.com)

Technical Specifications	
Mechanical Data	
Extremely small and flat aluminum pressure casting housing	
4 mounting points on housing	

Technical Specifications	
2 connectors with high pin density	
Extremely shock and vibration proof hybrid technology	
Size	120 x 90 x 40 mm
Weight	250 g
Temperature range	-40 to 125°C
Electrical Data	
Max. power consumption	10 W at 14 V
Power supply	
Full operation	9 to 16 V
Recommended	11 to 14 V
Inputs	
2 lambda interfaces LSU	
4 inputs for Hall-effect wheel speed sensors	
1 input for inductive crankshaft sensor	
1 input for Hall-effect camshaft sensor	
22 universal inputs 0 to 5 V	
2 knock sensor inputs	
Outputs	
6 injection power stages	
6 ignition power stages (7.5 to 8.0 A)	
8 power stages (1 A/2 A; low side; PWM)	
2 power stages for lambda heater	
1 H-bridge (5 A)	
2 sensor supplies 5 V/100 mA	
Software	
Modas Sport Calibration Software	Inclusive
WinDarab Analysis Software	On request
Environment (not included)	
Programming interface MSA-Box II	F 02U V00 327-02
Data logger C 50	F 02U V01 164-01
Display DDU 7	F 02U V01 130-01
12 Steps Switch for Traction Control	B 261 209 641-01
Mating Connectors (not included)	
Mating connector I	D 261 205 139-01
Mating connector II	D 261 205 140-01
Communication interfaces	
1 K-line serial interface	
1 CAN interface	

Ordering Information	
MS 3 Sport	F 01T A20 067-01
Software Options	
SW upgrade Electronic throttle control	F 01T A20 051-01
SW upgrade Knock control	F 01T A20 053-01
SW upgrade Traction control	F 01T A20 052-01
SW upgrade Variable Valve Timing VVT	F 02U V00 395-01

3.1 Input channels

The MS 3 Sport offers input channels for different types of sensors.

Input channels for temperature sensors

Temperature inputs have an internal pull-up resistor for use with an NTC sensor (negative temperature coefficient). Depending on the used sensor (e.g. 15 KOhm or 2.5 KOhm NTC) the corresponding linearization curve has to fit.

Example:

- tmot (engine temperature)
- tair (intake air temperature)

Input channels for voltage sensors

For measuring of sensors delivering a voltage (active sensors), pull-up resistors are not allowed. These sensors must be calibrated with the sensors offset and sensitivity values (at Bosch sensors you find this values printed on the sensor housing).

Example:

- ath (throttle position)
- pfuel (fuel pressure)
- poil (oil pressure)

Input channels for inductive speed sensors

- For the ignition trigger wheel an inductive speed sensor is necessary.

Input channels for Hall-effect speed sensors

- For the camshaft a Hall-effect sensor is necessary.
- For wheel speed measurement Hall-effect sensors are recommended. 4 Hall-effect wheel speeds can be connected directly to the ECU.

Input channels for lambda measurement and control

For wide range lambda measurement and control the lambda sensor Bosch LSU 4.2 is needed.

3.2 Output channels

3.2.1 Injection Valves

The table shows details of the injector power stages that are necessary to choose the fitting injection valves.

Injector power stages	6
Maximum current of injector output drivers	2.2 Ampere
Internal valve resistance	min. 6 Ohm

Notice	**Don't use Bosch injection valves with 1.2 Ohm**
	A few Bosch injection valves have an internal resistance of just 1.2 Ohm. These types can not be used here.

3.2.2 Ignition Power Stages

The MS 3 Sport has integrated ignition power stages. The wiring is shown in the following picture.

Notice	In case of ignition-caused malfunctions, please use screened sensor wires.

A typical 6 cylinder engine with firing order 1-5-3-6-2-4 is connected as follows:

Firing	1	5	3	6	2	4
IGN	A	B	C	D	E	F
INJ	A	B	C	D	E	F

3.3 Power supply

The MS 3 Sport requires an external main relay to be wired to the harness. This relay is controlled by the MS 3 Sport to realize that important information can be stored after switching off the ignition.

Please ensure that you have a good ground installation. That means:

- A ground that has a solid, low resistance connection to the battery minus terminal.
- Connection should be free from dirt, grease, paint, anodizing, etc.
- Cylinder heads make a good grounding point.
- Use large diameter wire.
- More metal-to-metal contact is better!

Connection of the power supply

The following notations for power signals are used:

- KL15 is a switched battery rail controlled by the ECU driver.
- KL30 is an unswitched battery positive rail (same as battery positive terminal).
- KL31 is an unswitched ground rail (same as battery negative terminal).

Caution	**Wrong polarity / high currents**

Wrong polarity of the terminals and high currents damage the MS 3 Sport. Be careful to observe current limits of wires and connector pins!

Notes:

- ECU requires a dedicated relay to be installed in the car

- KL30 is HAAT (Hot At All Times)

- KL15 is hot only when ECU engages relay

- ECU will engage relay after 12V is detected on pin 'J' by pulling pin 'B' to ground

- ECU will disengage the relay after 12V is removed from pin 'J', but may be delayed for up to 2 seconds after engine speed signal is zero.

- It is recommended to fuse the KL30 circuit

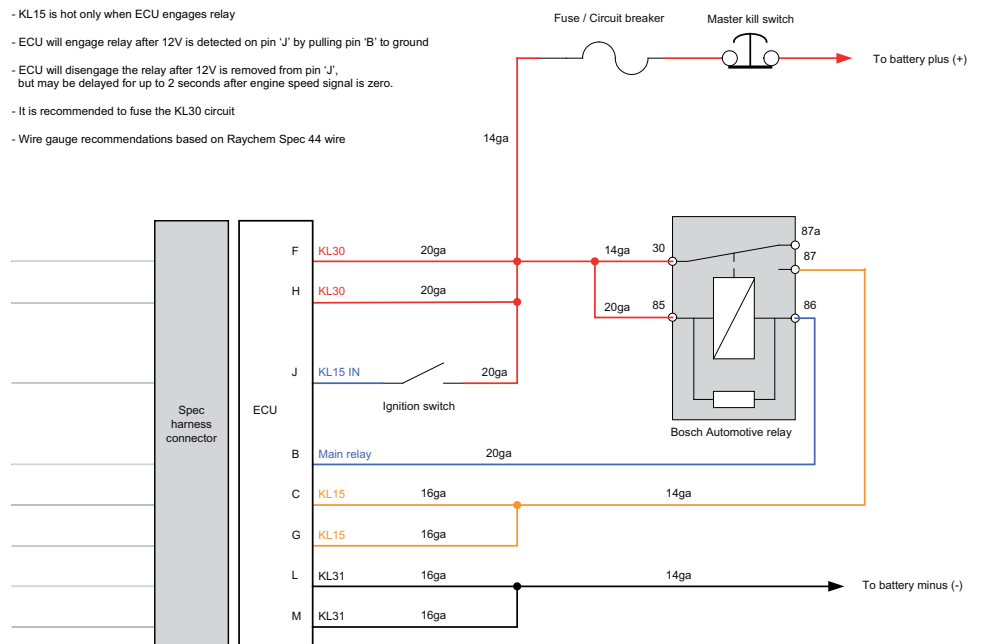- Wire gauge recommendations based on Raychem Spec 44 wire

Fig. 2: Power supply connection plan

3.4 Ignition trigger wheel

To start the engine, the ECU requires information about the position of the cam-shaft and crankshaft. These are determined by using sensors on the cam and crankshaft generator gear.

In this chapter you'll find the sensors you need to detect the camshaft and crank-shaft position and how to tune the components to each other.

3.4.1 Camshaft and Crankshaft Sensors

Camshaft trigger sensor

The camshaft trigger sensor is a Hall-effect type with a single tooth trigger wheel. Bosch Motorsport recommends the use of Hall-effect sensor HA-P.
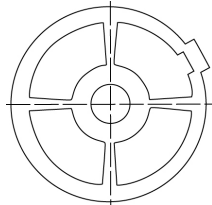
Fig. 3: Camshaft wheel

Crankshaft trigger sensor

The software assumes a 36-2 teeth or a 60-2 teeth trigger wheel for proper oper-ation. The type can be choosen in the software Modas Sport. The crankwheel trigger sensor must be an inductive type for default configuration. Bosch Motor-sport recommends the use of inductive speed sensor IA-C. The picture below shows the correct installation position.
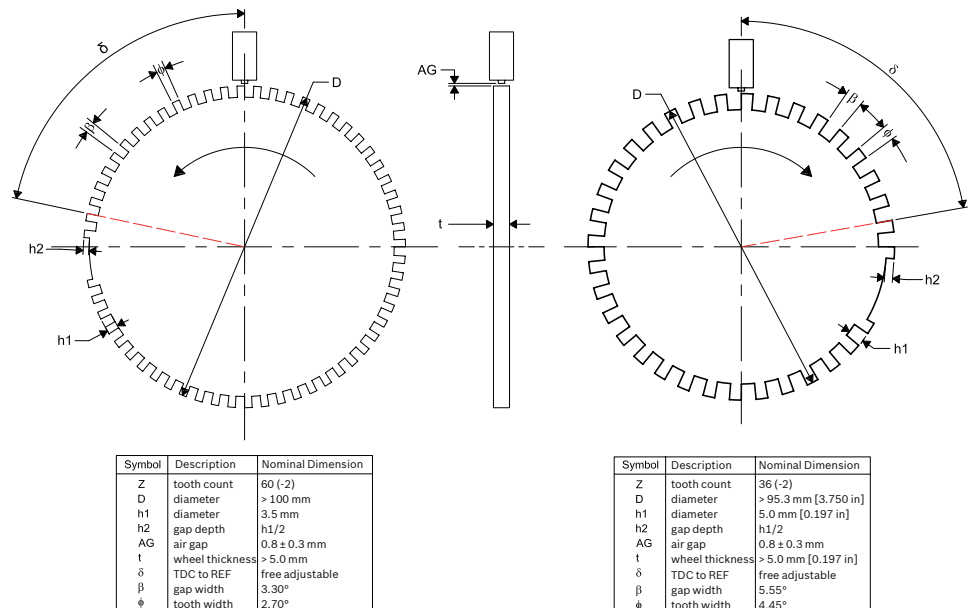

Symbol	Description	Nominal Dimension
Z	tooth count	60 (-2)
D	diameter	> 100 mm
h1	diameter	3.5 mm
h2	gap depth	h1/2
AG	air gap	0.8 ± 0.3 mm
t	wheel thickness	> 5.0 mm
δ	TDC to REF	free adjustable
β	gap width	3.30°
ϕ	tooth width	2.70°

Symbol	Description	Nominal Dimension
Z	tooth count	36 (-2)
D	diameter	> 95.3 mm [3.750 in]
h1	diameter	5.0 mm [0.197 in]
h2	gap depth	h1/2
AG	air gap	0.8 ± 0.3 mm
t	wheel thickness	> 5.0 mm [0.197 in]
δ	TDC to REF	free adjustable
β	gap width	5.55°
ϕ	tooth width	4.45°

Fig. 4: Crankshaft wheel

3.4.2 Mounting of the Sensors

Procedure to find the right position for the crank and cam triggers:

1. Rotate the engine to the precise position of TDC compression for cylinder #1.

2. Rotate the engine (*) crankshaft degrees backwards.

3. Adjust the position of the crank trigger wheel in reference to its inductive speed sensor: the longitudinal axis of the sensor must point exactly towards the reference mark (2nd falling edge after the gap).

4. Adjust the position of the cam trigger in reference to its Hall Effect speed sensor: the sensor must be about at the centre of the tooth.

5. Turn the engine by 360 crankshaft degrees to reach the position of (*)° before TDC exhaust for cylinder #1.

6. Verify that the crank trigger reference mark is in alignment with the longitudinal axis of the sensor (same as Step 3) and that the cam trigger tooth is at the opposite side of its speed sensor.
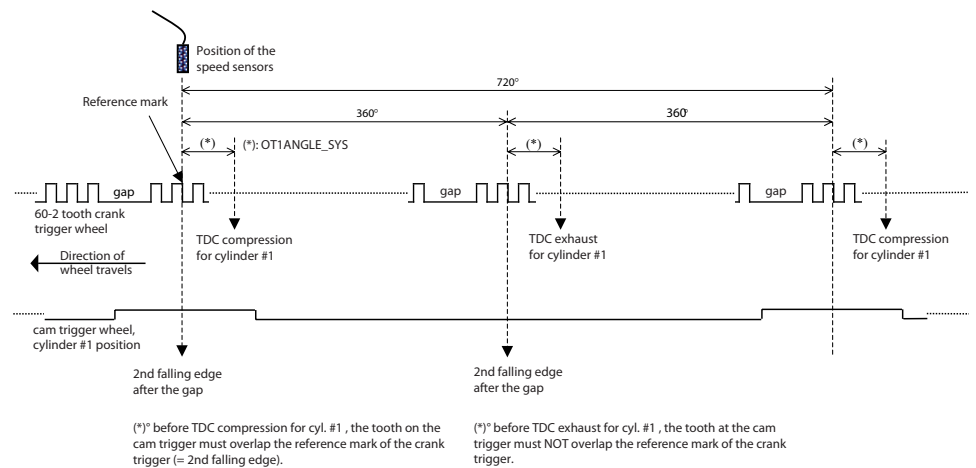
Fig. 5: Position of the sensors

- All angles are shown and indicated in crankshaft degrees.

- The width of the cam trigger tooth is not important; however it must be wide enough to ensure a safe overlap of the crank trigger reference mark at any time.

- The Hall-effect signal is the inversion of the shape of its cam trigger: the tooth effects a 'low' signal at the sensor and vice versa.

- With 4 and 6 cylinder engines, the value of 66 degrees must be replaced by 78 degrees.

3.5 Sensor recommendation

The sensors shown on this page are partly based on production type parts and proofed hundreds of times in races all over the world. They offer good value for money.

Detailed information about each sensor (technical specifications, characteristic curves, dimension drawings, installation notes) can be found on our website www.bosch-motorsport.com.

The volume of applied sensors may differ depending on individual software extents.

Model	Range of application	Connector Loom	Part No.
NTC M12-L	Ambient air temperature	D 261 205 288	0 280 130 039
NTC M12-H	Fluid temperature (oil, water, fuel)	D 261 205 337	0 281 002 170
TCP-K	Exhaust gas temperature	ASL 0-06-05SD-HE	B 261 209 385-01
PSA-C	Ambient air pressure	D 261 205 289	0 261 230 037
PSA-C	Crankcase pressure	D 261 205 289	0 261 230 037
PSS-10	Fluid pressure (oil, water, fuel)	1 928 403 968	B 261 209 341-01
PSA-C	Air pressure (manifold, boost)	D 261 205 289	0 281 002 389
LSU 4.2	Lambda value	D 261 205 138	0 258 006 065
IA-C	Crankshaft revolutions	D 261 205 334	0 261 210 136
HA-P	Camshaft revolutions	D 261 205 335	0 232 103 037
HA-P	Wheel speed	D 261 205 335	0 232 103 037
RP 86	Throttle angle	D 261 205 334	0 280 122 016
RP 100 twin	Acceleration pedal angle	AS 0-07-35SN	B 261 209 591-02
KS-P	Knock	D 261 205 337	0 261 231 120
RP 308	Gear detection	ASL 0-06-05SA-HE	B 261 209 570-01
GSS-2	Gear shift	ASL 0-06-05SC-HE	B 261 209 227-01
AM 600-3	Acceleration	ASL 0-06-05SA-HE	B 261 209 313-02
YRS 3	Yawrate	F 02U 002 235-01	0 265 005 838
RP 308	Steering angle	ASL 0-06-05SA-HE	B 261 209 570-01

4 Starting up the ECU

4.1 Offline Data Application

This chapter deals only with the main parameters which should be checked before a first engine start-up. The car's ignition has to be switched on. The offline data application guide helps you to get the engine started the first time without problems.

This chapter does not explain the parameters in detail and does not mention all available parameters. To work on these parameters after the first start-up, please refer the full-scope function sheet which is available in the "Documentation" section of www.bosch-motorsport.com.

Caution	**Serious engine damages using wrong setup data**
	Wrong engine setup data may lead to serious engine damages. If the TDC angles do not match the expected configuration of a symmetrical or V engine the setup won't be accepted and for safety reasons the engine will not start (engsetupOK_b = FALSE).
	Refer to the offline data application chapter of this manual to set up the engine or contact Bosch Motorsport.

4.1.1 Basic Engine Setup

How many cylinders does the engine have?

The Sports System can be used for engines with different number of cylinders using the same program.

How many teeth does the crankshaft wheel have?

The System supports wheels with 60-2 or 36-2 teeth. The TDC angles are defined starting from the second tooth after the gap in the rotating direction. The first cylinder in the firing order should have its TDC after the gap.

Is the ignition symmetrical? If not, how are the angles defined?

Engines with 6 cylinders can have a V configuration which in some cases requires unsymmetrical ignition angles. The software Modas Sport supports any variation but you must define the TDC angle for each cylinder accordingly.

Is the harness wired according to the firing order?

The Sports System is defined to have the first cylinder in the firing order connected to the output A, the second to output B and so on. This is the recommended wiring configuration. In this case, your TDC angles must be input in ascending order.

First make sure you have installed the calibration software Modas Sport following the instructions provided. Then follow these steps:

1. Look for the characteristic value CYLNUMBER and enter the cylinder number of your engine.

2. If the crankshaft wheel has 36-2 teeth set CRANKWHEEL36 to 1. It if has 60-2 set it to 0 (default value).

3. Enter the TDC angles for each cylinder according to the convention defined above in TDCCYL1 to TDCCYLN where N is the number of cylinders of the engine.

Example 1

To better understand this process a symmetrical 6 cylinder engine with a standard crankshaft wheel will be described. The first TDC is 78° from the second tooth after the gap. In this case the following parameters must be input:

Parameter	Ignition power stage identification
CYLNUMBER = 6	-
CRANKWHEEL36 = 0	-
TDCCYL1 = 78	A
TDCCYL2 = 198	B
TDCCYL3 = 318	C
TDCCYL4 = 438	D
TDCCYL5 = 558	E
TDCCYL6 = 678	F

Notice that the angle between each TDC is 120° because the engine has symmetrical ignition.

Example 2

Now suppose the same engine has a V configuration 90°-150°. In this case the TDC angles are:

Parameter	Ignition power stage identification
CYLNUMBER = 6	-
CRANKWHEEL36 = 0	-
TDCCYL1 = 78	A
TDCCYL2 = 168	B
TDCCYL3 = 318	C
TDCCYL4 = 408	D
TDCCYL5 = 558	E
TDCCYL6 = 648	F

4.1.2 Injection

The label INJCALC contains parameters to calibrate the fuel injection time.

The base injection time parameter TI_DEF is influenced by many correction parameters mentioned below to optimize combustion.

Parameter	Function
TI_DEF	Base injection timing in milliseconds

The injection time depends mainly on throttle position, engine speed, fuel pressure and injection valve type. To get a first estimation, the following characteristics must be known:

- displacement per cylinder V_C (m³)
- expected intake manifold pressure (after throttle) p_i [Pa]
- desired lambda value λ
- operating fuel pressure p_f [bar]
- injection valve flow rate Q_{stat} [g/min] at reference fuel pressure p_{fRef} [bar]
- intake air temperature T_i [K]

The fuel mass m_f is calculated by:

$$m_f = \frac{p_i \cdot V_C}{R \cdot T_i} \cdot \frac{1}{14.5} \cdot \frac{1}{\lambda} \text{ (kg) with R=287 (J/kg) const}$$

The energizing time of the injection valves is calculated by:

$$ti = \frac{m_f}{Q_{stat}} \cdot \sqrt{\frac{p_{f\,Ref}}{p_f}} \cdot 10^6 \cdot 60 \text{ (ms)}$$

Parameter	Function
TI_FAK	Global factor, set to 1.0 for startup.
TIBAT_OFF	Battery voltage correction. Predefined value for Bosch Type valves EV6, characteristics can be requested by the valve manufacturer.
TITAIR_FAK	Correction by intake air temperature. This value is predefined. If unsure, set it to 1.0 constantly for first start up.
TITMOT_FAK	Correction by engine coolant temperature. This value is predefined. If unsure, set it to 1.0 constantly for first start up.
TIPFUEL_FAK	Correction by fuel pressure. This value is predefined. If unsure, set it to 1.0 constantly for first start up.
TIRE-VPCORR_FAK	Correction by ambient pressure / air box pressure. This value is predefined. If unsure, set it to 1.0 constantly for first start up.
PCORR_CW	Select correction mode. Ambient (0) or air box (1) pressure.

Cylinder Individual

These parameters allow calibrating each cylinder individually.

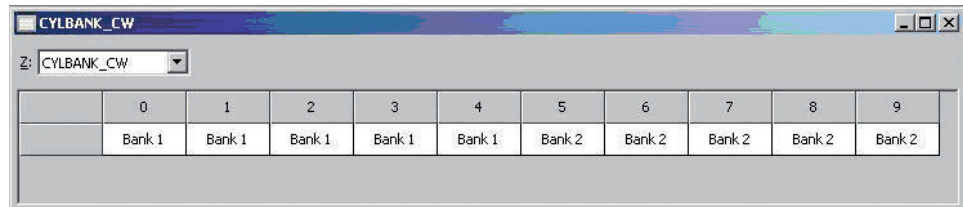| Parameter	Function
CYLBANK_CW	Assigns which cylinders are on which bank for proper lambda control, bank 1 or bank 2. Open the label and allocate the cylinders to the right bank via dropdown menu. Please note that the cylinders are displayed in firing order!

Fig. 6: Lambda control via label CYLBANK_CW

Notice

Engines with one lambda sensor (e.g. 4-in-a-row) run as 1-Bank-Systems. Set CYLBANK_CW to 0.

Parameter	Function
TIREVATH_FAK_x	Cylinder individual corrections. Set to 1.0 for first startup. Numbering refers to firing order!
INJOFFPATTERN	Torque reduction by injection fade out. Different, repeating fade out patterns can be defined for several full power strokes of the engine (720° crank or 2 full rotations). This prevents single cylinders from cooling down too much and makes it possible to find optimal patterns.

fade out level injoff →

y/x	0	1	2	3	4
0	0	1 (=0001b)	3 (=0011b)	7 (=0111b)	15 (=1111b)
1	0	2 (=0010b)	12 (=1100b)	7 (=0111b)	15 (=1111b)
2	0	4 (=0100b)	3 (=0011b)	14(=1110b)	15 (=1111b)
3	0	8 (=1000b)	12 (=1100b)	13(=1110b)	15 (=1111b)

Fig. 7: Cylinder fade out level

Example: 4 cylinder engine:

The cylinders are assigned bitwise, the lowest bit represents cylinder 1 in firing order (FO1), e.g. injoff = 1:

- First power stroke 0°-720°: Cylinder 1 (FO1) is faded out

- Second power stroke 720°-1440°: Cylinder 2 (FO2) is faded out

- Third Power stroke 1440°-2160°: Cylinder 3 (FO3) is faded out

- Fourth Power stroke 2160°-2880°: Cylinder 4 (FO4) is faded out

- Fifth Power stroke 2880°-3600°: Cylinder 1 (FO1) is faded out

- ...

Injection Start

Parameter	Function
TISTARTBASE	Base injection time for engine start. Can be set to a value near full load from the maps TI_MIN/DEF/MAX in atmospheric engines. Scale down proportional to boost pressure for turbo engines.

Further corrections: Predefined. If unsure, set to 1.0 for first start up.

Injection Angle

Parameter	Function
INJANGREVATH	End angle of injection. The angle (in degrees crankshaft) is in relation to top dead center. Make sure, the injection is ended before the inlet valve closes. Try 200° - 300° for first startup.
INJANGSTREV	End angle of injection pulse in engine start. Refer to INJANGREVATH.

4.1.3 Injection Controls

LAMCTRL

These parameters adjust the Lambda-controller.

The following conditions must be met in order to enable lambda control:

- Lambda sensor installed and operational
- Lambda control enabled (LAMCTRL_CW = 1)
- No manual override of injected fuel amount, e.g. for application purposes (ti-fak_b = 0)
- Engine speed higher than LAMCTRLREV_MIN
- Boost pressure higher than LAMCTRLP22_MIN

Parameter	Function
LAMCTRL_CW	Activate Lambda-controller by setting = 1. Deactivate by setting = 0.
LAM_MIN LAM-DEF LAM-MAX	Set values in the engine speed / boost pressure dependent lambda maps. For each map position, there is a separate lambda map (minimum/default/maximum) that can be chosen by the map switch.

INJCUT

This parameter adjusts injection cut-off and cut-in.

Fuel cut-off is enabled above the engine speed INJCUTREV_MX if the throttle is closed and it is allowed by the selected gear INJCUTGEAR. Fuel will turn back on if the driver opens the throttle or if the engine speed falls below INJCUTREV_MIN.

Parameter	Function
INJCUTGEAR	Activate injection cut-off depending on gear. Deactivate by setting = 0.0.

INJENRICH

This parameter adjusts injection enrichment upon acceleration.

This function corrects the injected fuel amount during changes of throttle position. It allows for additional fuel to be added immediately after the change in throttle position and then taper off over a number of engine cycles.

Parameter	Function
INJENRI-CHREV_MIN	Injection enrichment is activated when the engine speed is higher than the entered value. Deactivate by setting = 32768.

4.1.4 Ignition

The label IGNCALC contains parameters to calibrate the ignition timing.

Important note: Positive values stand for ignition angles before TDC, negative values after TDC. Begin with moderate values to protect your engine from damages.

Parameter	Function
IGNSTARTREV	Base spark advance in engine start. Set to 5 to 10 deg.
IGNSTARTT-MOT_OFF	Correction by engine coolant temperature. Set to 0.0 for first startup.
TDWELLBAT-TREV	Coil dwell time. Consult the coil manufacturer for details. Most coils need dwell times about 1.5 to 2.5 milliseconds at 12 to14 V.
TDWELL-MAX_OFF	Dwell time limitation. Stay with predefined value for first startup.
IGNREV_OFF_x	Cylinder individual corrections. Set to 0.0. Numbering refers to firing order!

Ignition Maps

Parameter	Function
IGN_MIN IGN_DEF IGN_MAX	Base Injection timing in deg crankshaft before TDC The values (minimum/default/maximum) can be chosen by the map switch. Use modest values at the first time. Atmospheric engines may run safe at 20 – 25 deg in part load, Turbo engines at high boosts may demand even less spark advance. These values are strongly dependant on compression ratio, fuel quality, temperature and engine specifics. If you know you're using "bad" fuel, run at high temperatures or your engine is very sensitive on spark advance, go to the safe side.

Further corrections: Predefined. If unsure, set to 0.0 for first startup.

4.1.5 Injection and Ignition Controls

GEARCUT

Parameter	Function
GCREV_THR	Adjusts the engine torque reduction / blipper while shifting. Deactivate by setting = 32768.

REVLIMIT

These parameters adjust the engine speed limiter.

The engine speed limiter works in 3 steps:

- Soft limitation by ignition retardation
- Hard limitation by Injection cut off
- Absolute limitation by full injection and ignition cut off

Parameter	Function
REVLIMITSOFT-GEAR	Soft limiter, gear dependant: Apply the revs at which the limiter shall become active (same value to all gear break points on dyno).
IGNREVLIMIT-SOFT	Apply the ignition angle (absolute) dependant on the engine overspeed (rev – REVLIMITSOFTGEAR).
REVLIMITHARD-GEAR	Exceeding this value, the injection will be cut off.
REVLIMITIGN-OFF_OFF	Maximum overspeed relative to REVLIMITHARDGEAR. Injection and ignition fade out when exceeded.

SPEEDLIMIT

These parameters adjust the pitlane vehicle speed limiter.

Parameter	Function
SPEEDLIMI-TREV_MAX	Set the maximum engine speed limitied by the speed limiter. Deactivate by setting = 32768.
SPEEDLIMI-TREV_MIN	Set the minimum engine speed at which the speed limiter can be enabled. Deactivate by setting = 32768.

4.2 Online Data Application

Sensors and peripherals can be checked when the system is powered up electrically.

- Do not start the engine before all steps in this chapter are carried out.
- Make sure the battery is connected properly, all sensors are connected, ground wiring is fixed before powering up the system.

- Check all sensors for errors (bits ..._e) before starting the engine.

4.2.1 Pressure Sensors

The label PRESSURES contains parameters to calibrate oil pressure POIL, ambient pressure PAMB, crank pressure PCRANK and fuel pressure PFUEL. All pressures are calculated in the same way.

Example: Ambient pressure PAMB

Parameter	Function
PAMB_OFF PAMB_GRD	Sensor offset and gradient. Consult the sensor manufacturer for details.
PAMB_UMX PAMB_UMN	Maximum and minimum accepted sensor voltage. Set to approx. 250 mV / 4750 mV. If violated, an error is set (pamb_e = 1).
PAMB_DEF	Default value. If a sensor error is set, the output is switched to this default value.
PAMB_FIL	Filter constant. Use modest values, ~ 10 - 40 milliseconds.

All other parameters are named by the same rule. Replace PAMB by e.g. POIL to apply data for the oil pressure sensor.

4.2.2 Temperature Sensors

The label TEMPERATURE contains parameters to calibrate oil pressure TOIL, intake air temperature TAIR, engine temperature TMOT, fuel temperature TFUEL, etc.. All pressures are calculated in the same way.

Example: Intake air temperature TAIR

Parameter	Function
TAIR_UMX TAIR_UMN	Maximum and minimum accepted sensor voltage. Set to approx. 200 mV / 4800 mV. If violated, an error is set (tair_e = 1).
TAIR_LIN	Sensor characteristic. Consult the sensor manufacturer.

4.2.3 Lambda Value Detection

The label LAMDET contains parameters to calibrate lambda value detection.

Parameter	Function
LAMTYPE_CW	Select the sensor type. Set to '0' for LSU 4.2.

Keep the predefined values for other parameters.

4.2.4 Throttle-Plate Angle Detection

The label ATHDET contains parameters to calibrate throttle-plate angle detection.

Notice	**Using ETC (electronic throttle body)**
	If using ETC the label ATHDET is not activated. The ATHDET functionality is integrated in label ETC.

Parameter	Function
ATH_UMX, ATH_UMN	Maximum and minimum accepted sensor voltage. Set to approx. 250 mV / 4750 mV. If violated, an error is set (ath_e = 1).

Check if the sensor output value 'ath_u' is changing when throttle is moved.

CALIBRATION

These parameters calibrate the throttle-plate angle.

Parameter	Function
ATHPOS1	Lower calibration point. Set to 0.0 %.
ATHPOS2	Full load point. Set to 100.0 %.
ATHIDLECAL	Set to desired idle ATH value.
ATH_CW	Close throttle and set ATH_CW to 1. Open throttle fully and set ATH_CW to 2. Set throttle to idle point and set ATH_CW to 3.

Check calibration by moving throttle.

4.3 Activation of Software Options

If you buy optional software, you will get a code number with eight ciphers from Bosch Motorsport. We enable this code number exclusively for one defined ECU serial number. It will work with this ECU only.

To enter the code number in Modas Sport, follow the instructions below.

In this example, the traction control function will be activated by entering the code number: 974C 5395

Start the application tool Modas Sport. You will find a predefined worksheet called 'Licence' there, see picture below.
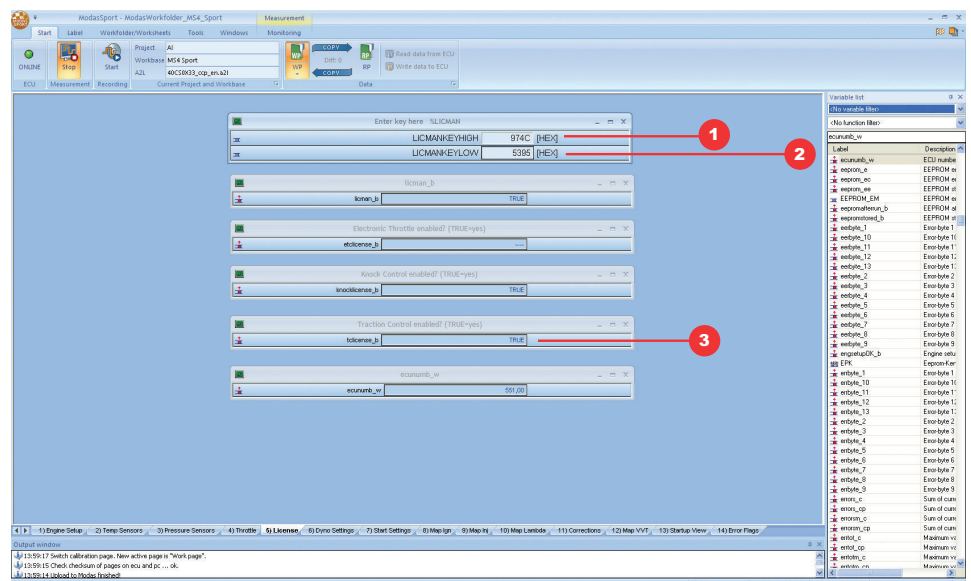
Fill in the first four ciphers of your licence code (here 974C) into the input box LICMANKEYHIGH (1).

Fill in the last four ciphers of your licence code (here 5395) into the input box LICMANKEYLOW (2).

If you have filled in the right code number, the according software option 'tclicense_b' will be set on TRUE (3).

Exception: Near Bank/Far Bank and VVT. These functions require an ECU software update. Please contact us for more information.

5 Extensibility

Bosch Motorsport developed a lot of extras for the ECUs. That is e.g.:

- Displays
- Data loggers
- Telemetry units

Find more information on: www.bosch-motorsport.com

Moreover, you can expand some additional functions of your ECU by sending us the serial number. Than we will send you the licence for:

- Traction control
- Drive-by-wire
- Knock control