



Engine Control Unit MS 6

Manual

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1 Getting Started

Disclaimer

Due to continuous enhancements we reserve the rights to change illustrations, photos or 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. Bosch Motorsport software is developed for Windows operation systems. 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.



Risk of injury if using the MS 6 inappropriately.

Use the MS 6 only as intended in this manual. Any maintenance or repair must be performed by authorized and qualified personnel approved by Bosch Motorsport.



Risk of injury if using the MS 6 with uncertified combinations and accessories

Operation of the MS 6 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 is only permitted when they have been determined to be compliant from a performance and safety standpoint by a representative from Bosch Motorsport.



NOTICE

For professionals only

The Bosch Motorsport MS 6 was developed for use by professionals and requires in depth knowledge of automobile technology and experience in motorsport. Using the system does not come without its risks.

It is the duty of the customer to use the system for motor racing purposes only and not on public roads. We accept no responsibility for the reliability of the system on public roads. In the event that the system is used on public roads, we shall not be held responsible or liable for damages.

2 Technical Data

The MS 6 engine control unit features a powerful digital processing dual-core with floating point arithmetic and a high-end field programmable gate array FPGA for ultimate performance and flexibility.

The software development process is based on MATLAB® & Simulink®. It significantly speeds algorithm development by using automatic code and documentation generation.

Custom functions can be generated quickly and easily. The flexible hardware design allows the MS 6 to support complex or unusual engine or chassis configurations. Integrated log-ger control areas present a cost efficient and weight optimized all-in-one solution.

2.1 System Layout

- Controls for max. 12 cylinder engines are available with the selection of low- or high pressure injection.
- Integrated torque-structures for power control functions as speed-, launch, rpm and traction limitations or regulations
- Two engine bank related separated lines for physical air mass determination, influenced by own Lambda corrections
- Options from simple gear cut support up to complete gear change functions
- Different target maps to differ applications like Lambda-, spark- and electrical throttle controls
- State of the art engine functions like fuel cut off, idle control, injection valve corrections and knock control are already integrated in the basic program structure.
- Sequential fuel injection realized also for asymmetric injection and ignition timings
- Various networks like 2 Ethernet-, 1 USB, 1 LIN for system communication, 3 configurable CAN for external device communication and 1 RS232 for online telemetry data.
- Functionalities may be linked to in and outputs for free system design or harness adaptation
- Internal data logger divided into 2 partitions, 1 GB each
- Option to copy all data to removable USB stick

Layout restrictions

Ethernet Network	MS 6, as Time master, permits the extension of two additional devices. Using		
	 MS 6.1 F02U.V01.961-03, MS 6.2 F02U.V01.867-06, MS 6.3 F02U.V01.963-03 or MS 6.4 F02U.V02.019-06 permits the extension of 4 additional devices. 		
CAN Network	Extended number of members and wiring leads extend the risk of error frames		
RS232	Limited to one additional component		
USB	Limited to additional Bosch Motorsport USB stick		
LIN	Permitted for the use of Bosch Motorsport preconfigured configur- ations		



2.1.1 Structure of Devices and Licenses

To accommodate the wide range of different engine requirements and racetrack operating conditions, the MS 6 Motronic system is classified into the main groups high- and low pressure injection support, subdivided into fully equipped- and functional reduced versions.

Beside the change from low- to high-pressure systems, all limited functions may be activated later. The license concept is related to the individual device and the requested upgrading.

For MS 6.1				
Engine function package l	To activate electronic throttle, camshaft and turbo control			
Engine function package II	To activate traction and launch control			
For MS 6.1 and MS 6.3				
Measurement package	To increase from 21 to 42 analogue channel inputs			
For MS 6.3				
High pressure injection package	To activate 2nd engine bank and 2nd MSV controls			
For MS 6.2, 6.3 and 6.4				
Customer Code Area	Enable Customer Code Area			

For all MS 6 Versions			
Logger package l	Increase the number of measure channels up to 720 Sampling up to 1,000 Hz or 1 synchro Max. number of 1,080 channels are to respect		
Logger package ll	Activation of partition 2, 1 GB memory, 720 channels Sampling up to 1,000 Hz or 1 synchro Long term recording, own data protection code		
Logger package III	Copy data to USB data stick, USB-port unlocked		
	 Incl. adapter cable to USB-port 		
	 Incl. rugged USB flash drive 		
	 Incl. connector for wiring harness 		
Gear control package l	Gear change control, based upon Mega-Line func- tions (License model via Mega-Line) [included for base versions beginning with MS6A_BASE_0800 or comparable]		
Link to N	lega Line Support Request		
Link to Meg	ga-Line License Request Form		
Gear control package II	Strategy for pneumatic forced gear change control		
Innovation License Device	Activation of engine speed functions* and near/far injection function per unit		
Innovation Package Project	Activation of engine speed functions* and near/far injection function per project version		
SW Package MS 6 Drag 1	Launch Timer Launch Distance Torque Pre-Control Launch RPM Control Universal Outputs for Time/Distance Controls		
SW Package MS 6 Drag 2 (requires Drag 1 License)	Acceleration Sensor MM5.10 included Time/Distance Boost Control Driveshaft Speed Control Driveshaft Gradient Control Acceleration Control Wheelie Control		



NOTICE

Verify the necessity of gearbox control licenses by checking the Features info window in RaceCon (see section Feature/License Activation [▶ 19]).

2.2 Mechanical Data

Aluminum housing

2 automotive connectors, 196 pins in total

Vibration suppression via multipoint fixed circuit boards

Size without connectors	226 x 181 x 44 mm
Weight	1,086 g
Protection Classification	IP54
Temperature range	-20 to 80°C
Inspection services recommended after 220	h or 2 years, no components to replace

2.2.1 Installation

Mounting	4 housing integrated screw sockets
Offer drawing	Available at Bosch Motorsport website on MS 6 product page.
3D Data	Available at Bosch Motorsport website on MS 6 product page.

Recommendation

Use rubber vibration absorbers for soft mounting in the vehicle. To assist the heat flow, especially if HP injection is active, the device has to be mounted uncovered and air circulation has to be guaranteed around the entire surface area.

Inside touring cars placement passenger side is favored, open connectors should not be uncovered to vertical axe. It has to be assured in mounting position that water cannot infiltrate through wiring harness into the ECU and that the pressure compensating element and the sealing in the revolving groove do not get submerged in water. Wiring harness needs to be fixed mechanically in the area of the ECU in a way that excitation of ECU have the same sequence.

2.3 Electrical Data

Power supply	6 to 18 V
CPU	Dual Core 667 MHz; FPGA

2.3.1 Communication

3 x CAN	The MS 6 has 3 CAN buses configurable as input and output. Dif- ferent baud rates are selectable. Please note that the MS 6 contain integrated switchable 120 Ohm CAN termination resistors.
1 x LIN	The Bus is not configurable by the customer, but Bosch Motorsport offers data selectable protocols to integrate LIN based devices into the system.
2 x Ethernet	Integrated are 100 Mbit full duplex Ethernet communication ports, internally connected with an Ethernet switch. The ports have "cable auto crossover" functionality
1 x USB	For data transfer to an USB-stick
1 x RS232	One serial port with programmable baud rate for online telemetry
1 x Timesync Co- ordination	For additional devices added via Ethernet

2.3.2 Inputs

The analogue inputs are divided in different hardware classes and qualities.

3.01 kOhm pull-ups are fixed or switchable designed to assist passive sensor elements like NTC temperature sensors or to change to active signal inputs.

Some of the inputs assist only active sensors and offer no pull-up.

To improve measurement tasks, angle related measurements are an option for some inputs, mainly used for engine related leading signals.

The connection between function and related input is free selectable, beside electronic throttle functionalities.

All linearization mappings are open to the customer, some signals offer online modes to calibrate gain and offset.

Digital inputs for speed measuring offer divers hardware options to connect inductive- or digital speed sensors.

Please respect: for camshaft- or wheel speed signals Hall-effect or DF11 sensors have to be used and for wide range Lambda measurement and control the Lambda sensor Bosch LSU 4.9 has to be used.

42 analog inputs in a mix of different hardware designs

6 x reserved for electronic throttle controls

10 x no integrated pull-up

4 x option for time synchronous measurement, no integrated pull-up

2 x option for time synchronous measurement, switchable 1.47 kOhm pull-up

5 x fixed 3.01 kOhm pull-up

13 x switchable 3.01 kOhm pull-up

2 x thermocouple exhaust gas temperature sensors (K-type)

6 internal measurements

1 x ambient pressure

1 x triax acceleration

2 x ECU temperature

2 x ECU voltage

8 function related inputs

2 x Lambda interfaces for LSU 4.9 sensor types

1 x lap trigger/beacon input

4 x knock sensors

1 x digital switch for engine ON/OFF

9 digital inputs for speed and position measurements

1 x switchable Hall or inductive sensor for flywheel measurement

2 x Hall sensor for sync wheel detection

4 x switchable Hall or DF11 sensors for camshaft position or wheel speed

2 x switchable Hall or inductive sensors for turbo speed measurement

2.3.3 Sensor supplies and screens

4 x sensor supplies 5 V / 50 mA

3 x sensor supplies 5 V / 150 mA

7 x sen	sor grounds		
2 x sen	sor screens		

2.3.4 Outputs

19 freely configurable outputs in a mix of different hardware designs

8 x 2.2 amp pwm lowside switch

- 4 x 3 amp pwm lowside switch
- 2 x 4 amp pwm lowside switch
- 2 x 1 amp pwm lowside switch
- 2 x 1 amp pwm lowside switch, low dump resistant
- 1 x 8.5 amp H-bridge

38 function related outputs

12 x ignition controls, support of coils with integrated amplifier only

12 x low pressure injection power stages for high impedance valves

(max. 2.2 amps and min. 6 Ohm internal resistance of the injectors)

8 x high pressure injection power stages for magnetic valves (HDEV 5)

2 x outputs for high pressure pump controls (MSV)

2 x 8.5 amp H-bridge for electronic throttle control

2 x 4 amp pwm lowside switch for Lambda heater

3 output signals

1 x flywheel

1 x trigger wheel

1 x engine rpm

2.3.5 Supply System

Please ensure that you have a good ground installation with a solid, low resistance connection to the battery minus terminal. The connection should be free from dirt, grease, paint, anodizing, etc.

- MS 6 power consumption at appr. 13 V (vary according to use cases)
 - ~ 25 30 amps (4 cyl. FDI at 8,500 1/min/200 bar single injection, 1 MSV, 1 electronic throttle, standard chassis equipment)
 - ~ 35 40 amps (8 cyl. FDI at 8,500 1/min/200 bar single injection, 2 MSV, 2 electronic throttle, standard chassis equipment)
- Power consumption of LP-injectors, actuators and coils are to calculate separately.
- The MS 6 power supply is separated into the maintenance of controller and power stages.
- Ensure controller supply UBAT is activated before the power stages.
- The MS 6 is able to control a main relay or even the power box itself via a low side output.
- As long as the controller is activated, data logging, telemetry and communication is also ongoing.
- The engine On/Off switch activates the ignition and injection outputs to enable engine start separately from power supply.



2.3.6 Ignition Trigger Wheel

To detect the engine position and to calculate the exact crankcase position, the system assumes toothed trigger wheels for proper operation. Recommended is to use 60 (-2) teeth for the flywheel and one teeth for the camshaft detection. Modifications of the mechanical designs are possible, such as using quick-start production designs for the camshaft or different number of teeth for the flywheel **(limited to 30 to 60 teeth)**.



NOTICE

Less number of teeth reduces the accuracy of the system angle measurement.

Not usable are flywheels with 4-1 or 6-1 teeth. Please follow the description below as recommendation for the mechanical dimensions.

Recommended values:

- D = min. 160 mm
- h1 = 3.5 mm
- h2 = h1/2 (important for the use of inductive sensor)
- LSKW = 0.8 mm +/- 0.3 mm
- t = min. 5 mm
- LNSW = 1.0 mm +/- 0.5 mm





 $(*)^{\circ}$ before TDC compression for cyl. #1 , the tooth on the cam trigger must overlap the reference mark of the crank trigger (= 2nd falling edge).

 $(*)^\circ$ before TDC exhaust for cyl. #1 , the tooth at the cam trigger mustNOT overlap the reference mark of the crank trigger.



NOTICE

All angles are shown and indicated in crankshaft degrees.

The width of the cam trigger tooth is not important, however it is recommended to use at least 48 crankshaft degrees (24 cam degrees).

The Hall effect signal may be the inversion of its cam trigger: the tooth effects a "low" signal at the sensor and vice versa for other trigger wheel configurations the indicated values may vary.

2.4 Disposal

Hardware, accessories and packaging should be sorted for recycling in an environmentfriendly manner.

Do not dispose of this electronic device in your household waste.

3 Starting up



NOTICE

All following chapters (Starting up to Harness / Wiring) refer to the MS 6 base family. Some screenshots were taken from the MS 6 family.

3.1 Installation of Software Tools

PC tools and ECU programs for the MS 6 system are available at Bosch Motorsport homepage for free download.

RaceCon V2.5.1.400 or higher	System configuration, data application and online measurement
WinDarab V7	Data analysis tool, Light version as share- ware or Expert version if license available
MS 6 customer_delivery	ECU programs and function description

All tools are delivered as self-installing executable files.

Select your personal installation folder.

3.1.1 Communication PC to device

Ethernet as used network may have some restrictions by firewall and IT protections. Be assure no firewall is active at the PC.

For assistance, Bosch Motorsport homepage explains the necessary PC installations.

The MS 6 system requests a defined IP-adress at the PC, for example 10.10.0.14.

Internet Protocol Version 4 (TCP/IPv4)	Properties			
General				
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.				
Obtain an IP address automatically				
Ouse the following IP address:				
IP address:	10 . 10 . 0 . 14			
Subnet mask:	255 . 255 . 255 . 0			
Default gateway:	· · ·			
Obtain DNS server address auton	natically			
O Use the following DNS server addresses:				
Preferred DNS server:				
Alternate DNS server:	• • •			
Validate settings upon exit	Advanced			
	OK Cancel			

Middle of 2016, programs and basic systems were extended to handle automatic TCP/IP selection also. Former produced devices and program versions may be modified to customer request and -order.

MS 6 devices are connectable via commercial CAT7 cables to the PC; also Bosch Motorsport offers diagnostic cable and programming harnesses as track- and office connections.

Successful connection between PC and MS 6 is shown as green marked connection in the top left corner of RaceCon.

3.2 Configuration of the system

Bosch MS 6 devices are delivered in a not engine executable mode. The customer has to include the correct programs, data applications and licenses.

The MS 6 offers two mainly different configuration areas, related to the two core areas of the controller.

MS 6 ECU

1st core area for the functional part of the MS 6 program. The available content is documentated in the functional descriptions Bosch Motorsport adds to the customer deliveries. Application works will be done via opening the data labels in the edition windows of INCA or RaceCon.

MS 6 Logger

2nd core area for the tool displayed parts like logger-, lap trigger, telemetry and CAN-network configurations. Application work will be done in the predefined function windows of RaceCon.

MS 6 Programming

For system programming or flashing of the device we developed the system configuration tool RaceCon. After the start of the tool, RaceCon opens the screen "Welcome to Race-Con".

With "Last Projects" former projects can be opened directly.

3.2.1 First Steps to create and configure a Project

File / New / RaceCon Project opens a new project in RaceCon.



To create a new vehicle configuration, the devices can be pushed via drag & drop from the toolbox to the vehicle. Then they are part of the project and can be configured.

Select an ECU model MS 6 from the Toolbox / Devices / ECUs.

Drag the ECU icon with pressed left mouse click on the vehicle view, then a dialog opens.



Now the ECU program archive PST files must be selected. These archives are delivered by Bosch or are available at Bosch Motorsport homepage. Specify the MS 6 program archive: MS6B_XXX_xxx.pst.

specify th	e program archive
This crea	tes all devices defined in the program archive
CU progra	m archive:
osch\Race	Con\Daten\MS6\MS6A_BASE_0403\Customer-Delivery\MS6A_BASE_0403.pst
i) The pro	ogram archive is valid.
IP Add	ess: 10.10.0.202
Contain	ned devices:
MS6.4-	ECU DataPath ECU
rates	DataPath:DLP Supports: - Logger (2 recordings, PCode: 444C) - External Display, resolutions: (640x480) - 3 CAN Interfaces - 14 AIVM Types - 2 supported CCPMaster devices - PEP Features: - UPDATE1 - Extended Recording - Enhances channel count and measurement - UPDATE2 - Longterm Recording - Enables second recording as longterm - UPDATE3 - USB Recording: copy 1st measurement additionally to usb stick
	<back next=""> Brish Cancel</back>

Access to all configurable data is now available.

Installation may now be saved as customer project for further data application.



3.2.2 Programs Installation

Going Online for program and license configuration

In the project tree both parts of the MS 6 core are shown as >red<, means MS 6 device and RaceCon project differ in the used program version.



Synchronize MS 6 and RaceCon program version / update the firmware of the device:

Project-tree / right mouse button to one of the red MS 6 core / synchronize / update firmware > select customer software of the MS 6 (file with extension: -.pst)



In the project tree, the MS 6 logger core is shown as >yellow<, means the firmware of MS 6 device and project are identical, but the data differs.



The offline preconfigured data have to be sent to the MS 6. Option one, select: Project tree / right mouse button to the yellow MS 6 core / synchronize / or follow the RaceCon menu:



Both MS 6 cores are shown as green, means firmware and data of device and project are now identical.



3.2.3 Feature/License Activation

For code area generation, additional functionalities and/or data logging licenses may be requested for activation. Generally all MS 6 licenses are related to one specific device and the delivered code is only to activate for this ECU. Both cores, MS 6 ECU and MS 6 logger, content own license structures. Double-click to the core symbol at the project and choice features info. Select the license feature and activate the functionality using the related license code.



Unlock Feature	
Unlock specified feature.	
ENG_PACK2	
Requested KEY:	
<enter pin=""></enter>	

The licenses for gearbox and engine controls are to activate at the MS 6 ECU core. The licenses for USB or logger packages are handled in the MS 6 logger core. MS 6 ECU is now ready for customer data and use.

4 Prepare Data Base

Using RaceCon, the data base is already generated and the modification may start immediately. For information, please see RaceCon manual.

4.1 Initial Data Application

The following chapter deals only with the main parameters which should be checked before a first engine startup. Several functions are recommended to be switched off, many software labels will not be explained in detail. To work on these functions and labels after the first startup, please refer the full-scope function description. The offline data application guide shall help to get the engine started the first time without problems.



Wrong engine setup data may lead to serious engine damages.

4.1.1 Basic Engine Data

The MS 6 system can be used for engines up to 12 cylinders. Please ensure that the correct software variant is loaded in your ECU. Define the engine parameters like number of cylinders, firing order, injection system and cam- and crankshaft designs in relation to TDC.

4.1.2 Crank- and Camshaft Wheel

Main Data Labalata andianya fan mark

The system initially supports wheels with 60-2 teeth. Other configurations **in** the limits between **30- and 60 teeth** may be possible to configure also. Please refer also to the chapter Ignition Trigger Wheel [> 12].

Iviain Data Labels to configure	Main Data Labels to configure for crank- and camsnaft wheel		
CRANK_TOOTH_CNT	Number of teeth of the flywheel (including the missing teeth) (limited to 30-60 teeth)		
CWINTF_A047_A048	Selection of used crankshaft sensor type (Hall or induct- ive type)		
CRANK_GAP_TOOTH_CNT	Number of missing teeth on the flywheel		
CAM_MODE	Camshaft position detection mode		
CAM_TOOTH_CNTx	Number of teeth on the camshaft		
CAM_POS_EDGESx	Position [°CRK] of positive camshaft edges		
CAM_NEG_EDGESx	Position [°CRK] of negative camshaft edges (online measurement, see channels cam_neg(pos)_edges_xxx)		
ANG_CAM_CATCHx	Max. deviation of cam edges angles allowed		
SYNC_CAM	Camshaft signal used for engine synchronization		

4.1.3 Initial Steps

The following data must be set initially to start injection calibration for the first time.

Main Data Labels to configure for firing order and engine design		
DISPLACEMENT	Displacement of all cylinders	
CYLBANK	Cylinder allocations bank 1 or bank 2	
	Example typ. 8 cyl. engine:	
	Cylinder 1 2 3 4 5 6 7 8 9 10 11 12	
	CYLBANK 1 1 1 1 2 2 2 2 0 0 0 0	
	Engines with one Lambda sensor (e.g. 4-in-a-row) run as 1- bank-systems	
	Set CYLBANK to 1.	
CYLNUMBER	Number of cylinders	
CYLANGLE	Angle of cylinder TDCs relative to reference mark (RM \rightarrow TDC)	
CWINJMODE	Selection of injection mode	
QSTAT	Static valve quantity for n-heptane in g/min (injectors are typically measured with n-heptane)	
TDTEUB	Battery voltage correction low-pressure injection. Character- istics can be requested at the injector valve manufacturer.	
TECORPRAIL	Battery voltage correction high-pressure injection. Charac- teristics can be requested at the injector valve manufacturer.	

4.1.4 Basic Path of Injection Calculation

The ECU MS 6 is a so called physically based system. This means in particular that corrections are made according to their origin influence (e.g. air temperature, fuel pressure etc.). For it, the initial engine load signal (throttle angle ath) or the engine charge signal rl (relative load) is defined as 100 %, if the cylinder is filled with air of 20°C and 1013 mbar ("standard condition"). Corrections related to the air path (air temperature, ambient pressure) are therefore performed to this value rl. Based on this central value most of the relevant ECU signals are calculated, first and foremost injection and ignition.

Due to this constellation changes in the air path are centrally considered for all following functions, independently whether they are caused by ambient influences, mechanical changes of the intake system or even a change from alpha/n-system to p/n-system.

Using this rl value, a relative fuel mass rfm is constructed. For an operating point of rl = 100 %, a fuel amount of 100 % is needed, if the desired Lambda = 1. All corrections to the desired fuel quantity like start enrichment, warm up factor, transient compensation, but also the desired Lambda value and the correction factor of the Lambda control are considered as an adjustment of this relative fuel mass. I.e. all corrections are still made independently of the size and other specifications of the injectors.

Next step is the conversion of the relative fuel mass to a desired injection time te. Here the engine's displacement, the fuel flow through the injector and influences of the fuel pressure are considered.

Finally the actual duration of the control pulse ti is calculated, considering pick-up delays of the injectors, fuel cutoff (e.g. overrun cutoff, speed limiter, gear cut) and cylinder individual correction factors. Please refer also to the system overview in the Function Description ECOV.

4.1.5 Main Data Labels to configure for Engine Start up

Main Data Labels to configure for engine start up		
MP_MIXCORR(2)	Mixture correction, set to 1.0 for startup	
MIXCORR_APP	Global factor for mixture correction, set to 1.0 for the be- gin of startup	
CWPRAILCOR	If a correction by fuel pressure is intended, set = 1. In this case please set PRAILREF according to the referenced fuel pressure. Also refer to MP_P22MOD. Usually the pre-defined values are suitable. If unsure, set CWPRAILCOR to 0 for first startup.	
FINJ_WARMUP	Correction via engine coolant temperature. Usually the predefined values are suitable. Ensure, that for coolant temperatures driven on your dyno during calibration, no warm up factor applies (i.e. FINJ_WARMUP is 0.0 for this temperature).	
MP_LAM_MP1	Desired Lambda value, valid for map position 1. According to your expectations, e.g. 0.9. For alternative positions of your map switch the maps MP_LAM_MP2 (3) or (_PACE) apply, therefore ensure correct switch position	

4.1.6 Main Data Labels for Load Calculation

Main Data Labels for Load Calculation		
CWLOAD	Decision between alpha/n or p/n related load calculation	
CWLOADP1	Decision between P1 and ambient pressure	
alpha/n system		
FRLPAMB_P1	Correction via intake air pressure	
FRLTINT	Correction via ambient temperature Usually the predefined values are suitable. If unsure, set FRLTINT to 1.0 for first startup.	
MP_RL	Relative load depending on throttle angle and engine speed. Set value until your desired Lambda is matched.	
p/n systems		
FRLPAMB_P1	Correction via intake air pressure	
FRLPTINT	Correction via ambient temperature. Usually the pre- defined values are suitable. If unsure, set FRLPTINT to 1.0 for first startup.	
FRLPTHR	Factor to throttle dependence. If unsure, set to 1.0 for star- tup.	
MP_RLP1 P4	Relative load depending on throttle position 1-4	

Main Data Labels for Load Calculation	
PALTCOR	Altitude correction for relative load. If unsure, set PALTCOR to 0.0.
MP_RL	Relative load depending on throttle angle and engine speed. Set value until your desired Lambda is matched.
Notice: For details please ref	er to the Function Description LOADCALC.

4.1.7 Main Data Labels for Injection

Main Data Labels for injection		
CWHPI	Choice LP- or HP battery voltage correction	
CWINJANGMODE	Choice of angle of injection relation	
MP_AOINJ	Map begin/end of injection	
LP-system	Standard choice to end of injection pulse, refers to com- bustion TDC (degrees before TDC). Make sure, the injec- tion is finished before the inlet valve closes. Try 200° - 300° for first startup.	
HP-system	Standard choice to start of injection pulse.	
Notice: Before calibration starts, turn off Lambda closed loop control.		
CWLC	Codeword for enabling of the Lambda closed loop control. Set to 0 during initial calibration, afterwards = 1	

4.1.8 Labels to configure Injection during Start Conditions

After initial calibration the start factors for injection may be optimized.

Injection during start conditions		
AOINJ_START_NMOT	Map begin/end of injection during start	
MP_INJSTART	Decay of the start enrichment factor over the number of engine revolutions	
FINJSTART_TMOT	Basic start enrichment factor depending on the engine temperature	
FINJSTART_NMOT	Basic start enrichment factor depending on the engine speed	
Nation: For dataile place refer to the Eurotian Description INURPECTRI		

Notice: For details please refer to the Function Description INJPRECTRL

4.1.9 Main Data Labels for Ignition

Main Data Labels for ignition

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

g	
MP_TDWELL	Coil dwell time. Consult the coil manufacturer for details. Most coils need dwell times about 1.5 to 2.5 ms at 12 to 14 V. For further back- ground information please refer to the Function Description IGNITION.
DIGN_CYL112	Cylinder individual corrections. Set to 0.0. Num- bering refers to mechanical cylinders.
MP_IGN_START/DIGN_ST_TINT	Base spark advance during engine start. Set to 5 to 10 deg, according to the requirements of the engine.
MP_IGN(2/3)	Base ignition timing in deg crankshaft before TDC. Use modest values at the first time. Atmo- spheric engines may run safe at 20 to 25 deg in part load, turbo engines at high boosts may de- mand even less spark advance. These values are strongly dependant on compression ratio, fuel quality, temperature and engine specifics. If you know you're using "poor" fuel, run at high tem- peratures or your engine is very sensitive on spark advance, go to the safe side.
MP_DIGN_TEMP/MP_DIGN_TEMPW	Ignition angle temperature dependent
DIGN_APPL	Delta value for spark advance, use for applica- tion work. Start at 0.0 for first startup.
IGN_IDLE_STAT	Ignition timing during idle. 10 deg are suitable for most applications
NIDLE_NOM / DIGN_IDLECTRL	Desired engine idle speed for idle stabilization. Set value to desired speed or deactivate stabiliz- ation by setting DIGN_IDLECTRL to 0.0.

4.1.10 Main Data Labels for Engine Speed Limitation

The rev limiter works in two steps:

- Soft limitation by ignition retardation or cylinder individual cutoff of injection and/or ignition
- Hard limitation by injection cut off and/or ignition cutoff of all cylinders

To achieve a good dynamic behavior by advanced intervention, the engine speed is predicted by means of the speed gradient.

Main Data Labels for engine speed limitation		
CWNMAX_CUTOFF	Codeword for type of intervention during soft limiter: 0 = only ignition retard 1 = injection cutoff 2 = ignition cutoff, 3 = injection and ignition cutoff	
CWNMAXH_CUTOFF	Codeword for type of intervention during hard limiter: 1 = injection cutoff 2 = ignition cutoff, 3 = injection and ignition cutoff	
NMAX_GEAR	Engine speed limit, gear dependent	
NMAX_P	Determines the slope of the soft limiter between soft limit and hard limit. Predefined. Vary according to your engine's dynamic beha- vior.	
TC_GEARNMAXPR	Prediction time for rev limiter, depends on the inertial torque of the engine. If oscillations occur, reduce value or turn off by setting = 0.0.	

4.1.11 Main Data Labels for Cutoff Pattern

Cutoff Pattern	
MP_COPATTERN	Defines the appropriate cylinders for torque reduction by cylinder cutoff.
	At the beginning of an intervention the next possible cylin- der for starting the cutoff pattern is determined. Based on this info the actual pattern is taken out of the map.
	Pattern should be defined in view of minimized oscillations of the crankshaft.
	Usually a regular distribution of firing and non-firing cylin- ders leads to the best result. However, investigations of the individual engine are recommendable.
	For it, cutoff pattern can be also turned on manually via CUTOFF_APP and CWCUTOFF_APP
	Example: 4-cylinder engine
	Start Cyl./Cutoff stage 1 2 3 4
	1 1 (=0001b) 2 (=0010b) 4 (=0100b) 8 (=1000b)
	2 9 (=1001b) 6 (=0110b) 6 (=0110b) 9 (=1001b)
	3 11 (=1011b) 14 (=1110b) 7 (=0111b) 13 (=1101b)
	4 15 (=1111b) 15 (=1111b) 15 (=1111b) 15 (=1111b)
	The cylinders are assigned bitwise, the lowest bit represents cylinder 1.
	Numbering refers to mechanical cylinders, e.g. pattern = 9: Mechanical cylinders 1 and 4 are fade out.

Cutoff Pattern	
CUTOFF_APP	Cutoff pattern for test purposes. Bit representation as de- scribed at MP_COPATTERN
CWCUTOFF_APP	Codeword for type of intervention during test cutoff: Set: 1 = injection cutoff 2 = ignition cutoff 3 = injection and ignition cutoff.

Notice: This option is also useful for searching a misfiring cylinder. Select one cylinder after the other during test cutoff and watch your engine.

4.2 Peripherals

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.



NOTICE

Make sure the battery is connected properly, all sensors are connected and ground wiring is fixed before powering up the system. Check all sensors for errors (E_...) and reliable measure values before starting the engine.

Sensor configuration

The MS 6 has the option to link a lot of functionalities to a possible hardware input. The chapters "ECUPINS, SWITCHMATRIX and Input Signal Processing" of the functional description explains the details. All functions of Base MS 6 programs are linked like described in the MS 6 documents (e.g. function description ADC_ECU_MAP) or the wiring diagrams.

Analogue sensor inputs

The physical way of conversion from sensor signal voltage to physical values follow the same structures. The hardware input may be connected to different kinds of pull-up options. Inputs with fixed 1.47 kOhm or 3.01 kOhm pull-up resistors are prepared to handle passive sensor elements, for instance temperature sensors with integrated resistors (NTCor PT100 sensors). Inputs without any pull-up resistors are prepared to handle active sensor elements, which deliver 0 to 5 V signals, for instance pressure-, potentiometer- or acceleration sensors. Inputs with switchable 1.47 kOhm pull-ups are designed to handle mainly active sensors with disabled pull-up, but are prepared for future measuring of digital signals. Inputs with switchable 3.01 kOhm pull-ups offer the most options and are recommended to link after the standard sensors are connected. The pull-up resistor itself is not modifiable and for better measure results may be, the version of sensor/mapping line has to be changed. To activate the Pin-Selection, first the label "PIN_IN_function" has to be enabled. Error detection of an analogue input signal detects short cuts to ground, U"function"_MIN recommended to be set to 0.2 V and short cuts to power supply U"function"_MAX recommended to be set to 4.8 V. Failure are activated after the adjustable debounce time of diagnosis TD"function". If a sensor error is set, the output is switched to the default value "function"_DEF.



Pressure measurements

The system offers many different pressure channels; please see function description input signal processing for details. For gradient and offset information contact sensor manufacturer.

Example: Ambient Pressure	
PAMB_OFF, PAMB_GRD	Sensor offset and gradient
UPAMB_MIN, UPAMB_MAX	Minimum and maximum accepted sensor voltage. When violated, an error is set (E_pamb = 1).
PAMB_DEF	Default value if an error occurred.
FCPAMB	Filter constant. For ambient pressure use 1 second, for other pressures choose appro- priate values, ~ 100 to 200 milliseconds

All other variables are named by the same rule; replace "pamb" by e.g. "poil" to apply data for the oil pressure sensor.

Temperature measurements

The system offers many different temperature channels; please see function description input signal processing for details.

Example: Intake Air Temperature	
UTINT_MIN, UTINT_MAX	Minimum and maximum accepted sensor voltage. When violated, an error is set (E_tint = 1).
TINT_CONV	Sensor characteristic. Consult the sensor manufacturer.

Example: Intake Air Temperature

PULLUP_TINT

Value of the used pull-up resistor. If only the ECU's pull-up is used (standard case). Keep the predefined value of 3.01 kOhm.

Thermocouples

The exhaust gas temperatures are measured via thermocouple elements, using a special evaluation circuit. Predefined values should be suitable for NiCrNi or k-type elements. For further details and project specific variants, please refer to the function description.

Digital sensor inputs

MS 6 digital sensor inputs used for frequency measurements are possible to configure to different of sensor types.

CWINTF_A047_A048	Selection between Hall effect or inductive sensor for flywheel measurement, related to MS 6 contact A047 (use ground A048 if in- ductive type is selected).
CWINTF_K045/K046	Selection between Hall effect or inductive sensors for frequency measurements, like turbo- or driveshaft speeds, related to MS 6 contacts K045 or K046 (use ground K062 if inductive types are selected).
CWINTF_A049/A050/A051/A052	Selection between Hall effect or DF11 sensors for frequency measurement, like wheel speeds or cam position detection, re- lated to MS 6 contacts A49, A50, A51 or A52.

4.3 Throttle Control

The system supports mechanic and electronic throttle controls.

Using an MS 6.1 EVO device, respect the necessary license for electronic throttle is activated. Electronic Throttle Control is a safety-critical function. The Bosch Motorsport Electronic Throttle Control System (ETC) is designed and developed exclusively for use in racing cars during motorsport events and corresponds to prototype state. Therefore the driving of an ETC equipped vehicle is limited exclusively to professional race drivers while motorsport events and to system-experienced drivers on closed tracks for testing purposes. In both cases the driver must be instructed regarding the functionality, possible malfunctions of the system and their consequences and must be familiar with possible emergency actions (e.g. pressing the emergency stop switch or the main switch). The system must have emergency switch, whose activation at least cuts the throttle valve actuator from the power supply. Depending on specific use and/or construction, the safety functions, fault detections and fault responses of the ETC system may differ in several points from ETC systems used in series production. Hence before each vehicle-commissioning the system must be checked for accuracy and faultlessness.

Using an MS 6.1 EVO device, respect the necessary license for electronic throttle is activated. Electronic Throttle Control is a safety-critical function. The Bosch Motorsport Electronic Throttle Control System (ETC) is designed and developed exclusively for use in racing cars during motorsport events and corresponds to prototype state. Therefore the driving of an ETC equipped vehicle is limited exclusively to professional race drivers while motorsport events and to system-experienced drivers on closed tracks for testing purposes. In both cases the driver must be instructed regarding the functionality, possible malfunctions of the system and their consequences and must be familiar with possible emergency actions (e.g. pressing the emergency stop switch or the main switch). The system must have emergency switch, whose activation at least cuts the throttle valve actuator from the power supply. Depending on specific use and/or construction, the safety functions, fault detections and fault responses of the ETC system may differ in several points from ETC systems used in series production. Hence before each vehicle-commissioning the system must be checked for accuracy and faultlessness.

The functionality of the ETC diagnosis and the fault responses are described in the technical documents, handed over to the customer together with the system. Each driver must be briefed regarding the system description. Further information you will find in document "SICHERHEITSHINWEISE-Systemanforderungen zum Betrieb eines Bosch Engineering GmbH EGas-Systems" or can be enquired at Bosch Motorsport.

The customer is responsible for the activation of all ETC-relevant diagnosis and for their correct parameterization. By disregarding this information the functionality of the ECU and the safety cannot be ensured.

Notice: For detailed information see function description ETC

The usual route of ETC determines the drivers input measuring the pedal position and transferring this leading signal via functionality options into the control of an electrical throttle actuator. Pedal- and actuator positions are generally measured in a secondary redundant way to verify the reliability of the function. To activate the system, first verify the signal tolerances and error messages by moving acceleration pedal and throttle actuator manually. An inactive system usually is the result of inverted wired sensor signals or actuator controls. Calibrate the pedal- and throttle positions.

Verification of acceleration pedal signals:

The mathematic value of voltage pedal signal 1 - 2*voltage pedal signal 2 has to be below 0.5 V or below value of "UAPSCM_MAX".

Signal principle of an acceleration pedal sensor:



UAPS_MIN, UAPS_MAX:	Minimum and maximum accepted sensor voltage. Set to approx. 200 mV/4,800 mV. Check if the uaps(x) outputs are changing when the pedal is moved.
CWAPSADJ	Codeword to adjust acceleration pedal sig- nal:
	0 = calibration inactive
	1 = calibrate release pedal
	2 = calibrate full-pressed pedal
E_APS	Detected error messages of acceleration pedal functionality. If errors are detected, the ETC functionality will become inactive.

Verification of throttle position signals:

The mathematic value of voltage throttle signal 1 + voltage throttle signal 2 - 5 V has to be below value of "UDTHRCM_MAX" (recommended 0.2 V)

The signal sequences of a throttle position sensor:



Throttle position main data labels:

CWTHR	Codeword for type of throttle controls:
	0 = mechanical throttle
	1 = mechanical throttle with backup poten- tiometer
	2 = electric throttle single bank
	3 = electric throttle dual bank

Throttle position signals:

UDTHR_MIN, UDTHR_MAX	Minimum and maximum accepted sensor voltage. When violated, an error is set (E_thr = 1). Set to approx. 200 mV/4800 mV Check if the uthrottle(xx) outputs are changing when throttles are moved
uthrottle	2 sensor output values and their redundant

uthrottle_b	signals (_b). The system expect a rising up
uthrottle2	voltage for the main signals and a falling signal
uthrottle2_b	for the redundant one.
UDTHRCM_MAX	max. allowed difference between sensor output and redundant signal
	abs (uthrottle(x)+uthrottle(x)_b)-5V < UD- THRCM_MAX

Calibration:

CWTHRADJ	Codeword for throttle adjust:
	1 = automatical calibration process
	2 = calibrate lower mechanical stop
	3 = calibrate upper mechanical stop
	4 = calibrate limp home position

Manual Procedure:

- Close throttle and set CWTHRADJ to 2.
- Open throttle fully and set CWTHRADJ to 3.
- Adjust the throttle to idle point.
- Do not forget to set CWTHRADJ back to 0. Check calibration by moving throttle.

4.4 Vehicle Test

Before starting with your vehicle test, some initial data should be set:

Speed & distance measurements	The signals for speed calculation may be available from different sources, like MS 6 own measurement, GPS data or via CAN re- ceived information from ABS calculation. For MS 6 own calculation, mechanical influ- enced data like number of available sensors, front wheel drive, number of detected incre- ments, wheel circumferences and dynamic corrections like corner speed application a lot of functional options assist the calcula- tion of the effective vehicle speed. Distance measure channels may be derived from speed information. For detailed information see function description >CARSPEED<
CWWHEELCAN	Selection for car speed from CAN signal
CWWHEEL	Connected number of wheel speed sensors or -signals
CWFWD	Selection of front driven vehicle
CWSPEEDDYN	Release of dynamic speed calculation

INC_FRONT	Number of pulses per revolution of the front speed signal
INC_REAR	Number of pulses per revolution of the rear speed signal
CIRCWHEEL_F	Wheel circumference of the front wheels
	Consider dynamic increase of the tire
CIRCWHEEL_R	Wheel circumference of the rear wheels. Consider dynamic increase of the tire.
Vwheel_xx	Measure channel of the individual wheel speeds
Speed	Result of calculated vehicle speed
Accv	Result of speed based derivation of longit- udinal acceleration
Ltdist	Lifetime distance as accumulated result of speed derivation
Lap information and -functions	The necessary data application is integrated in the system configuration tool RaceCon. The wizard leads to configure the beacon input, asks for trustable limits of lap- and signal detection. Additional options for track segmentation, additional on track beacons are also available. Drag and drop the subfolder lap trigger of the measure- ment sources into the project and follow the wizard.



	Depending to the configuration, values for lap-and outing counter, lap time, segment times and differential lap- or segment times for data analysis and driver informa- tion will be created.
Laptrigger_xxxx_yy	Results and measure channels of lap-func- tionalities
Consumption-calculation	Is designed in the same way as lap-inform- ation, drag and drop the subfolder to the project and follow the wizard
Set time & date	MS 6 device is equipped with a real time clock which is supplied for max. 14 days, if the ECU is disconnected from power sup- ply. Please connect the ECU to the PC and click on "SET DATE & TIME" in the context menu of the MS 6.
time_xx	The measure channels of the real time clock.

Ĵ	Open			
01	Create measuring views			
P	Download configuration			
•	Save			
Ľ	Synchronize	•	Ø	Set Date & Time
P	Create dataset			with ECU
7	PIN/SuperPIN	٠		Change program archive
e	Export		1010 0101 7-10	Update firmware
•	Import			Upload configuration
7	Properties		×	Clear logged data
×	Delete		-	Clone ECU .
īje	Rename			Adjustment data

5 ECU plus Data Logger

The MS 6 combines ECU and data logger in one common housing for a cost efficient and weight optimized all-in-one solution.

5.1 Software Tools

RaceCon	Create and configure a project Configuration & management of recordings Create a new recording Add channels to a recording Create user-defined conditions for the recording Download recording configuration
WinDARAB	Upload recorded data Display and analyze the data

5.2 First Recording (Quick Start)

Starting up the data logging

The following chapters demonstrate how to set up data logging and how to analyze the recorded data. It shows the most important functions and features of RaceCon and Win-Darab. For this tutorial we assume, that you have a MS 6 connected to your computer via an Ethernet line.

The MS 6 data recording is separated in two partitions. Both are completely independent. The free of license storable channels have to be selected into the >Recording< folder. Data logging extensions for more than 100 channels or the 2^{nd} partitioning have to be activated in front of the configuration.

Select topic >Logger < in the menu bar.

>Recording < selects data logging package I or the free area for data logging.

>Longterm< selects data logging package II.

Drag and Drop the channels of your selection.

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MS6.4Logger	r and Display config	puration & manageme	nt						Show all	
Add new cha	nnel Edit chan	nel(s) Delete ch	annel(s) 🛛 🗄 Elat view						Name	👻 💌 Func 💌 🔺
Group 1		Nerne	· Source	Rate / True rate	 Condition 	 Telemetry 	 Datatype 	-	a_cametri	CAMCTRL, CA
0 chann	vels Ø 0 KB/s	a_candri	MS6.4-ECU	10 ma		None	16 Bit signed		a_cametri_out	CAMCTRL, CA
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4 chann		a_camotrl_out2	MS6.4-ECU	10 ms		None	16 Bit signed		a_candff	CAMCTRL
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									accx_cal_a	ISACC
									accx_cal_c	ISACC
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Longterm J	Recording	🛛 Settings 🛛 🛄 Sta	atistics					_	4 III	
Ready.								😝 MS6.4ECU, I	E_tmot(Max), for 244,7 s	Aultiselection 😁 🚥

>settings < For limited recording, please follow the wizard.

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M56.420J Stata M55.4Loger and Display			d ⊁ Data-Recording ⊐
	MS6.4Logger and Diselay settings Namestings Agglication: Race Insid: • Becording format: WHECHAOLB V6 •	File fragmentation gave 20 (± 46) File fragmentation gave 200 (±) esc	Show all
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🛐 Longtonn 👔 Recording 🔠 Settings 🙀 Statistics			Sec. (4, 2 Sec. (4, 2 Sec. (4, 2) Sec. (4
Aug. 1			

> statistics < check the selection to ensure the system limits are respected.

	Base_Project.rtp - RaceCon V2.5.1.400 *	_ a x
System Logger Display	r Calibration,Measuring Tools	<u> </u>
M56.4-ECJ Status Recording		
MS6.4 Logger and Display	4 b	Data - Recording #
	Tel:64 Lloger and Factoria Series Series	Court all Court all
Longterm Recording Settings	Statistics	
Pearly	AND A FOLL F. treat/May) for 1105-44 Content/MS6-41 content	and Display Longer Recording New Group

>group< to separate measure channels into different groups, referring to customer- or functional structures.

> edit recording channel < right mouse button to one or a selection of recorded channels opens the option to modify the sampling rate and/or the selection for online telemetry.

Edit Recording Channel		
Change channel, rates, condition or teleme	ry mode of the recording char	inel.
<u>Channel:</u>		
🐺 📑 a_camctrl		-
not logged		
Recording		
Rate:		
10 ms	•	
Condition:	True rate:	
	· .	~
Telemetry:		
None	•	

> Project Window / MS 6 Logger / right mouse button / download configuration.

> download configuration < Send your configuration to the device, the recording will start within the defined limits (without defined condition, the recording will start immediately).
5.3 USB Data Recording

The MS 6 data recording contents the feature to send a copy of the recorded data to an USB stick. Required is just an activated USB-license and wire installation. Technical aspects of commercial USB sticks may lead to connection- and data storage problems. Therefore Bosch Motorsport recommends and offers just USB drive with the Bosch Order Number F02U.V01.342-02.

Please format the storage medium to Bosch file system available at >RaceCon / menu bar / tools / format USB stick< before the first use. Please press >format USB stick< first, then insert the stick.

~	DB SLICK			
Please in	sert a USB stick to start	formatting.		•**
USB stick	info			
Size:	unknown			
Format:	unknown			
Otatua - Wr	iting for LISP etick			
Jidius. We	iting for 050 slok			
All statements				
i) Please	insert an USB stick			
i) Please Detecti If the U	insert an USB stick ng the stick may take s SB stick is still plugged	some time. Please be d in, remove it and ir) patient. Isert it again.	

Measure channels to verify USB data recording

usb_mediastate	0: not found
	1: stick detected
	2: stick installed
	3: stick unplugged
	4: (access)
	5: error
	6: corrupted
meas_cnt_forked	counter of recorded data blocks

6 Project Configuration

6.1 Math Channels

- Arithmetic and logical operations on up to 4 measurement channel(s)
- Numerical result
- Result can be used as input source for various display elements (numeric elements, alarms, bargraphs) and further calculations in the whole RaceCon project

Creating a new Math Channel

1. Follow the steps shown in the screenshot. The "Create/edit math channel" window appears.

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	fe Mith Chatrels		Multipoint Adjustr	Jent
the Project tree	- Group adjustments		Prequency sources	
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		U 113848 D0/7-76 Logger dda wishtins tre loca osis. 113848 D0/7-76 Losger dda wishtins tre loca osis.		
		11:38:24 D0U7-Ne Successfully connected to device[Ethemet]VCP].		
		IIIIac2+ U0/7-789% CROSSER.psf/19/00000000000000000000000000000000000	-	
	CanchangeoprotectionState	11:13k:25 DDU7-Ne Logger data watches the local data.		
		Phile States Phile Low - stated		

2. Define the math channel using the following configuration possibilities:



- a) Enter the name of the math channel.
- b) Enter a description of the math channel.
- c) Enter the formula.
- d) Select the logical operator.
- e) Choose a measurement channel.
- f) Define a value that can be used as a constant in the formula.
- g) Choose a function.
- h) Describes the function selected above.

Click 'Finish' when done. The math channel is displayed in the math channel window.

6.2 Conditional Functions

- Arithmetic and logical operations on one or more measurement channel(s)
- If-Else structure with reset
- Numerical result
- Result can be used as input source for various display elements (numeric elements, alarms, bargraphs) and further calculations in the whole RaceCon project.
 All math and conditional channels can be used globally in the whole RaceCon project.

Creating a new Conditional Function

1. Follow the steps shown in the screenshot. The "create/edit math channel" window appears.

		0007.00 - Katolon V25.02002	
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the drandown	and the second second		Computed sources
те агориомп	Data - Matricharres + X		Characteristic Curve
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<i>c ·</i> · ·	E Math channels properties	(J) 11/455 0007-Ne BrChecks.cossR4. (BK Device: 1007_8A6E_0727) 4. 11/455 Almon-Ne No channel science: entranced. Science: America.	
function	Name Math Channes	11:H2:53 D0U7-Ne Logger data matches the local data.	
•		11/4/13 D0(7-Ne Lost connection to device(Dimension(DP). 11/4/13 D0(7-Ne Lost connection to device(Dimension(DP). 11/4/13 D0(7-Ne)	
		11:41:14 DDU7-Ne IPK-check successful. (IPK-Denior: DDU7_JM&E_0727)	
	CanChangedProtectionState	104215 Alam - Ne No channel source configured, slopping element 101112 1012 1012 1012 1012 1012 1012 1012 101	- 00

2. Define the math channel using the following configuration possibilities:

	ĺ	Create/edit conditional function		×	
		Define the conditional function's gener	ral properties and it's calculation rules.	fx.	
		Name:			
a)		p_br_front_mx			
b)		f: p_br_front > 20	Then: Max (p_br_front, p_br_front_mx)		 d)
		Otherwise:	Reset value:		
c)		p_br_front_mx	10	🛉	 e)
		 If (p_br_front > 20) is TRUE, then return Reset value is used: before If-condition becomes TRUE for th or when If-condition changes state from 	n (max (p_br_front, p_br_front_mx)), else return (p_br_front_mx). he first time after power-up FALSE to TRUE.		
			< Back Next > Finish	Cancel	

a) Enter the name of the conditional function.

b) Enter the If-condition. Click pencil symbol to open an editor to enter expressions.c) Enter the Then-condition. Click pencil symbol to open an editor to enter expressions.d) Enter the Otherwise-condition. Click pencil symbol to open an editor to enter expressions.

e) Enter the reset value (must be a number).

Click 'Finish' when done.

The conditional function works the following way:

The program always calculates the condition entered in the IF window and checks if the condition is TRUE or FALSE.

If the condition entered in the IF window is TRUE, the program calculates the condition entered in the THEN window. The returned value is the content of the new variable (entered in "Name").

If the condition entered in the IF window is FALSE, the program calculates the condition entered in the OTHERWISE window. The returned value is the content of the new variable (entered in "Name").

The reset value is always set for the new variable (entered in "Name"):

- before the If-condition becomes TRUE for the first time after power-up
- when the If-condition changes state from FALSE to TRUE.

An example of a condition to set up the maximum front brake pressure is given on the next page.

The conditional function is displayed in the MS 6 math channel window.

Example: Setting up a condition for maximum front brake pressure Brake pressure 'front p_br_front'



- At power-up, the reset value (10) is used for 'p_br_front_mx'.

- 'p_br_front' rises to 30. As 'p_br_front' is > 20 (condition is TRUE), the condition 'max (p_br_front, p_br_front_mx)' in the THEN window is triggered. The condition sets the bigger value as new value for 'p_br_front_mx'. As 'p_br_front' (30) is bigger than 'p_br_front_mx' (10), the new value for 'p_br_front_mx' is set to 30.
- Although 'p_br_front' falls to 25, the value of 'p_br_front_mx' stays 30. This is caused by the THEN-condition, because p_br_front_mx' (30) is still bigger than p_br_front' (25).
- 'p_br_front' rises to 40. As 'p_br_front' (40) is bigger than 'p_br_front_mx' (30), the new value for 'p_br_front_mx' is set to 40.
- As 'p_br_front' falls below 20, the IF-condition turns to FALSE. Now the OTHERWISEcondition is triggered. Because the condition 'p_br_front_mx' sets the value of 'p_br_front_mx' and the value is already set to 40, nothing changes.
- When 'p_br_front' rises to 40, the IF-condition changes to TRUE again and triggers the THEN-condition. Now the reset value (10) is used for 'p_br_front_mx' in the THENcondition.
- The new value of 'p_br_front_mx' is 40 because 40 is bigger than 10.

6.3 Conditional Channels

- Logical operations on measurement channel(s)
- If-Else structure with reset
- Logical result
- Result can be used as input source for alarm display elements and further calculations in the whole RaceCon project.

Creating a new Conditional Channel

1. Follow the steps shown in the screenshot. The "Create/edit condition" window appears.



2. Define the condition channel, using the following configuration possibilities:

	Define the conditions general properties and Select between single channel/value or multiple co	the condition itself.	nparing mode. fx
	Name:		
-	Comparing mode Constant Channel	Range	Multiple (constant list)
-	Input channel:	Operator: Constant value	:
	General settings	Output setting	
		Output mode:	Constant TRUE/FALSE
	Tum on delay:	u 🐑 ms	

a) Enter the name of the conditional channel.

b) Select the comparing mode:

- Constant: Compare a measurement channel with a constant value.
- Channel: Compare a measurement channel with a measurement channel.
- Range: Compare a measurement channel with a defined value range.
- Multiple: Compare a measurement channel with up to 5 constant values.

c) Depending on the chosen comparing mode, you can enter the following values:

- Constant: Choose the measurement channel or condition, the operator and enter the value of the channel.
- Channel: Choose the measurement channel or condition, the operator and the measurement channel or condition to be compared.
- Range: Choose the measurement channel or condition, the operator and define the minium and maximum value.
- Multiple: Choose the measurement channel or condition, the operator and enter the value of up to 5 constants.

d) Enter the minimal time to detect the signal of the measurement channel, to avoid highfrequent switchovers.

e) Enter the time by which the signal of the measuring channel is delayed after its end.

f) Choose the output setting of the result.

- Constant TRUE/FALSE: Result is as a constant with the value TRUE or FALSE.
- Blinking: Result is a blinking, if the condition is fulfilled.
- Pulse: Result is a short one-time pulse, if the condition is fulfilled.
- Toggling output: Result is a pulse that lasts until the next condition is fulfilled.
- Click 'Ok' when done. The conditional channel is displayed in the MS 6 condition channel window.

6.4 Condition Combination

- Combination of several (up to 16) conditional channels for more complex calculations
- Logical results
- All conditions can be used globally in the whole MS 6 project.

Creating a new Condition Combination

Follow the steps shown in the screenshot.

		0007.g- Kastin (3.5.500) s debashasing hak index	•
	DD.7 Race Hole India Anima	նել նաև նաև նաև ներությունը։ Հիվ հուհորդ։ Դի հոտ։ հետ հետությունը։	N Toolbox 0 K
1st: Double-click on 'Conditional Channels' in Project Tree	A Man Tourist A Man T	The output care of experiments of the southers, and the southers,	Deam Depts Reveals Research Reveals Reveals Research Reveals Research Reveals Reveals Research Reveals Research Reveals Research Reveals Research Reveals Research Reveals Research Reveals Research Reveals Research Reveals Research Reveals Reveals Research Reveals Research Reveals Reveal
the dropdown arrow beside 'Add condition'	Dece al	anne i è a fondi è concerne Bittem Bittem Bittem i i ben i i ben di è tradi à tamat	Pref
3rd: Choose	21 Y standard - - • 21 21 Y standard - - • • Conditional channels properties frame Conditional Durvels B Defug Centrogenets Top Conditional Top	Ministra # @ finally [a]	N N N
'Conditional combination'	CasChangedTruitection58ate	1010 1010 1000 <td< th=""><th></th></td<>	

The "Create/edit condition combination" window appears. Define the condition combination, using the following configuration possibilities:

	Create/edit condition combination		
	Combine multiple conditions.	fx	
a) b)	 Name: Add AND Add OR Remove Edit		
	< Back Next > Finish	Cancel	

a) Enter the name of the condition combination.

b) Create the condition combination in the window.

- Choose a channel (condition, conditional function, math, measurement channel with binary values) to be compared.
- Combine multiple conditions, by adding 'AND' or 'OR' relations.
- To negate a condition, click with the right mouse-button on the condition and select 'Negation (!)'.
- Combine several (up to 16) conditions.

Click 'Next' to go to the next page. Choose the output setting of the result:

Create / edit condition combination				×
Create / edit condition combination				fr
Combine multiple conditions.				JX
Name:				
condComb				
Output configuration:				
Constant TRUE/FALSE				ĸ
Constant TRUE/FALSE				5
Pulsing				
	< Back	Next >	Finish	Cancel

- Constant TRUE/FALSE: Result is as a constant with the value TRUE or FALSE.
- Blinking: Result is a blinking, if the condition is fulfilled.
- Pulsing: Result is a short one-time pulse, if the condition is fulfilled.
- Toggling output: Result is a pulse that lasts until the next condition is fulfilled.

Click 'Finish' when done. The conditional combination is displayed in the MS 6 condition channel window.

6.5 Display Switch Module

You can use the Display Switch Module to switch display pages and brightness. The output is a display page or brightness output that can be used in display configurations. The value sustains over a power cycle.

The conditions for incrementing/decrementing the value can be set freely. The maximum value can be set as constant or read from a measurement.

The page can be configured to wrap around. In this case, no page down condition is needed.

Display Switch Wizard - Add New						×
Display Switch properties Setup the up and down signal sources	s and the maximum cou	unt of steps.				_+
Source for signal Up:					Edge:	
📮 🙆 page_up				2	Falling	\sim
Source for signal Down:					Edge:	
睅 🛃 page_dn				<i>i</i> ~	Falling	\sim
Maximum count of steps: Signal source: Constant: Display switch does not wrap around Measurement Sheet:					1	2.
						~
	< Back	Next >	Finis	h	Can	cel

The resulting outputs are the display switch value and the input conditions.

Measurement label	Function
name	page or brightness value
name_ dn	input condition for decrement
name_ up	input condition for increment
Example:	
displayPage_dn displayPage_up displayPage_up	C80 Logger C80 Logger C80 Logger

6.6 Timer Module

The Timer Module is designed to implement timing triggers, i.e. for rallye stage timing or minimum pit time calculations. Any event in the system can be used for starting, stopping and resetting the timer.

Up counting mode and down counting mode are available, triggers are fired at set time (up counting) or at zero (down counting). The running timer will keep its state over a power cycle.

Timer Wizard - Add New			×
Timer configuration Specify timer properties and a set of	control signals.		D n
Properties Mode: Count down Count up 10.00 s Measurement sheet V	Control signals Start timer: Stop timer (optional): Cond_start Stop timer (optional): Cond_stop Reset timer (optional): Cond_reset Use timer expiration to reset timer		Edge: Falling V Edge: Falling V Falling V
	< Back Next >	Finish	Cancel:

The output channels for this module depend on the name used for the module and are called ..._time and ..._trig.

Measurement label	Function
name_ time	actual timer value
name_ trig	trigger set by timer alarm

In this example, the module is named "Timer_Module". Resulting channels are:

Timer_Module_time	C70
Timer_Module_trig	C70

6.7 GPS Trigger Module

The GPS Trigger Module triggers depending on GPS-position, similar to the GPS-laptrigger. There are 2×10 GPS trigger points available, 10 in the parameter and 10 in the macro-based mode.

If the car passes one of the trigger points, an output signal is set to 1 shortly. Each trigger requires a defined latitude, longitude and detection range.

PS Trigger configuration			
Specify GPS Trigger input signals.			
PS source:	Trigg	ers to store GPS position (optional)	
Latitude:	1	Cond start	
🖳 🔤 gps_lat	~		
Longitude:	2.		~
💾 🔤 gps_long	 ✓ 3. 		~
Direction (optional):	4		~
🖳 🔤 gps_direction	~		
Speed (optional):	5.		~
💾 👜 gps_speed	~ 6.		~
	7.		~
	8.		~
	9.		~
	10.		~

The parameter-based trigger points need to be set manually in RaceCon, the macrobased trigger points will store latitude and longitude values when the configurable trigger condition comes true (i.e. steering wheel button). This trigger condition and the detection range need to be configured in RaceCon.

GPS Trigger Wizard - Edit gpsmo	od		>
GPS Trigger configuration Specify GPS Trigger configuratio	n.		9
Fudge Factor:	GPS positions (Parameter based)	Detection range (Macro based)	
Measurement sheet	Latitude [DD]	Longitude in [DD]	Detection range [m]
~	0,00000000	0.0000000	20.00 🜩
	0.00000000 🜩	0.0000000	20.00 🜩
	0.00000000	0.0000000	20.00 🜩
	0.00000000	0.0000000	20,00 🖨
	0.00000000 🜩	0.0000000	20.00 🖨
	0.0000000	0.0000000	20,00 🜩
	0,0000000	0.0000000	20.00 🖨
	0,0000000	0.0000000	20.00 🖨
	0.0000000	0.0000000	20,00 🜩
	0,0000000	0.0000000	20,00 🜩
	< Back	K Next > F	inish Cancel

The GPS trigger points can also be used for segment triggering. If used as segment triggers and i.e. 3 trigger points are selected, the laptrigger module will use the first 3 trigger points on the list. The channel names depend on the name used for the module, in this example GPS_Trigger. Each trigger has a distance and a trigger channel with the abbreviation m for macro or p for parameter based. The trigger channel will be set to 1, when the lowest distance to the trigger point is detected. For the macro-based trigger, the stored latitude and longitude values can be seen with the channels.

Measurement label	Function
name_ lat	interpolated gps latitude
name_ long	interpolated gps longitude
name_ ptrig_110	trigger output of parameter based trigger (n)
name_ pdist_110	distance to trigger of parameter based trigger (n)
name_ mtrig_110	trigger output of macro based trigger (n)
name_ mdist_110	distance to trigger of parameter based trigger (n)
name_macro_lat_110	stored latitude for macro based trigger (n)
name_macro_long_110	stored longitude for macro based trigger (n)
Example:	
GPS_Trigger_mdist_2	©1C70
GPS_Trigger_mtrig_2	0 C70
GPS_Trigger_pdist_2	C70
GPS_Trigger_ptrig_2	©1C70
GPS_Trigger_macro_lat_2	C70
GPS_Trigger_macro_long_2	© C70

6.8 CPU Load Limits

As all microprocessors, the two processors of the MS 6 have limited capacities. The current load of the processors can be monitored using the channel "cpu_load_001" or "cpu_load_002". When configuring your device, please make sure the used CPU load is in a save range below 100 %.

Bosch recommends a maximum CPU load of 85 % (averaged). Exceeding this limit might result in the MS 6 not being able to fulfill its required measuring/logging/display tasks or even in crashing and rebooting.

Main factors influencing the CPU load are:

- Number and complexity of math channels
- Number and complexity of conditions
- CAN traffic on both CAN lines
- Logger configuration (total logging rate [kB/s], conditional measurement rates)

To help respecting the limit of 85 % CPU load, the MS 6 creates an error memory entry. To trigger this error entry, the CPU load must exceed the limit for 5 minutes without interruption.

When being confronted with this error memory entry (see 'Error info' in RaceCon) or when being confronted with MS 6 resets due to complex configuration setups, please consider reducing the demands on the MS 6 adapting the influencing factors mentioned above.

7 CAN Configuration

MS 6 has 3 fully configurable CAN buses.

- Baudrate (125 kBaud to 1 MBaud)
- Input configuration: read messages from CAN bus and convert to MS 6 measurement variables
- CAN bus supports row counter configuration
- Output configuration: write MS 6 measure variables to CAN messages
- Configurable output frequency and row counter
- CAN gateway functionality (transfer from one bus to another)
- Verify errors on the CAN bus and configurable default values

7.1 CAN Bus Trivia

CAN message

- 11 Bit (standard) or 29 Bit (extended) identifier
- Up to 8 bytes of data payload

CAN bus

- Needs termination resistors (120 Ohm) in wiring harness
- All devices connected to the bus must use identical data rate

Configuration of MS 6 data rate in 'Properties' menu

by double click on the CAN bus in project tree (1 MBaud, 500 kBit, 250 kBit, 125 kBit)



7.2 CAN Input

7.2.1 Input configuration



7.2.2 Create a new CAN channel

Double-click on any CAN bus item, to open the "CAN messages overview".

Select 'Add CAN-IN' and choose the desired CAN bus for the new input channel.

	System	00010.0p - Ka	econ v2.5.5507.11				
System Logger Display Calibration/Measuring Tools	Windows						0
DUU3b Rece Mode Voider Rece Mode Rece	rfie to rfie from sove WPJRP Dov vid recessoon	Articed SuperFills	Unlock				
Fried 9 x		1 (H)					Toolbox 6
4 An india 9 4 An india 9 6 CO30 9 1 COM india 9 2 COM india 9 Compared Comments Compared Comments 4 Macrosoft Compared Comments 9 Macrosoft Compared Comments 9 Macrosoft Compared Comments	DOULID OAI Investopes OAI Bas 1 Baudinte: OAI Resistor: OAI Out start feller: OAI Out start feller:	00000/0000 21 Millioned • 21 Million	CAN Bus 2 Boudrate: CAN Resistor: CAN Out start delay: CAN Out rate linit:	L Minud • of • • • ms • messages/m	ON Bus 3 Boudrate: ON Resistor: ON Out start deby: ON Out case linit:	Contraction of the second seco	COURS C
	CAN computation filles	CAN In IDs 0 / 128			CAN OUT IDs 0 / 12	8	MSS.8
		CAN In channels 0 / 500			CAN Out channels 0 /	400	NS24 light
napoles • • • • • • • • • • • • • • • • • • •	CAN BUS 1. CAN BUS 1. CAN BUS 2. CAN BUS 3. CAN BUS 4.	GAN ID V Start Br	ete E Length (Bits)	V Grid V M	utplexer Value 💌 Type	CAN Bus	Al MS2S Sport proce proce processory ac Crash ECU Prover centrol unit processory pr
Application	Statistics ./s Math Che	arnels 🖉 - Canditional Channels	🗟 CAN messages 🔤	Meeros Metrogs 🕕 Device	rfe 🛛 😣 Error infe 🔤 🛱 Fe	sstures info	Measupement Sources
Show all	Function Views	* * 1	nto / Stotus Errors 🔥 Warnin F Time Send	gs () Messages er Message			5 A
		No information	Info / Status CAN Log-	Stopped SYS Log - Stopped	_		

A CAN channel configuration window opens.

Insert the name and description of the channel.

New CAN-IN me Configure the n	ssage ew CAN-IN message ar	nd an optional mult	iplexer.		
Name:					
o_oil					
Description engine oil pressure					
CAN ID:	0	hex		Extended	
Timeout:	0	🔹 ms	Default value:	0	x raw
Measured Value					
Value:			Raw:		
		none			
Use Multiplexer					
Representation:	Byte	*	Value:	0	A. V
Start:	0	A V	Length:	1	A V
Туре	Unsigned	Ŧ	Endianes:	Big	Ŧ
Data					
Representation:	Byte	-			
Start:	0		Length:	1	-
Туре	Unsigned	-	Endianes:	Little	-
0 1	2	3	4 5	6	7
Conversion					
Factor:	1.0	none/Bit	Minumum:	0.0	anone
Offset:	0.0 🍃	🌲 none	Maximum:	255,0	none
Unitgroup:	none	•		🔲 Adjust automat	ically
Unit:	none	•			
Measurement She	et				
Select one, or ente	er a new name:		 The CAN-IN me specified sheet. 	ssage will be added for	measuring in the

Click 'OK' when done.

The channel is listed in the Data window.

		CAN Bus	2		CAN Bus 3		
Baudrate:	1 MBaud	 Baudrate 	: 1 MBaud	•	Baudrate:	1 MBaud	•
CAN Resistor:	off	CAN Resi	stor: off	•	CAN Resistor:	off	Ŧ
CAN Out start delay:	0 ms	CAN Out	start delay:	0 ms	CAN Out start delay:	0	ms
AN Out rate limit:	0 messag	jes/ms CAN Out	rate limit:	0 messages/ms	CAN Out rate limit:	0	messages/m
AN Bus 4							
audrate:	1 MBaud	•					
AN Resistor:	off	¥					
AN Out start delay:	0 ms						
AN Out rate limit:	0 messag	ges/ms					
	evel						
AN configuration fill I	CAN IN IDS 1	128			CAN Out IDs 0 / 12	3	
AN configuration fill I	00010001				CAN Out channels 0 /	400	
AN configuration fill	CAN In channels	1 / 500					
AN configuration fill	CAN In channels	1 / 500					
AN configuration fill Add CAN-IN - S me A	CAN In channels Add CAN-OUT + DEdit CAN ID	1 / 500 Delete Start Bit 💌 L	ength [Bits]	Grid 💌 Multij	olexer Value 💌 Type	CAN	Bus





7.2.4 Extracting data from CAN bus

Representation: Byte

Some CAN devices need to be addressed by a byte represented CAN channel. The address can be assigned in this window and is illustrated by a bar graph.



a) Enter CAN message ID. If extended IDs (29 bit) are used, check the box.

b) If replacement values are used, specify timeout period and raw value.

c) If a multiplexer (row counter) is used, check the box.

d) Enter data position, length and format.

e) The bargraph shows assignment of the bytes.

- Red colored fields show the assignment of the data bytes.

- Orange colored fields show the assignment of the multiplexer bytes.

Representation: Bit

Some CAN devices need to be addressed by a bit represented CAN channel. The address can be assigned in this window and is illustrated by a matrix table.

	Edit CAN-IN message					<u> </u>
	Edit CAN-IN mess Configure the CA	sage N-IN message and its option	nal multiplexer.			\$
	Name: p_oil					
	Description engine oil pressure					
a) 🔶	CAN ID:	0	hex		Extended	
) ——	Timeout:	0	ms	Default value:	0	raw
	Measured Value Value:		none	Raw:		
.)	Vse Multiplexer					
-, -	Representation:	Bit		Value:	0	
	Start:	0		Length:	7	
	Туре	Unsigned •		Endianes:	Little 🗸	
	Data					
d) —	Representation:	Bit			-	
	Start:	25		Length:		1
e)	0 8	16 2	4 3	2 40	48 56	
	Conversion	(
	Factor:	1,0	none/Bit	Minumum:	0,0	none
	Unitaroup		none	Maximum.	Z00,0	none
	Unit:				- Adjust automatically	
	Measurement Sheet Select one, or enter	a new name:	•	The CAN-IN messa specified sheet.	ge will be added for measurin	g in the
					ОК	Cancel

a) Enter CAN message ID. If extended IDs (29 bit) are used, check the box.

b) If replacement values are used, specify time-out period and raw value.

- c) If a multiplexer (row counter) is used, check the box.
- d) Enter data position, length and format.

e) The bargraph shows the assignment of the bits.

- Red colored fields show the assignment of the data bits.
- Orange colored fields show the assignment of the multiplexer bits.

7.2.5 Conversion to physical values

		o on o o o o o						
a)		Factor:	1,0	bar/Bit	Minumum:	0,0	bar 🗲	— e)
b)	\rightarrow	Offset:	0,0	bar	Maximum:	255,0	bar 🔫	— f)
c)		Unitgroup:	pressure •			Adjust automatically	-	g)
d)		Unit:	bar 🔹					



7.2.6 Online view of CAN channels in vehicle

- 1. Double-click on 'Sheet 1' in Project Tree. Measurement Sheet 1 is displayed in Main Area.
- 2. Click on 'Measurement elements' in the Toolbox.
- 3. Drag the desired Measurement element (e.g. Numeric Indicator) and drop it on the Measurement Sheet.

Coloration/Messuing D0U7.rbp - RaceCon V2.5.0.2002	- 4	a x
System Logger Display Calibration/Mastoring Tools Folder/Sheets Format		0
Sol Sol <th></th> <th></th>		
The Heasurement Folder 1 4 b	Toobax -	-
	Devices	
	Display Elements	- 8
	Measurement Elements	
Drag + Drop	Segent Segent Segent Segent Segent Segent Segent Segent Segent Vecal large Vecal large Vecal large Vecal large Vecal large Vecal large Segent Vecal large Vecal larg	
(B) Dent 2 (B) Sent 1	Measurement Sources	_

- 4. Click on folder 'CAN Input' of desired CAN bus to display available channels.
- 5. Drag desired Measurement channel and drop it on the Measurement element.



The measurement element displays the values of the assigned channel.

6. Connect PC to the vehicle and switch to 'Race Mode' by clicking 'F11' on the keyboard to display online data.

7.2.7 Import a CAN database (DBC) file

- 1. Click with the right mouse button on any CAN bus item.
- 2. Select 'Import CAN-IN messages from DBC file...' from menu.
- 3. A file browser opens.
- 4. Select the DBC file to import and click 'Open' when done.
- 5. A channel import window opens.

99 channels and 12	/ mes	ssages	s availa	able	D	Description		channels to import:
Name	U	Id	Size	Row	Row	Description	A	
ABS_Active		5C0	1					
ABS_Lamp		5C0	1					Add ->
JAX1	g	80	16				Ξ	
AX1_Bremse60	g	5C0	16					Add all
	g	70	16					
AY1_Bremse60	g	5C0	16					
BLS		5C0	1					
EBD_Lamp		5C0	1					<- Bemove
P_Hz	bar	5C0	16					
SwitchState		5C0	8					Remove all
→WS_FL	m/s	140	16			Radgeschwindigkeit		
WS FI Bremse2	m/s	24A	16				Ψ.	
*						•		

- 6. Select the desired channels on the left and use the 'Add' button to add them to the import list.
- 7. Click 'OK' when done.

The channels are inserted in the Data window.

7.2.8 Export in RaceCon

You can choose to export the whole project or you can export specific parts of the project.

Proceed with the following steps to perform an export:

- 1. Click with the right mouse button on an item in the project tree.
- 2. Select 'Export...' from menu. An 'Export Selection' window opens.

Elemente la manat		Describer	
These elements will be expected		These elements will be also expected because they are used at No	u Drojest
- Ital New Project		Mensurement Container	ALIOPER
Massurement Container		Measurement Folder 1	
Measurement Folder 1		- Meddelenen forder f	
Sheet 1	-		
	=	Sheet 2	-
Sheet 2			
		- Macros	
Macros		- & Math Channels	
- & Math Channels		- fr Conditional Channels	
- Is Conditional Channels		Scoup adjustments	
Scoup adjustments		Computed Channels	
Computed Channels		# I/O Channels	
- # I/O Channels		E-9 Logger	
e Cooper		in the Logging 2	
Logging2		Group 1	
Group 1	_	E R Longing 1	

- 3. Click on 'Export' to select a destination to store.
- 4. Specify the filename.
- 5. Click 'Save' when done.

7.2.9 Import in RaceCon

You can choose to import the whole project or you can import specific parts of the project.

Proceed with the following steps to perform an import:

- 1. Click with the right mouse button on any item in the project tree.
- 2. Select 'Import...' from menu. A file browser opens.
- 3. Select the input file and click 'Open'. An 'Import Selection' window opens.



4. Select channels to import.

- 5. Drag and drop the channel to 'CAN Input' of desired CAN bus on right hand side.

 Importing from file export (street(25.5.0)

 TraggOrag elements from the import content to the current project...

 Summary: I imported element, imported elements complete!

 Import content (source)

 CAN bus 1

 CAN bus 1

 CAN bus 1

 CAN bus 1

 CAN bus 2

 CAN bus 3

 CAN bus 4
- 6. Click 'Finish'. If a measurement channel belongs to more than one source, the 'Solve Label Ambiguity' window opens.



- 7. Assign the ambiguous channels to the desired source.
- 8. Click 'Finish'.

7.3 CAN Output

7.3.1 Output configuration



7.3.2 Create new CAN output message channel

Double-click on any CAN bus item, to open the "CAN messages overview".

1. Select 'Add CAN-OUT' and choose the desired CAN bus for the new output channel.

	uten DDU10.rlp - Rac	eCon V2.5.5507.11 *		
0001 Face Mode 2020/0 Wate				
Working Working Working Working Use Stage Stage	Execution Execution	Citi the Citit th	ON had S Boutine S ON had S ON out tat have S O	Carbon Control 1 Control 1<
onnoe 0 x 21 IT standerd - ⊡ - ₩	Stations A Math Observes A Conditional Channels	O Sectors	to 🕐 Emprinto 🖨 Festures Velo	Custom ECU Prover control unit B Paxes Costan Paxes Osplay Bernents Measurement Elements Measurement Sources
nov all ane rei Source e Decription e A	secton • Used No information	rfe / Scalus © Encers Mannings 1) Messages Tree Sender Message		, a e e a (0 p
		We / Status CVN Log - Stapped SYS Log - Stopped		

w CAN-OUT messag	je				— ×
New CAN-OUT me Configure the CAN	ssage I-OUT message and an optional multiplexer.				<
Name:					
CAN Message					
Description					
CAN ID:	0	hex	Extended		
Grid:	100 ms	•	Trigger channel:		
			Trigger on:	Rising - ed	ge
Use Multiplexer Representation:	Byte	•	Value:	1	
Sidir.	0	T	Endianes:	Big	
📑 Add row 🔜	Delete row(s) 🔄 Add channel 📑 Add	constant <table-cell></table-cell>	🕽 Edit 🗟 Delete	Bit index inverted	
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					ol

The 'New CAN-OUT message' window opens.

2. Enter name of message, description, CAN-Id and Grid (output interval). Optionally, specify a multiplexer.



- 3. Click on 'Add channel' or 'Add constant', this opens the 'Add new CAN out channel' window.
- 4. Select the desired measurement channel and specify the message settings.

Canal Change archite	a 🔣 Write für ta 🔤	Creargency unlock		
0010 Roce Mode with Protection Short 🏪 Update Firmw	ere 🖏 Read lie frem. New CAN-OU	T message		8
Iscked Set date Iscked Mode Project Security	Set system logger New CAN-	OUT message		0
ect.	Configure	the CAN-OUT message and an optional	Rullipk Add new CAN out channel	Tealace
94 New Project	Name		Add new CAN out channel	Devices
- DDU10	CAN Messa	9*	Specify the properties of the CAN out channel.	Citplays
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B B B B B B B B B B B B B B B B B	Function Used ter ration ation n n mand diagroe	No information		
	Function Used ter ration abon m mand diagnoe diagnoe diagnoe t t	No information		

The measurement channel is now assigned to the CAN message.

7.3.3 Export in RaceCon

You can choose to export the whole project or you can export specific parts of the project.

Proceed with the following steps to perform an export:

- 1. Click with the right mouse button on an item in the project tree.
- 2. Select 'Export...' from menu. An 'Export Selection' window opens.

Elemente la manat		Describer	
These elements will be expected		These elements will be also expected because they are used at No	u Drojest
- Ital New Project		Mensurement Container	ALIOPER
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Sheet 2			
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- Macros		- & Math Channels	
- & Math Channels		- fr Conditional Channels	
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e Cooper		in the Logging 2	
Logging2		Group 1	
Group 1	_	E R Longing 1	

- 3. Click on 'Export' to select a destination to store.
- 4. Specify the filename.
- 5. Click 'Save' when done.

7.3.4 Import in RaceCon

You can choose to import the whole project or you can import specific parts of the project.

Proceed with the following steps to perform an import:

- 1. Click with the right mouse button on any item in the project tree.
- 2. Select 'Import...' from menu. A file browser opens.
- 3. Select the input file and click 'Open'. An 'Import Selection' window opens.



4. Select channels to import.

- 5. Drag and drop the channel to 'CAN Input' of desired CAN bus on right hand side.

 Importing from file export (street(25.5.0)

 TraggOrag elements from the import content to the current project...

 Summary: I imported element, imported elements complete!

 Import content (source)

 CAN bus 1

 CAN bus 1

 CAN bus 1

 CAN bus 1

 CAN bus 2

 CAN bus 3

 CAN bus 4
- 6. Click 'Finish'. If a measurement channel belongs to more than one source, the 'Solve Label Ambiguity' window opens.



- 7. Assign the ambiguous channels to the desired source.
- 8. Click 'Finish'.

8 Online Measurement and Calibration

- Verify system status and diagnosis.
- Check and calibrate sensors of the system.
- Data application in online mode.
- PC and device are connected.
- Local PC data match to MS 6 configuration (devices are indicated as green).
- From the context menu of the project, new measurement pages can be created.

8.1 Setting up an Online Measurement

- Expand measurement container and measurement folder in the project tree.
- Double click on Sheet 1 opens the main area.
- The context menus offer a lot of options, like add, delete and rename folder or sheets, also import and export functionalities for data storage are available.



- The main area opens additional window data sheet and toolbox.
- Drag and drop the measure channels and select the graphic rendition or select first toolbox offers and place the channel to the element.

Version Lagor Decky Colordon Melaury Decky Provide Annual Version Vers	Manualrip - RaceCon V2.5.1.1102 * active	_	- 0
Suitas Mode Measureg Cald		Deta 0	Teabox
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Sect 1 (Boet?)		<u> </u>	Measurement Sources

Measure and calibration:

(Example: damper position measurement)

Base of the data list are the function- and measure labels, described in details in the function description.

- To assist the discovery of relevant labels, data list may be graduated.
- Description and label symbol explain the task of the data label.
- Structure of Bosch Motorsport Labels shall communicate recognition values.

CMbaar	Code Word starts an action for the function
CVVXXX	Code-word starts an action for the function
CWDAMCAL	Code-Word damper travel adjustment
	"True" sets the actual measure values of all dampers to 0
CWDAMCAL_FL	Code-Word damper front left adjustment,2- point sensor calibration added by offset ad- justment for each single damper
dam_xx	measure values are always typed in small letters
dam_fl	damper position front left
udam_xx	voltage values starts always with "u", the value represents the sensor signal
DAM_XX_YY	Data Label are always typed in big letters
DAM_FL_GRD	Gradient for damper travel sensor, front left, values are available from sensor manufac- turer
Software Services and Services	amadr(p - RookCon V2.5.1.1102 * - 0 × 0 -



8.2 Using the Measurement Sheets

- When RaceCon is online, press "F11" key to switch from Design Mode into Race Mode.
- The measurement sheet is extended to full screen.
- Switch between different sheets using the tabs at the bottom of the page or the keyboard shortcuts associated with the sheets.
- Press ESC key to return to Design Mode.

9 Error Memory

9.1 Error Memory representing in RaceCon

- Bosch Motorsport devices feature an error memory. Information on detected errors can be visualized via RaceCon (online measurement) or can be transmitted via telemetry.
- Select any configured device of the system and inspect the "error info" folder.

		System	ManuaLrip - RaceCo			
System Looper Digola	y Calibration Measuring Tools	Windows				0 -
		(W)				
🔍 🔍 🐼 📢						
MS7-ECU Race Mode visible Protect	son Sheet					
Status Node Protect Sc	locked					
Project F x	NS7 Project					Toobox [©] ×
and MS7 Depart						A 100
Laptrigger						Liences
+ + MS7Logger						Displays
🕀 📲 MS7-ECU 🦉	Existing MS7-EOU errors					0000
Measurement Folder 1	MIL 😁				Clear	
+ of Sheet 1	Location	Type	Duration Active	DateTime	Opcurrences A	
🖃 🚱 Sheet 2	E thr2	Min Plaus Min b	945.2 🚱 True	3/10/2016 3:50:29 PM	1	DDU-S2 Plus
Measurement list	E_aps	Min	945.2 🙀 True	3/10/2016 3:50:29 PM	2	ECUs
Measurement list	E_gbctrl_comp_mli_a	Temperature p-Reservoir	945,1 👩 True	3/10/2016 3:50:29 PM	1	III MS3 Sport
	E_gbctrl_gearp_mli	Voltage range	945,1 👧 True	3/10/2016 3:50:29 PM	1	M54 Sport
	E_psdia_mainrelay	Open load	945 🐼 True	3/10/2016 3:50:29 PM	1 1	MS15 Sport
	E_mapsw	Max	945 😵 True	3/10/2016 3:50:29 PM	1	M515.1
	E_fuelressw	Min	945 🐼 True	3/10/2016 3:50:29 PM	1	M515.2
	E_launchsw	Max	945 🐼 True	3/10/2016 3:50:29 PM	1	🜉 MSS.0
Properties F ×	E_pitspeedsw	Max	945 🔞 True	3/10/2016 3:50:29 PM	1	MS5.1
Still 2 standard - 3 - 🐼	2	304	0.2 False	3/10/2016 3:50:29 PM	1	MSS.2
Description description front 4	E_tmot	Max	944,6 🥸 True	3/10/2016 3:50:29 PM	1	MS5.5
Name B dan fl	E_texh	Min	944,6 🥸 True	3/10/2016 3:50:29 PM	1	MS5.6
Physical conversi (Verbal/FALSE[0]TRU	E_texh2	Min	944,6 🐼 True	3/10/2016 3:50:29 PM	1	🗰 M56
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Physical minimum 0	E_bint2	Min	944.6 🐼 True	3/10/2016 3:50:29 PM		MSS.8
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	Certerno Generalio	eatres no				Measurement Sources
			🗧 🗶 Info / Status			¢ ×
dam			C Errors	Warnings(1) (1) Messages(13)		14/14 🗙
🔿 🔿 🖓 🖾 🗿 Show al			Type Time	Sender Message		-
Name 🖉 🔽 Source	2 Description	A B_dam_fl []	 ① 15:5 	D:46 MS7-ECU - MS7_Project EPK check successfu	I. (EPK Device: MS7A_BASE_0102)	
📲 B dam fl 📰 MS	7-BCU damper position front l	eft sensor	- (1) 15:5	0:46 MS7 Logger - MS7_Proj Successfully connect	ted to device(Ethernet/XCP).	
B_dam_fr MS	7-ECU damper position front r	ight sensor , damper position front left sen	(i) 15:5	0.56 MS7-ECU - MS7 Project Successfully created	dataset MS7-ECU.	
B dam rl	7-ECU dameer position rear le	ft sensor n	15:5	0:57 MS7-ECU - MS7_Project ECU data matches th	ne local data.	-1
1					·	
Ready.				NS7	Logger, CAN(Warning), for 761,2 s 🛸 🔄 NS7	Project/MS7-ECU/B_dam_f1 🚥 🚥

- Adapt the messages to the configured hardware. In general, properties of the error memory and properties of an individual error need to be distinguished.
- The memory is situated inside the device and non-volatile. As a consequence, an error which has occurred and has not been cleared by the user will remain in the error memory even after a power cycle. The error state will then reflect if the error is still active or not.
- An error is deleted from the list when
 - the user actively clears the error memory,
 - the user updates the firmware.
- Clearing the error memory
 - in the top right corner of the error monitor,
 - alternatively at the bottom of the menu bar,
 - alternatively reset the error monitor in the measurement folder >CLRERRMON <
 = TRUE.

9.2 Writing an Error

For the functional part of the MS 6 system (MS 6-ECU) the error bits are related to the function and have to be distinguished if the function is activated. If an error is detected, the information may be shown as part of the error monitor in RaceCon, as display information and as measure channel. To support driver visibility, an activated error may activate also an output to enable the MIL-light (B_mildiag will be enabled).

CW_EM_xxx	Individual error related to a function
0	Error will not be stored in the monitor
1	Error is stored in the monitor
2	Not valid
3	Error is stored in the monitor and the MIL condition is switched on

The single error bits may be collected in the error monitor.

9.3 Error Memory Properties

The following property is available for the error memory itself.

CLRERRMON	Reset of the error monitor
Error Status /device	measurement label error_state
0	No error present in the memory
1	At least one inactive error present in memory, no active errors
2	At least one active error present in memory

If displayed in a measurement sheet, this property value (0, 1 or 2) is translated into a verbal description.

Measurement list				
CLRERRMON	TRUE -			
error_state_MS7-ECU	Active error(s) present			
error_state_MS7 Logger	Active error(s) present			

It is also represented by a color scheme within RaceCon (provided RaceCon is online with the system):

0 (no error present in memory)

		System	DDU10_Test.rlp ·	RaceCon V2.5.5.0 - Masterlicense Bo	osch * 💶 🗷
System Logger Display C:	alibration/Measuring Tools	Windows			<u> </u>
DDU9 Race Mode visible Protection Shee					
Status Mode Project Security	d				
Project 0 x	New Project	x			Techov 0 X
Reg. Boll New Project					Devices
C Laptrigger					Display Elements
🗈 📲 DDU9	Existing DDU10 errors				Measurement Elements
DDU10	Existing Doo to errors				Measurement Sources
Direlay	MIL U				Gear Sensors
CAN Bus 1	Location Type	Duration Active	DateTime	Occurrences Description	Bosch Wizard
🚡 🛄 CAN Bus 2					Customized Sensor
👜 🛄 CAN Bus 3					Analog sources
E CAN Bus 4					Marking and Advertised
Computed Channels					Sensitivity/Offset
Calibration Items					Frequency sources
👼 Macros					Characteristic Curve
f. Math Channels					Revolution
f Conditional Channels					
Group adjustments					 Computed sources
Master Devices					Adjustment channel
- 😭 Measurement Container					Disalay Suitch
					Fuel
					Gear Lookup Table
					Hysteresis
					Captrigger
					NWM Out
					Sensitivity/Offset
	Start detection of cable				Speed
	Statistics & Math Channe	els 🔰 🅼 Conditional Channels 🔰 🚨 CA	N messages 🛛 🖬 Macros 🖉 🎫 Set	tings 👔 Device info 🥑 Error info 😭	Features inf
Data			Info / Status		
error_			Errors(1) Marnings(33)	(i) Messages(124)	158/158 🗙
📑 🔤 🔟 Show all			Type Time Sender	Message	*
Name 🕹 💌 Source	 Description 		17:35:13 DDU10 - N	ew Project Lost connection to device(Et	hemet/XCP).
			(i) 17:35:20 DDU10 - N	ew Project Successfully connected to de	evice(Ethernet/XCP).
			17:35:20 DDU10 - N	ew Project EPK check successful. (EPK I ew Project Device data matrices the loc	levice: DDU10_BASE_0401_TST4)
		No information	17:35:22 DDU10 - N	ew Project Calibration data successfully	uploaded and initialized.
			17:35:54 DDU10 - N	ew Project Successfully cleared the error	r memory.
					*
·	•		Info / Status CAN Log - running		
Ready.				No errors detected - all cleared or state unio	iown 👻 🐗 New Project/DDU 10/1/O Channels 🐵 🚥 🚅

System Logger Depiny Co System Copper Depiny Co Dour Status Pode Pode Visible Protection Pode Pode Pode Security	bration/Measuring Too	System Is Wind	ows		DDU10_Te	est.rlp - RaceCon '	V2.5.5.0 - Masterlicense Bosch *	_ = : Ø
Project 0 ×	Existing DDU10 errors MIL Location ANA04 ANA05 ANA07	Type Open line Open line Open line	Duration 114.3 113.8 113.5	Active False False False	DateTime 114/2000 6.28 26 114/2000 6.28 26 114/2000 6.28 26	Occurrence: AM AM	Description No further information avail No further information avail No further information avail	Tochox 0 > Qevices Display Elements Measurement Elements Measurement Elements Bosch Wizard Schow Wizard Schow Wizard Clustomized Sensor Analog Sources Analog Sources Characteristic Curve Schow Sensor
(j)- Computed Channels (j)- Collibration Rems (j) Marcins (j) Anth Channels (j) (j) (j) Group adjustments (j) (j) (j)	ANAD9	Open line	113.1	False	14/2000 6-28 27	AM	1 No further information avril	Multipoint Agustment Sensitivity/Offat Frequency sources Revolution Revolution Velocity Compatibility Com
Data	🗠 Statistics 📗 👉 Math C	hannels /	- Conditional Channels	De CAN ma	issages 🛛 💽 Macros	💓 Settings 🛛 🚺 D	evice info 🧕 😟 Error info 🛛 着 Features infi	,
error_					🕽 Errors(1) 🚺 Warn	ings(33) 🚺 Messa	ges(123)	157/157 ≽
Source	Description	No	o information		ype Time Se 17:33:18 DI 17:35:13 DI 17:35:20 DI 17:35:20 DI 17:35:20 DI 17:35:20 DI 17:35:20 DI 17:35:22 DI 17:35:22 DI	ender 2010 - New Project 2010 - New Project	Message Start of cable breakage detection successful. Lost connection to device(Ethernet)ACP). Successful, grownetted to device(Ethernet)A EFK check successful, (EFK Device: DDU10,6 Device data matches the local data. Calibration data successfully uploaded and in	CP). ASE_0401_TST4) tialized.
٠	•			Ŀ	nfo / Status CAN Log -	running	101110 ANADO(Concellera) for 112 1 c = 100 Ma	Device borris bio channels

1 (at least one inactive error present in memory, no active errors)

2 (at least one active error present in memory)

System Logger Doplay C DDU9 Race Mode Web Protection Sher Loge Protection Sher Loge	albration,Measuring Too	System	-	DDU10_Test.rl	p - RaceCon V.	2.5.5.0 - Masterlicense Bosch *	_ = × @ ·
Project R ×	DDI New Project 🖬 DDI	U10 🗙					Toolbox 🛛 🖓 🗙
B- fat New Project							Devices
🙆 Laptrigger							Display Elements
⊕⊸(≝ DDU9	Existing DDU10 errors					<u>e :</u>	Measurement Elements
						Gam	Measurement Sources
Disnlay						Ciear	 Sensors
CAN Bus 1	Location	Type Duration	Active	DateTime	Occurrences	Description	Bosch Wizard
🔓 🛄 CAN Bus 2	ANA04	Open line	83.3 🐼 True	1/4/2000 6:28:26 AM		1 No further information avai	Customized Sensor
👜 - 📑 CAN Bus 3	ANAUS	Open line	82,9 🐼 True	1/4/2000 6:28:26 AM		1 No further information avai.	 Analog sources
😥 🛄 CAN Bus 4	ANAU7	Open line	82.5 😋 True	1/4/2000 6:28:26 AM		1 No further information avail	Characteristic Curve
Computed Channels	MINMU3	Open line	02.1 🥶 1108	1/4/2000 0.20.27 AM		I No further Information avail.	Multipoint Adjustment
Calibration Baros J. Macros J. Matro Channels Group adjustments Group adjustments Group adjustments Master Device Group Master Devices Group Master Devices Group Master Devices	Start detection of	cable	anes Scatters	ages bytanos C	Settings 👔 De	uce refe 🥑 Erroy Info 🌈 Kestures ref 🔹 😱	Treaders sources Cove Cove
			· · ·	/ Status			U + ^
error_				Errors(1) Warnings(32) (i) Message	es(119)	152/152 🗙
Show all			Тур	e Time Sender		Message	^
Name / Source	Description	No informa	ation	17:33:10 DDU10 17:33:11 DDU10 17:33:12 DDU10 17:33:13 DDU10 17:33:16 DDU10 17:33:18 DDU10	- New Project - New Project - New Project - New Project - New Project - New Project	Successfully connected to device(Ethernet/KCP). EPK check successful. (PK Device: DOLID_BASE_ Device data matches the local data. Calibration data successfully uploaded and initializ Successfully cleared the error memory. Start of cable breakage detection successful.	_0401_TST4) ed.
<	•		Inf	o / Status GAN Log - runni	ng		
Ready.					6 0	DU 10, ANA04(Open line), for 78,0 s 👻 🐗 New Pro	oject/DDU 10/I/O Channels 📖 🚥 🔒

10 Legal

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ANTLR-2.7.7

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The primary ANTLR guy:

Terence Parr parrt@cs.usfca.edu parrt@antlr.org

10.2.2 antlr311runtime.jar License ANTLR-3.1.1

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/

10.2.5 Sensor Driver for BMI160 Sensor

Applies to BMI160

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10.2.6 stringtemplate License

[The "BSD licence"]

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10.2.7 xml_io_tools License

xml_io_tools

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10.3 REACH Statement

According to the REACH regulations, any supplier of an article containing a substance of very high concern (SVHC) in a concentration above 0.1 % (w/w) has the duty to provide the recipient of the article with sufficient information to allow safe use of the article. Our product contains:

SVHC Substance	CAS Number
Lead monoxide (lead oxide)	1317-36-8
Lead	7439-92-1
11 Pin Layout

The pin layout is available at Bosch Motorsport website on MS 6 product page.

Most of MS 6 functions to pin relations may be modified to project demands.

Please see details in the function description SWITCHMATRIX.

Bosch Motorsport tests check the defined connections of the pin layout.

Using a MS 6.1 or MS 6.3 version, ensure not using analogue inputs of the measurement package without enabled license.

For MS 6.1 and MS 6.3, these hardware-options are only available if MS 6 measurement package is in use.

12 Harness

Harness connectors

Bosch automotive connectors are not available as complete set of components, so Bosch Motorsport itself offers such a package. For more technical details please check Boschconnector homepage, 196 pins

http://www.bosch-connectors.com/bogscoca/category/142

MS 6 harness connector type A (105 con- tacts), coding variant 1	F02U.B00.712-01
MS 6 harness connector type K (91 con- tacts), coding variant 1	F02U.B00.711-01
Protection Classification	IP X6K, X8, X9K
Temperature range	-40 to 120°C
Shakeproofed	Max. 3.4 g
Wiring diameter	0.35 to 2.5 mm ²
Pinsize	1.2 mm; 2.8 mm

Dummy Plug

Dummy plug 1928.405.459 for unused con-	Matrix 1.2 / CB / 0.75 to 1.0 mm ²
nections	
Dummy plug 1928.405.460 for unused con- nections	Matrix 1.2 / CB / 1.0 - 1.5 mm ²
Dummy plug 1928.301.207	BTL 2.8

Tools and Contacts

ТооІ	Matrix	Contact	Wire size
1928.498.212	Matrix 1.2	Clean Body 1928.498.991	0.35 to 0.5 mm ²
1928.498.213	Matrix 1.2	Clean Body 1928.498.992	0.75 to 1.0 mm ²
1928.498.837	1928.498.840	BTL 2.8 1928.498.651	1.5 to 2.5 mm ²

Wiring

Bosch Motorsport recommends using the specified cable material and harness layout for automotive connectors and wiring applications.

For Ethernet and USB connection CAT5 specified material is recommended and the pairs and shield connections have to be strictly respected as shown in the wiring diagram.

For USB, the maximum wiring length is limited to 3 m and it is not allowed to be included into a common harness and also there is no interruption allowed.

Due to installation condition, the length may have to be reduced.

Keep network wiring in distance to main sources of electrical noise like coils, coil- and HPinjector wirings and also in distance to any telemetry transmitter.

CAN-networks need a 120 Ohm termination at 2 ends of the wiring.

The MS 6 is able to switch on an internal 120 Ohm termination, set CWCANx_TERM true to enable the termination.

For wiring layout, respect the common rules of failure reduction like separated sensor power supply between important system sensors (e.g. camshaft detection) and measure options (e.g. damper position).

Be ensure HP-injectors, electronic throttles and other high frequently switched actuators are connected within the wiring limits of 2.5 m and all wires are manufactured as twisted pairs.

If using a preinstalled production harness, first verify the way of sensor- and actuator controls.

Often production parts have to be connected to 12 V power supply and actuators are controlled in different ways. The production harness may need to be modified.

Office harness

Reduced layout to realize communication between PC, MS 6 device and Display DDU, recommended for flash configuration, display configuration and installation tasks. Bosch Motorsport part number: F02U.V01.809



The wiring diagram is available at Bosch Motorsport website on the MS 6 EVO product page.



NOTICE

The wiring diagram shows a principle of wiring and connection options.

ECU pin relation may change to customer data application and program layout. Sensor-, actuator- and power supplies may also change to the request of the project.



Bosch	Motorsport
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www.bosch-motorsport.com