



# Engine Control Unit MS 7.8

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 7.8 inappropriately.

Use the MS 7.8 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 7.8 with uncertified combinations and accessories

Operation of the MS 7.8 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 7.8 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. If the system is used on public roads, we shall not be held responsible or liable for damages.

## 2 Technical Data

The MS 7.8 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<sup>®</sup> & Simulink<sup>®</sup>. 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 7.8 to support complex or unusual engine or chassis configurations. Integrated logger control areas present a cost efficient and weight optimized all-in-one solution.

## 2.1 System Layout



## 2.2 Mechanical Data

Milled aluminum housing		
4 Motorsport connectors, 264 pins in total		
Vibration suppression via multipoint fixed circuit boards		
Size without connectors	198 x 180 x 42 mm	
Weight	1,610 g	
Protection Classification	IP67	
Temperature range	-20 to 85°C, measured at internal sensor	
Inspection services recommended after 250 during service	h or 2 years, internal battery to be replaced	

## 2.3 Electrical Data

Power supply	6 to 18 V
CPU	Dual Core 1,000 MHz; FPGA

### 2.3.1 Inputs

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

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

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 freely 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 diverse hardware options to connect inductiveor digital speed sensors.

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

#### 46 analog inputs

#### 8 analog/digital/SENT inputs (shared)

#### 12 digital inputs

4 x switchable Hall/inductive

4 x Hall

4 x switchable Hall/DF11

#### 21 internal measurements

- 8 x ECU Current (Sensor Supply)
- 8 x ECU Voltage (Sensor Supply)
- 1 x Boost Voltage
- 1 x Booster Supply Voltage
- 1 x Dynpwr Supply Voltage
- 1 x Supply Current
- 1 x USB Current

#### 18 function related inputs

- 8 x fast ADC for combustion chamber pressure input
- 2 x thermocouple exhaust gas temperature sensors (multi-type)
- 2 x Lambda interfaces for LSU 4.9 sensor types (LSU-ADV version available, see Ordering Information)
- 1 x digital switch for engine ON/OFF
- 1 x digital input for beacon receiver
- 4 x knock sensors

### 2.3.2 Sensor supplies and screens

8 x sensor supplies 400 mA, switchable 5 V/Vbat with voltage and current sensing

8 x sensor grounds

2 x sensor screens

### 2.3.3 Outputs

#### 38 function related outputs

High Pressure Injection

- 2 x high pressure pump with fuel control valve
- 8 x high pressure injection for magnetic injectors

Low Pressure Injection

12 x 2.2 A low pressure injection for high impedance injectors

#### Ignition

12 x ignition control, IGBT or BJT, coils with integrated power stage, or max. 8 cylinders and coils without integrated power stage, 20 A

2 x 8.5 A H-bridge reserved for electronic throttle

2 x 3 A pwm lowside switch for Lambda heater

#### 15 freely configurable outputs

- 2 x 8.5 A H-bridge
- 2 x 4 A pwm lowside switch
- 6 x 3 A pwm lowside switch
- 4 x 2.2 A pwm lowside switch
- 1 x 1 A pwm lowside switch low dump resistant

#### 5 output signals

5 x MUX outputs for internal signals like flywheel, knock signals, cylinder pressure

### 2.4 Description of Device Status LEDs

The MS 7.8 provides state LEDs showing various operation states by means of color / blinking frequency. In detail, there exits three LEDs: "LOG" (Data logger), "RUN" (Motronic Run) and "POW" (Motronic Power). Indications are as follows:



LOG	Amber constant	Recorded Data	Telemetry
	No measurement configuration on Logger	No	No
	Blinking green slow • Measurement configuration loaded • Start condition(s) not fulfilled	No	Yes
	Blinking green fast • Measurement configuration loaded • Start conditions fulfilled • Logger is recording data	Yes	Yes
	<ul> <li>Blinking amber slow</li> <li>Measurement configuration loaded</li> <li>Measurement setup error (external device missing)</li> <li>Start condition(s) not fulfilled</li> </ul>	No	Yes (but some missing)
	Blinking amber fast • Measurement configuration loaded • Measurement setup error (external device missing) • Start conditions fulfilled, Logger is recording data	Yes (but some missing)	Yes (but some missing)
	Blinking red fast • Firmware update in progress • Do not power off Logger	No	No
	Blinking red slow <ul> <li>Firmware update has finished</li> </ul>	No	No
	Red constant • Error during firmware update	No	No
POW			
	Black constant <ul> <li>One or more internal Power Supplies missing, D</li> </ul>	evice is not	operating

Green constant

• All internal Power Supplies of the Device available

## 2.5 Communication

- 1 Ethernet 1 Gbit
- 3 Ethernet 100 Mbit
- 5 CAN, 3 of them CAN-FD capable
- 1 LIN
- 1 USB
- 8 SENT
- 1 Time sync synchronization Ethernet
- 2 Network screens

## 2.6 Upgrades

The MS 7.8 provides the possibility to operate a wide range of different engine requirements and race track operating conditions.

Additional packages may be ordered separately, all of these may be activated later. The license concept is related to the individual device and the requested upgrading.

#### CCA Hardware Upgrade per device

Enable Customer Code Area

#### PERF\_LOG\_1

Increase logging Partition 1 from 4 GB to 16 GB memory

#### Gear Control Package 1

Gear control MEGA-Line functionality, has to be used with MEGA-Line components (License model via MEGA-Line)

-- Link to MEGA-Line Support Request--

-- Link to MEGA-Line License Request Form --

#### Gear Control Package 2

Gear control Bosch Motorsport functionality

#### Accessories

- Rugged USB flash drive
- Mating connector for USB flash drive on car loom side
- Adapter cable to PC USB-Port
- Cylinder pressure detection base package
- Knock detection via cylinder pressure evaluation
- Programming interface cable



#### NOTICE

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

## 2.7 Installation

Mounting	4 housing integrated screw sockets
Offer drawing	Available at Bosch Motorsport website on MS 7.8 product page.
3D Data	Available at Bosch Motorsport website on MS 7.8 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 must be mounted uncovered and air circulation must be guaranteed around the entire surface area.

Inside touring cars placement passenger side is favoured, open connectors should not be uncovered to vertical axe. It must 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 around the ECU in a way that excitation of ECU has the same sequence.

## 2.8 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 7.8 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 7.8 power supply is separated into the maintenance of controller and power stages.
- Ensure controller supply UBAT is activated before the power stages.
- The MS 7.8 is able to control a main relay or even the power box itself via a low side output.
- If 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.



## 2.9 Harness / Wiring

The wiring diagram is available at Bosch Motorsport website on the MS 7.8 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.

#### Harness connectors

The MS 7.8 is equipped with Motorsport connectors. On the harness side the following types apply:

LIFE	AS6-18-35SN (red ring)
ACTUATOR	AS6-18-35SB (blue ring)
COMBINED	AS6-18-35SC (orange ring)
SENSOR	AS6-18-35SA (yellow ring)

#### Wiring

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

For Ethernet and USB connection CAT5 specified material is recommended. For Gigabit Ethernet CAT6E specified material is recommended. 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.

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

CAN-networks need a 120 Ohm termination at 2 ends of the wiring. The MS 7.8 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.

#### Office harness

Reduced layout to realize communication between PC, MS 7.8 device and Display DDU, recommended for flash configuration, display configuration and installation tasks. Bosch Motorsport part number: F 02U V02 289

## 2.10 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





#### 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.

# 3 Starting up



#### NOTICE

All following chapters refer to the MS 7 base family. Some screenshots were taken from the MS 7.4.

## 3.1 Installation of Software Tools

PC tools and for the MS 7.8 system are available at Bosch Motorsport homepage for free download, ECU programs and function description on request.

 RaceCon Version 2.9.0.7 or later or higher is the tool mainly used for system configuration.

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 7.8 provides Gigabit Ethernet to communicate between tool and ECU. Please ensure that all components comply with this standard to take advantage of the increased data rate.

MS 7.8 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 7.8 is shown as green marked connection in the top left corner of RaceCon.

### 3.2 Configuration of the system

Bosch MS 7.8 devices are delivered in a not engine executable mode. The customer has to include the correct programs, data applications and licenses.

The MS 7.8 offers two mainly different configuration areas, related to the two core areas of the controller.

#### MS 7.8 ECU

1<sup>st</sup> core area for the functional part of the MS 7.8 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, Modas Sport or RaceCon.

#### MS 7.8 Logger

2<sup>nd</sup> 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 7.8 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 the ECU model MS 7.8 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. Specify the MS 7.8 program archive: MS 7.8 \_xxxx.deploy.pst



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 7.8 core are shown as >red<, that means MS 7.8 device and RaceCon project differ in the used program version.

	System			
System Looper Diple		Manual	np - RaceCon V2.5.1.1102	
MS7Logger Node Visible Protect	Workspace: ton Sheet locked Workspace: Show grid Show grid Show all			
roject F 🛪	Sol MS7_Project			Toobox 4
In our lange of the second of				Operation         Operation           Operation         Operation
				Display Elements
fame 'he project's name.	4		· · · · · · · · · · · · · · · · · · ·	Measurement Elements
and the second sec	Stat System Overview			Measurement Sources
oto	e 🔽 Description 🔺	¢ x	2-5 / 520/2	4 8/8 K Device:MS7A_BASE_0000T10).

Synchronize MS 7.8 and RaceCon program version / update the firmware of the device:

Project-tree / right mouse button to one of the red MS 7.8 core / synchronize / update firmware > select customer software of the MS 7.8 (file with extension: -.pst)



PSU1.0 Program firmware	×
Rash program firmware	010
Perform a firmware update of a device.	UPDATE
Select program archive (PST) file:	
PSU10_0210\deploy\PSU10_0210.deploy.pst	
3 The program archive is valid.	
No device description available	
Keep current device settings Preserve a Dataset	
ECU Identification	OK Cancel

In the project tree, the MS 7.8 logger core is shown as >yellow<, means the firmware of MS 7.8 device and project are identical, but the data differs.



The offline preconfigured data have to be sent to the MS 7.8. Option one, select: Project tree / right mouse button to the yellow MS 7.8 core / synchronize / or follow the RaceCon menu:

DDU10	
1	DDU10: Data differences detected Send local configuration to DDU10?
	Yes No

Both MS 7.8 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 7 licenses are related to one specific device and the delivered code is only to activate for this ECU. Both cores, MS 7 ECU and MS 7 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.

	tem Manu	uaLrlp - RaceCon V2.5.1.1102 *		_ a x
	ndows W			0
Change archive	to No superPIN - pi <sup>1</sup> Unlock			
MS7-ECU Race Mode visible Protection Sheet Set date	from Save WP/RP			
Status Mode Project Security Device Synchronisa Project 9 x DONS7. Project MINS7ECU X * NS7L	ton Device Pin			Tashar D. M.
- gat MS7_Project	MS7-ECU features info		·	Devices
	FCUTD #1485106:1561913a			Display Elements
	ECU ID ff485f06:f56f9f3a	Copy to dipboard		Measurement Elements Measurement Sources
	Status/Unlock Order informations			Sensors     Sensors     Bosch Wizard
	GEARBOX1 Gearboxcontrols, MegaLine functi			Customized Sensor
	GEARBOX2 Gearboxcontrols, Bosch Motorspo GEARBOX3 External gearbox control units	rt function		Analog sources     Characteristic Curve
	CCA Customer Code Area			Multipoint Adjustment Sensitivity/Offset
	CYLPRESS Cylinder pressure measurement		12	Frequency sources     Characteristic Curve
Properties II ×				Revolution
1 21 Y standard - 2 - 0				Velocity     Computed sources
EPROMidentifier MS7A_BASE_0102				Adjustment channel Characteristic Curve
Seed fie \DeviceDescriptio				Display Switch
Program andrive MS7A_BASE_0102				Gear Lookup Table Hysteresis
Name The name of the device			-	Ø Laptrigger
🚺 Device info 🛛 😡 Error info	💷 Settings 🤹 Features info			PWM Out
Data	÷	× Info / Status		+ ×
		Errors(2)      Warnings(6)      Messages(53)      Type Time Sender Message		61/61 🗙
Name 🖉 🔽 Source 🔽 Description		16:23:13 MS7-ECU - MS7_Project Calibration dat     16:23:13 MS7 Logger - MS7_Proj Successfully co	innected to device(Ethernet/XCP).	
a_canctrl MS7-BCU angle of camphaft control; ca a_canctrl_out MS7-BCU angle of camphaft control; cu	net No information	16:23:13 MS7 Logger - MS7_Proj EPK check succ 16:23:14 MS7 Logger - MS7_Proj Celbration dat	a successfully uploaded and initialized.	
a canchi out? MS7-FC1 ande of camihaft control: or	ifet	A 16:23:35 MS7 Logger - MS7_Proj Failed to down		
Ready.		•	MS7-ECU, E_gearpoti(Min Plausibility), for 951,5 s	MS7_Project/NS7-EOJ
ECU Destantion				
ECU Protection		×		
Unlock Feature				
Unlock specified feature.				
GEARBOX1				
Requested KEY:				
<enter pin=""></enter>				
Star BART 1, B172				
	OK	Cancel		
	<u>v</u> iv			

The licenses for gearbox and engine controls are to activate at the MS 7 ECU core. The licenses for logger related packages like Ethernet telemetry are handled in the MS 7 logger core. MS 7.8 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.



#### NOTICE

Wrong engine setup data may lead to serious engine damages.

### 4.1.1 Basic Engine Data

The MS 7.8 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

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 [ $\triangleright$  12].

Main Data Labels to configu	re for crank- and camshaft wheel
CRANK_TOOTH_CNT	Number of teeth of the flywheel (including the missing teeth) <b>(limited to 30-60 teeth)</b>
PIN_IN_CRANK	Selection of used crankshaft input pin
CWINTF_L43_L44	Selection of used crankshaft sensor type (Hall or induct- ive type), example for used pins L43/L44
CRANK_GAP_TOOTH_CNT	Number of missing teeth on the flywheel
PIN_IN_CAM_x	Selection of used camshaft input pin
CAM_MODE	Camshaft position detection mode
CAM_TOOTH_CNTx	Number of teeth on the camshaft
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-system.
	Set CYLBANK to 1.
CYLNUMBER	Number of cylinders
CYLANGLE	Angle of cylinder TDCs relative to reference mark (RM $\rightarrow$ TDC)
QSTAT	Static valve quantity for n-heptane in g/min (injectors are typically measured with n-heptane)
MP_TDTECORR	Injection valve delay correction map, low pressure
TECORPRAIL	Rail pressure correction for injection time

### 4.1.4 Basic Path of Injection Calculation

The ECU MS 7.8 is a so called physically based system. This means 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	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	
FRLTINT	Correction via ambient temperature. Usually, the pre- defined values are suitable. If unsure, set FRLTINT to 1.0 for first startup.	
alpha/n system		
MP_RL	Relative load depending on throttle angle and engine speed. Set value until your desired Lambda is matched.	
MP_FRLPLOAD	Correction via intake air pressure	
p/n system		
FRLPTHR	Factor to throttle dependence. If unsure, set to 1.0 for startup.	
MP_RLP1P4	Relative load depending on throttle position 1-4	
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 refer to the Function Description LOADCALC.		

### 4.1.7 Main Data Labels for Injection

Main Data Labels for injection	
CWINJMODE	Choice of injection system:

Main Data Labels for injection	
	– Low Pressure
	<ul> <li>Low Pressure plus Far Bank</li> </ul>
	– High Pressure
	<ul> <li>High Pressure plus Far Bank</li> </ul>
CWINJANGMODE	Choice of angle of injection relation
MP_AOINJ	Map begin/end of injection
Notice: Before calibration starts, turn off Lambda closed loop control.	
CWLC	Codeword for enabling of the Lambda closed loop control. Set to FALSE during initial calibration, afterwards TRUE.

### 4.1.8 Main Data Labels for Ignition

The MS 7.8 provides two alternatives to drive the ignition coils: For engines up to 8 cylinders the internal powerstages may be used. Alternatively, or for engines up to 12 cylinders external powerstages may be used.

IGNDRV_TYPE	For ignition coils with integrated powerstage set IGNDRV_TYPE to 0 ("External PS (CK200)"). To
	use the ECU's internal powerstages (for ignition
	coils without integrated powerstage), set
	IGNDRV_TYPE to 1 ("Internal PS") The ECU must
	be restarted for changes to take effect.

#### 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.

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

Main Data Labels for ignition	
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.

### 4.1.9 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 behaviour by advanced intervention, the engine speed is predicted by means of the speed gradient.

Main Data Labels for engine speed limitation	
Codeword for type of intervention during soft limiter:	
– no cut-off	
<ul> <li>injection cut-off</li> </ul>	
<ul> <li>ignition cut-off</li> </ul>	
<ul> <li>injection and ignition cut-off</li> </ul>	
Codeword for type of intervention during hard limiter:	
<ul> <li>injection cut-off</li> </ul>	
<ul> <li>ignition cut-off</li> </ul>	
<ul> <li>injection and ignition cut-off</li> </ul>	
Engine speed limit, gear dependent	
Determines the slope of the soft limiter between soft limit and hard limit. Predefined. Vary according to your engine's dynamic beha-	
viour.	
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.	

### 4.1.10 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.

Cutoff Pattern	
	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_APP	Cutoff pattern for test purposes. Bit representation as de- scribed at MP_COPATTERN
CWCUTOFF_APP	Set Codeword for type of intervention during test cutoff:
	– disabled
	– Injection
	– Ignition
	<ul> <li>Injection and Ignition</li> </ul>

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 7.8 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.

#### Analogue sensor inputs

The physical way of conversion from sensor signal voltage to physical values follows the same structures. Usually, inputs provide switchable 3.01 kOhm pull-ups. The pull-up resistor itself is not modifiable. 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. Failures 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 a lot of different pressure channels, please see function description input signal processing for details. For gradient and offset information contact sensor manufacturer.

Example: Oil Pressure	
POIL_OFF, POIL_GRD	Sensor offset and gradient
UPOIL_MIN, UPOIL_MAX	Minimum and maximum accepted sensor voltage. When violated, an error is set (E_poil = 1).
POIL_DEF	Default value if an error occurred.
FCPOIL	Filter constant. Choose appropriate values.

Most other variables are named by the same rule.

#### Temperature measurements

The system offers a lot of 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

Most of the MS 7.8 digital sensor inputs used for frequency measurements are possible to configure to different sensor types.

CWINTF_L43_L44 / CWINTF_L10_L19	Selection between Hall effect or inductive sensor for flywheel measurement, related to the appropriate contacts of MS 7.8. (Use ECU ground L20 if Hall type is selected.)
CWINTF_A38 / CWINTF_A46 / CWINTF_A47 / CWINTF_A54 /	Selection between Hall effect or DF11 sensors for frequency measurements like wheel speeds, related to the appropriate contacts of MS 7.8. (Use ECU ground L20 for reference.)
CWINTF_L47_L46 / CWINTF_L08_L07	Selection between Hall effect or inductive sensors for frequency measurement like turbo speed, related to the appropriate con- tacts of MS 7.8. (Use ECU ground L20 if Hall type is selected.)

The contacts L37, L03, L11, L06 are usually (but not necessarily) used for cam signal. They are fixed as Hall effect inputs.

### 4.3 Throttle Control

The system supports mechanic and electronic throttle controls.

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".





E_aps	Detected error messages of acceleration pedal
	functionality. If errors are detected, the ETC func-
	tionality will become inactive.

#### Verification of throttle position signals:

The addition of voltage throttle signal 1 (uthrottle) and voltage throttle signal 2 (uthrottle\_b) results in 5 V due to inverted lines. Hence the added signal minus 5 V has to be below the value of "UDTHRCM\_MAX" (recommended 0.2 V) to be plausible.

Signal principle 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/4,800 mV. Check if the uthrottle(xx) outputs are changing when throttles are moved.
uthrottle uthrottle_b uthrottle2 uthrottle2_b	2 sensor output values and their redundant sig- nals (_b). The system expects a rising up voltage for the main signals and a falling voltage for the redundant one.
UDTHRCM_MAX	max. allowed difference between sensor output and redundant signal
	abs (uthrottle(x)+uthrottle(x)_b)-5 V < UD- THRCM_MAX

#### Calibration:

CWTHRADJ	Codeword for throttle adjust:
	1 = automatically 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 avail- able from different sources, like MS 7.8 own measurement, GPS data or via CAN received in- formation from ABS calculation. For MS 7.8 own calculation, mechanical influenced data like number of available sensors, front wheel drive, number of detected increments, wheel circumferences and dynamic corrections like corner speed application a lot of functional op- tions assist the calculation of the effective vehicle speed. Distance measure channels may be derived from speed information. For de- tailed 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. Con- sider dynamic increase of the tire.
CIRCWHEEL_R	Wheel circumference of the rear wheels. Con- sider dynamic increase of the tire.
vwheel_xx	Measure channel of the individual wheel speeds
speed	Result of calculated vehicle speed

асси	Result of speed-based derivation of longitud- inal 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 de- tection. Additional options for track segmenta- tion, additional on track beacons are also avail- able. Drag and drop the subfolder lap trigger of the measurement sources into the project and follow the wizard.
System	Manual.r/p - RaceCon V2.5.1.1102 *



	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 information will be created.
Laptrigger_xxxx_yy	Results and measure channels of lap-func- tionalities. Drag and drop the subfolder "Laptrigger" to the project and follow the wizard.
Consumption-calculation	Designed in the same way as lap-informa- tion, subfolder is called "fuel". Drag and drop the subfolder to the project and follow the wizard.
Set time & date	MS 7.8 device is equipped with a real time clock which is permanently supplied by a battery. In order to set time and date, please connect the ECU to the PC and click on "SET DATE & TIME" in the context menu of theMS 7.8.
time_xx	The measure channels of the real time clock



## 5 ECU plus Data Logger

The MS 7.8 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 re- cording
	Download recording configuration
WinDARAB	Upload recorded data
	Display and analyze the data



## 6 System Configuration Tool RaceCon

RaceCon is an all integrated software tool for configuration and calibration of Bosch Motorsport hardware products, such as ECUs, displays, loggers. The communication is based on Bosch Motorsport MSA-Box interface.

Calibration of ECU maps and curves ECU data file and parameter file up- and download Diagnostic functionality for Bosch Motorsport ECUs Data file / Work base management Integrated flash functionality and Bosch sensor database Configuration of Bosch Motorsport displays, data loggers, CAN modules, ... Communication via K-Line/CAN/Ethernet (KWP/CCP/XCP) CAN communication log functionality (baud rate changeable) Quick data access over Race Mode

#### PC

IBM PC Pentium/AMD Athlon compatible, min. 1.6 GHz Min. 2 GB RAM Min. 1 GB free hard disc space VGA/WGA monitor (min. 1,024 x 768) Recommended Operating System: Windows 10

#### **Optional Accessories**

MSA-Box II

F02U.V00.327-03

## 7 First Steps

Install the software required for the operation of the MS 7.8. It is developed for Windows system software. The following software versions are used in this manual:

- MS 7.8 setup, configuration and calibration: RaceCon Version 2.9.0.7 or later.
- Measurement data analysis: WinDarab V7

Set up the 100 Mbit ethernet connection to the MS 7.8.

- The ethernet port has "cable auto crossover" functionality.

## 7.1 Connecting the unit to RaceCon

For testing new device configurations, you can connect the device to your computer via MSA-Box or ethernet cable.

#### Connection via MSA-Box

- 1. Reassure that the MSA-Box driver is installed properly on your computer. If needed, download the MSA-Box driver from www.bosch-motorsport.com.
- 2. Connect an ethernet line of the device to the ethernet line of the MSA-Box.

Please note, that the MSA-Box also requires power supply on the MSA-Box connector of your wiring loom.

- 3. Open RaceCon and connect the MSA-Box to the computer.
- 4. In the 'Info / Status' Box of RaceCon, you will receive messages that the connection was successful.

Info /	nfo / Status 🗖 🖣 🛪			
<b>(3</b> E	S Errors 🔥 Warnings 🕕 Messages(2)			
т	Time	Sender	Message	
(i)	12:16:09	RaceCon	Connected to MSA Box.	
<b>(i)</b>	12:16:09	RaceCon	MSA Box successfully connected.	
Info	Info / Status CAN Log - Stopped SYS Log - Stopped			

- 5. Reassure that the device is switched on.
- 6. 'Link LED' at the computer's network adapter will illuminate.

If the LED is off, check the wiring harness.

After you created a RaceCon project with the device, the status icon of the device will switch from grey to one of the following colors: red, orange, green. For further information on how to set up a project, see the chapter "Setting up a new RaceCon Project [▶ 36]". For the status color, see chapter "Color indication [▶ 47]".

#### Connection via Ethernet Cable

Instead of connecting the ethernet line to the MSA-Box, connect the ethernet directly to your computer.

#### Troubleshooting while setting up the network interface

The MS 7.8 contains a DHCP server, network addresses can be assigned automatically to the configuration PC. In case of problems during the network connection, please try the following steps:

7. Switch off the PC's firewall.

8. Reconfigure the PC or the MSA-Box network interface settings to obtain an IP address automatically as shown in the pictures below.

General Connecturing Connecturing Connecturing Contigue This connection uses the following item: Contigue Select Contigue C	an IP adress automatically following DNS Server adresses
--	--

### 7.2 Setting up a new RaceCon Project

The following screenshot shows an overview of the RaceCon Main Screen with its areas. All (sub-) windows are resizable and dockable. You can find them under the 'Windows' tab.

	System New Project.rlp - RackCon V2.5.5.0 *	_ a x
System Looper Displa		×
Apple     Apple     Apple     Apple     Apple     Apple       Apple     Apple     Apple     Apple     Apple     Apple       Note     Apple     Apple     Apple     Apple       Note     Apple     Apple     Apple     Apple       Note     Apple     Apple     Apple     Apple       State     Note     Apple     Apple     Apple       State     Note     Apple     Apple     Apple		
Project & X	dat liew Project	Toolbox 4 ×
E • 44 New Project	Main Area	Divides           Displays           C45-M3           DDU10           D
Project		Toolbox
Project Tree		MISSA MISSA
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Ready.	40 errors detector - al detector - al detector -	wa + 📴 New Project 🐵 🐵

1. Start the RaceCon software.


2. In the 'File' menu, select 'New project' to create a new project.



3. In the Toolbox, select the MS 7.8 and drag it into the Main Area. A pop up window to specify the MS 7.8 program archive appears.

- = + · + · ·	System	New Project	t - RaceCon V2.5.5.0		_ 5 X
System Logger (	Xsplay Calibration/Measuring Tools Windows				<b>.</b>
	Workspace:         Constant           Sheet         Sheet og and Sheet og and Sheet og and Arrangement         Special				
Project V X	64 New Project				Toobex 9 x
E 64 New Project		Create a new DDU10	X		Devices
i 🗴 🔞 Measurement Container		Specify the program archive This creates the device defined in the pro	agram archive		Displays     CAS-M3     DDU10     DDU7
		ECU program archive: Please specify the ECU program archive			DDU8 DDU9 DDU-52 Plus DDU-52 Plus CO4 M53 Sport M54.6 M515 Sport M55.2 M55.1 M55.2 M55.5 M55.5 M55.5
		< Box	Not > Front Canod		No.3.5     No.3.5     No.5.6     No.5.6     No.5.8     No.23     No.23
	•	C.	-		Measurement Elements
	🕼 System Overview 🚺 Dotsset monoger				Measugement Sources
Deta		+ ×	Info / Status		÷ ×
Show all Name A V Source	ce	v Used	Crors Warnings Messages		0,0 ×
NUTL SUIT	Puincon	No information			
Beady.				No errors detected - all cleared or state unknown	

- 4. Download the firmware for your device:
  - from the RaceConnect project file share for PSU. This .pst file should be provided to RaceCon.
  - from www.bosch-motorsport.com for VCUs, DDUs, and Loggers.
  - You can get firmware for ECUs on request.

An information shows if the archive is valid or not.

5. Click 'Next' (for PSU: go on with step 7).

🔊 🗄 🔷 r 🖉 r	System	New Project - RaceCon V2.5.5.0 *	_ a x
System Logger D	isplay Calibration/Measuring Tools Window	18	Ø ·
	Workspace:		
	Xection Sheet		
	<ul> <li>locked</li> <li>Snap to grid</li> </ul>		
	(		In case of the local division of the local d
Project 0 ×	Gill New Project	Create a new DDIIID.	Toolbox # × Pevices
Wew Project     Measurement Container			Displays
		Specify the program archive This creates the device defined in the program archive	CAS-M3 DDU10 DDU7
		EQU program socher CLLssolit.LANA TExatopit Auction (2010), BARE, 5001, 1514 parl Dragona Kons stall Packars 10:10:207 Cantore Weiner Construct Weiner Construct Weiner Construct Weiner Packars 10:207 Packars 10:20	0000 0000
		< Book Next > Finish Cancel	Power control unit
		Coox max Price Cance	Display Elements
	4 System Overview	· · · · · · · · · · · · · · · · · · ·	Measurement Elements Measurement Sources
	Construction and Construction		measurement Sources
Data		0 × Info / Status	t x
Show all		Errors     Marnings     Marnings     Messages     T., Time Sender Message	0/0 ×
Name / Source	e   Description  Function		
		No	
		information	
		momaton	
		Na Annors detacésió - Elf clearásió ar seastr anisment 🔹 🎁 New ProjectyM	easurement Container 🔤 🕮

6. Select 'Race track' or 'Testbench' mode according to your application.



7. Click 'Finish'.

Option     Option       First     Logic Decision       First     Logic Decision       First     Logic Decision       First     Text       First     Logic Decision       First     Text       First     Text	
Other manager	Poer code i unit     Poer
Data	4 x lafo/Status 0 x
Show all	O Errors A Warnings (1) Messages 0/0 ×
Name / Source Description Function Used	T Time Sender Message
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linoma	
Rusdy.	No errors Getected – all Gearled or state unknown * 🎽 New Freyet/Measurement Centainer 👛 📼

The MS 7.8 is inserted into the project and RaceCon tries to connect to the device.

RaceCon detects configuration differences between the MS 7.8 and the RaceCon project and asks for permission for data download.

Click 'Yes' to download the configurations to the device or 'No' to continue without downloading the data.



If the device turns red, you might need to do a firmware update on the device. For more information see chapter "Firmware update [> 114]".



The download starts and the MS 7.8 carries out a reset.

After the reset, RaceCon reconnects to the MS 7.8. Local configuration on both the PC and MS 7.8 match (indicated by green background and dot). The MS 7.8 is now connected to RaceCon.



For further information on the color indication, see chapter "Color indication [> 47]".

### 7.3 Feature activation

- Optional software feature packages are available for the MS 7.8
- All software feature packages can be purchased prior to delivery or after you have received your device.
- If you have purchased an optional software feature package, it must be activated before it becomes operational.
- The feature activation status is stored permanently in the device and requires activating once only.
- As the activation key is device specific, a key delivered with one MS 7.8 does not work on any other MS 7.8.
- When purchasing a software feature package, you have to tell Bosch the ECU ID code.
   The ECU ID code is device specific and can be found in the 'features info' window, shown in the screenshots below.
- If you have not purchased an optional software feature package, the next steps can be skipped.
- 1. Ensure a connection to the device.
- 2. To activate a feature, double-click on 'MS 7.8' in the Project Tree.
- 3. Click on the 'Features info' tab in the Main Area.

			System			_ = X
		oration,Measuring Tools	Windows			0.
	DOUID Race Mode Visible Protection Sheet					
	Status Mode Project Security		_			
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	- D Laptrigger	00	2010 features info			Displays
on DDU	B- Measurement Container	E	SCU ID 3950e77811007d540		Copy to dipboard	CAS-M3
						0007
			Status/Unlock Order Informations			E 0009
			CCP_MASTER F02U V02 213-01, Env	ble device to be CAN Communication Prot	scol Master	DOU-52 Mas
			FULL_LOG_1 F02U V02 304-01, Full			III MS3 Sport
			FULL_LOG_2 F02U V02 305-01, Ene USB_DATA F02U V02 214-01, Ene	ble full logging on second partition ble data copy from logger to Bosch USB si		M94 Sport
			ETHER_TELE F02U V02 138-01, End			MS15 Sport
			10_EXTENS F02U V02 205-01, Env	ble additional input / output channels		M515.2
2nd: Click on						₩55.0 ₩ MS5.1
'Features info' —						MS5.2
i cucui es uno						🗰 M55.6 🗰 M56
						🗰 MS7
						Display Bements
						Measurement Elements
		Statistics /- Math Channel			Device info 🛛 🛛 Error 🖬 🖓 Features info	Measurement Sources
	Data		÷ ×			= • ×
	🔿 🗃 🖓 🗃 🖨 🖉 🜌 🖉 🗃 Show at			C Erron(1) 🔥 Warnings(5)		45,45 🗙
	Name / * Source	Description	Channel ^	Type Time Sender	Message Project Data upload cancelled (try to resynchronize the di	evice by deconnecting/reconnecting it
	abslap COU10	Absolute lap count	Provided by DOU 30	A 11:07:07 DDU10 - New	Project Lost connection to device(Ethernet/XOP).	
	accx	longitudinal accele	Quantisation: 0,1/mc Limits: 0.15000	(1) 11:07:09 DDU10 - New (1) 11:07:09 DDU10 - New	Project BPK check successful. (BPK Device: DDU10_BASE,	_0401_TST4)
	accy COULD	transversal accele	Format: 547.1 Conversion: 0.1*Channel+2500	() 11:07:11 DOU10 - New () 11:07:11 DOU10 - New		writ in the second s
	Becz CU10	vertical accelerate	Data type: 16 Bit signed Address: 0x24700901	-		
	×			Info/Status CAN Log - running		
	Reedy.			Inclusion and inclusion	ing a feature of the state of t	sted there is the real there is a state of the second state of the

4. The 'MS 7.8 features info' window appears.

ECU ID	DOU10 features info       ECU ID       3950e778:1d0fd540       Copy to dipboard	
Feature status —	Status/Unlock       Order informations         Name       Description         CCP_MASTER       F02U V02 213-01, Enable device to be CAN Communication Protocoll Master         FUL_LOG_1       F02U V02 305-01, Enable deliloging on first partition         FUL_LOG_21       F02U V02 305-01, Enable data copy from logger to Bosch USB stick.         ETHER_TELE       F02U V02 214-01, Enable data copy from logger to Bosch USB stick.         ETHER_TELE       F02U V02 205-01, Enable dethernet / LTE Telemetry         ID_ENTENS       F02U V02 205-01, Enable additional input / output channels	List of available features
	Locked (disabled)	

5. Double-click on the feature you want to activate. A feature unlock window appears.

CU ID	3950e778:1	
	Name	nnormauons Description F02J V02 213-01, Enable device to be CAN Communication Protocoll Master
	ULL_LOG_1 ULL_LOG_2 ISB_DATA THER_TELE O_EXTENS	C2U V02 304-01, Full logging on first partition  ECU Protection Unlock Feature Unlock specified feature.  ETHER_TELE Requested KEY: d29856aal  OK Cancel

6. Enter the activation key you received for this feature on this device and click 'OK' when done. The feature's status changes to 'unlocked'.

Name         Description           CCP_MASTER         F02U V02 213-01, Enable device to be CAN Communication Protocoll Master           FULL_LOG_1         F02U V02 304-01, Full logging on first partition           FULL_LOG_2         F02U V02 305-01, Enable full logging on second partition           USB_DATA         F02U V02 214-01, Enable data copy from logger to Bosch USB stick           FTHER_TELE         F02U V02 138-01, Enable Ethernet / LTE Telemetry           IO_EXTENS         F02U V02 205-01, Enable additional input / output channels	Statu	s/Unlock Orde	r informations	
FULL_LOG_1         F02U V02 304-01, Full logging on first partition           FULL_LOG_2         F02U V02 305-01, Enable full logging on second partition           USB_DATA         F02U V02 214-01, Enable data copy from logger to Bosch USB stick           ETHER_TELE         F02U V02 138-01, Enable Ethernet / LTE Telemetry		Name	Description	
FULL_LOG_2         F02U V02 305-01, Enable full logging on second partition           USB_DATA         F02U V02 214-01, Enable data copy from logger to Bosch USB stick           ETHER_TELE         F02U V02 138-01, Enable Ethernet / LTE Telemetry	6	CCP_MASTER	F02U V02 213-01, Enable device to be CAN Communication Protocoll Master	
USB_DATA F02U V02 214-01, Enable data copy from logger to Bosch USB stick ETHER_TELE F02U V02 138-01, Enable Ethernet / LTE Telemetry	Ð	FULL_LOG_1	F02U V02 304-01, Full logging on first partition	
ETHER_TELE F02U V02 138-01, Enable Ethernet / LTE Telemetry	Ð	FULL_LOG_2	F02U V02 305-01, Enable full logging on second partition	
	ſ	USB_DATA	F02U V02 214-01, Enable data copy from logger to Bosch USB stick	
IO_EXTENS F02U V02 205-01, Enable additional input / output channels	ſ	ETHER_TELE	F02U V02 138-01, Enable Ethernet / LTE Telemetry	
	ſ	IO_EXTENS	F02U V02 205-01, Enable additional input / output channels	

- 7. Perform these steps to activate other features you purchased.
- 8. Switch the car's ignition off and on again to cycle the power of MS 7.8.

## 7.4 First recording (Quick Start)

This chapter explains the configuration of the recording of the battery voltage channel. See chapter 'Recording [> 86]' for a detailed instruction to configure recordings.

- 1. Click on the 'Logger' tab to go to the page 'Logger'.
- 2. Use the search bar in the 'Data' window, to search for 'ub' (measurement channel for battery voltage).



3. Drag and drop the 'ub' measurement channel into the recording area.

DDU10.r/p - RaceCon V.5.5503.10 *	×
System Logger Daplay Calibration/Nesauring Tools	@ •
South         Comment         Ramone         Image: Ramone <t< th=""><th></th></t<>	
Control of the control of the control of the factor could to. These have a book at the stated or the ranner stated coldulate.      Control of the control of the factor could to. These have a book at the stated or the ranner stated coldulate.      Control of the control of the control of the factor could to. These have a book at the stated or the ranner stated coldulate.      Control of the control of the control of the control of the factor could to.      Control of the contro	Control of the second sec
Corporal in toppog a Setting 10 Statuto	battery voltage         E           Quentisation:         0,11 V/           Limita:         0,425,5           Formati:         94,11           Precision:         0,62/11           Conversion:         0,62/11            =
Ready.	iject/DOU10/Logger/Logging1/Group 1/ub 📟 🚥 🚮

4. Click on the 'Download' button in the upper left corner. The configuration download starts and the MS 7.8 carries out a reset. Now you can find the 'ub' measurement channel in the 'Data Area'. As we did not define global start conditions, recording starts immediately.

	System DDU10.rlp - RateCon V2.5.5.0	_ a x
System Logger Display Calibration/Measuring Tools	Windows	<b>0</b> -
DUU30 Rece Mode Status Status Node		
Project 9 x	64 New Project	
ef New Nepet     de Constance     d	Contracting data to 0000 Contracting data t	Decest           © District            © District            © District            © District            © District            © COUT         © COUT           © COUT         © COUT
The project's name.	det System Overview     Delaset menoger	Measurement Elements Measurement Sources
J Deta	4 × [trfs/Status	= • ×
	Errors () Messages(6)	6/6 🗙
🗃 🗃 🗃 🗃 🗃 📓 🖬 📓 🚵 Show all	T Time Sender Message	*
Name / Source Decrybon / Botobap Dicture / Botobap Dicture / Botop Dicture / Botop Dicture / Botop / Dicture / Botop / Dicture / Dictu	Financian         Ibbel	

5. Start the WinDarab software.

🔅 🐴 🔹	WinDarab v7 Developer - Formula3			
Start Tools Windows				Style 🗸 🔞 -
Tier Files         V <sup>2</sup> Racetrack -           Channels:         Lvents           Colors         Deckable windows	Core Toggle			
•	•			
File Explorer a ×		Channels		a x
🎯 x   🔄 •   <b>Q</b> , 🖼 • 🔂				5
Out Lap Laptime		Name	Source	Descripti
	4 4 5 U X \V00K86887/			
	A A H X WORKSNEEL		^	
Events Time Car From To Duration Channel	to Var			ά×
				1707 MD free

- 6. Disconnect the MS 7.8 network cable.
- 7. Click on the 'Read Data from Logging Device' icon.

Choose your logger and click 'OK' when done. The 'Data Logger Import' dialog opens. Refer to the WinDarab V7 manual for instructions on how to use the 'Data Logger Import' dialog and for more detailed descriptions and instructions.



8. Choose the device and the IP address for the device.

Click 'Apply changes' when done.

🕈 Data Logger Import				-	Х	Choose your Device / IF
ettings Current Import	t Recent Import					from dropdown list
Import sources	Stick	Common option	ns IP cache entry after ping to device failed.			
	JUCK	_	sword, if not set by recording configuration:	/		
Burst			✓ New			
Device / IP: Export file: Save files in:		<ul> <li></li> <li></li> </ul>	Import al on connect Delete transferred files Import latest files first			
Subfolder template: Filename template:	[CardInfo]_out [outing]_lap[lap]	_frag[fragment]_[hour]	_[a]+ _[n]			
Advanced Con	mment Fields		Apply changes			

- 9. Connect the MS 7.8 network cable.
- 10. Click on the 'Current Import' tab.
- 11. Click on 'Import' in the lower right corner. If the 'Import all on connect' box is checked, the data transmission from the MS 7.8 starts automatically. Measurement files are stored automatically in the folder defined under 'Settings'.

🏘 Data Logger Import						• X
Settings Current Import Recent Impor	t					
Data source: FTP 23.06.2015 12:11:11				Network DDU7 - 10.10.0.207	•	18 ms
Name	Size (MB)	Get	Get (MB)	Progress		
FTP 23.06.2015 12:11:11	0.0		0.0	Connecting		
Auto Scroll Show all files					In	nport

- 12. Click on 'Close' when the transmission has finished.
- 13. Click on the Start button and choose 'Open measurement file'.
- 14. Select the measurement files from the storage folder.
- 15. Click on 'Open'.
- 16. Click on 'New Desktop' to open a new measurement data window.
- 17. Drag the 'ub' measurement channel from the channel list and drop it into the measurement data window. The 'ub' measurement channel's graph is displayed.



## 7.5 Set date and time

The MS 7.8 is equipped with a real time clock which is supplied by an internal accumulator. Once this accumulator is charged correctly by 12 V supply of the display, 'Date & Time' can be programmed by RaceCon.

Reassure that the time is set correctly, if the device has not been used for more than two weeks.

- 1. Connect the MS 7.8 to the PC.
- 2. Click on the 'Set date' button in the 'System' tab menu.



 Alternatively, click on 'Set Date & Time' in the context menu of the device. A 'Set Date & Time' menu opens

Project				Ŧ 🗙 Ka New F	Proj
🖃 🛤 New Project					
	Open				
📄 💼 Dis 🖾	Create measuring views				
	Download configuration				
	Synchronize	•	Ø	Set Date & Time	
	Current measuring media	•	¢۵	with ECU	5
	Create dataset		f)	Change program archive	
	PIN/SuperPIN	.		Update firmware	L
	Export		<b>₽</b>	Upload configuration	L
🕂 🕒 CA 🔿	Import		×	Clear logged data	-11
	Properties		Ŕ	Clone ECU	-
	Delete			Adjustment data	
- 📄 Co aje	Rename	_	••	Save •	
📥 📲 1/0 Ch	annels	_			

- 4. Set the current local date and time as coordinated universal time.
- 5. At 'Set a specific date & time' click and type on the value you want to change or choose from the dropdown menu.

Set date&time for DDU10	×				
Sets the date & time on a logger device. Use the 'set' buttons to configure the logger's recording date & time.					
Set current local date & time 11/8/2017 Set as UTC Set					
Set a specific date & time 08.11.2017 10:53:35					
The logger's current date & time 1/13/2000 17:33:01					
	Close				

## 7.6 Color indication

The color indication in RaceCon visualizes different messages, such as differences between tool and device, status of the device configuration or the accrual of errors.

#### Visible color indications:

- In the status area in the upper left corner.

۵ و	• •	• •	• •	• •	• •

 As a background, as well as a little dot around the display icon in the 'System window'.

		<u> </u>			
--	--	----------	--	--	--

C80 Logger C80 Logger C80 Logger C80 Logger C80 Logger

- As a colored stripe beside the device name in the project tree.

🖃 📲 New Project	🖃 💷 New Project
🞯 Laptrigger	DDU10
🚛 🛗 Measurement Container	🗄 🛗 Measurement Container

- As a colored background around the device name in the project tree.



- As a colored MIL in the "Error Info" window.

Existing DDU 10 errors			Existing DDU10	errors	
MIL 😑			MIL 🔵		
Location	Туре	Du	Location	Туре	Du
ANA04	Open line		Location	1700	00

- As a colored dot in the error memory at the bottom.

💛 DDU10, SYSTEM(laptrigger master), for 885,6 s 🔻

The colors and their meaning:

- Grey: No connection with the device.
- Green: Matching configuration and firmware between device and project.
- Orange: A different configuration between device and project.
- Red: A different firmware between device and project.
- Purple: Device is bricked, too many resets. Reflash the device, reconsider last changes.
- Colored background with orange stripes: Matching configuration with stored (inactive) errors in the device.
- Blinking colored background with orange stripes: Matching configuration with active errors in the device.
- Black MIL: No errors.
- Orange MIL: Inactive Errors (Error entries existing, but no longer active).
- Blinking MIL (orange/black): Active Errors.

For further information, see chapter Error Memory Properties.

# 8 Project Configuration

## 8.1 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.

		Cellesten/Mezzano Todo III-do II	_ = ×
	COUP Race Mode Voice Project		
	🖶 🗞 × 🎓 × - ×		
1st: Double-click on "Math Channels" in the Project tree 2nd: Click on	Next         Conjunct         X           Conjunct         Desting to the second	Re montany in const (W) and out advances (A) definition - () ((a) defi	
"Add channel"			Speed
	Proverse - Halt Counsel     Proverse - Halt Counsel     Prove     Debug     Debug	Test         Solution         Test           1018.00         001-46         Model Solution (Letter Solution	9 x 1234 ×
	CanChangedProtectioeState	ILINE 3 Nam - New. No downed source cardigated, dispong element     ILINE 3 0007 - New. Isoger data methods the local data.	*

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.

## 8.2 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.

-			
	A      A  A     A     A     A   A   A   A   A   A   A   A   A   A   A   A   A   A	0007/dp - K82808 V2.5.0.202	- • *
	Systen Lopper Disc	ay Calibration/Messuring Tools Windows	Ø -
	🕒 🔯 🍛 🕻		
	0007 Race Mode with Prot		
	Children Maria	loled	
	Project 3 X	/51 NevProtet ) 10 0007 4 P	x Toobes 9 X
	integect a x	4 Mer Project / 10 0002	X TOODOX U X
	e e DDUO	<u>,</u>	Display Elements
1-to Davible aliate	a Copper	1007 rah darred configuration	Neasurement Elements
1st: Double-click of	CAN Bus 1	J <sub>0</sub> Add channel. J <sub>0</sub> Edit channel. J <sub>0</sub> Dalets chappel()_	Measurement Sources
	👜 📑 CAN Bus 2	fo Methichannel. In Description Value In Conditional value International value Interna	Sensors
"Math Channels"	- Differences	In Conditional Justices.	Customized Sensor
	Calibration Items		<ul> <li>Analog sources</li> </ul>
in Project Tree	- 🖷 Macros		Characteristic Carve Multipoint Adjustment
	fr MithChanies		Sensitivity/Offset
	Group adjustments		Frequency sources
	CCP Mester		Characteristic Curve
2nd: Click on	B- 6 Measurement Container		Revolution Velocity
			Computed sources
the dropdown	Data - Math Channels # X		Adjustment channel
the uropuowin			Characteristic Curve
arrow beside	Show all		Fuel
unow beside	None 💉 💌 Sou		Hysteresis
			E Laptigger
'Add channel'			PWH Out Sensitivity/Offset
			Speed
	· = ,		
Judi Chasses	Properties - Math Channels # X	🖀 Statistica 🗴 Mash channels 💪 Conditional Channels 🎑 CAN messages 🔩 Macros 🛄 Settings 🕕 Denice Info 🏠 Peatures info	<b>1</b>
3rd: Choose	81 6 Waterdard + 10 + 60	1652bba	x
	8 Debug	C Inter(i) (1 Meniapo(4) (2 Meniapo(67) 144/144	< .
'Conditional	CanChangedPror True CanChange/Isibil True	Type Time Sender Message	*
	E Math channels properties	0 11-10-51 00/7-1e BK deck successful. (EK Decke: 00/7_JMSE_0727 )	
function'	Nane Math Channels	▲ 112-051 Alam-1e Na dramed source configured, signing element ① 112-051 DUCF-1e Logger data nationale the local data	
,		11:40:13 D0L/7-Ne Last connection to device[Ethemeth/DP].	
		11-90-114 DDU? -Ne Successfully connected to device@hermeth/D2.     10-0114 DDU? -Ne DPK-shek successfull_DPKC-Neico DPK_2PK2 (2017) DPK-shek successfull_DPKC-Neico DPK_2PK2 (2017) DPK-shek successfull_DPKC-Neico DPK_2PK2 (2017) DPK-shek successfull_DPKC-Neico DPKC-Neico DPKC-NE	
	CarrChangedProtectionState	11-32-15 Nam - Ne No dwarnel source configured, slopping element	
		(i) 11-Vit 15 DDU7-Vie Logger data matches the local data.	-

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



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 7.8 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 OTHERWISE-condition 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.

## 8.3 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:



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 7.8 condition channel window.

## 8.4 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 7.8 project.

### Creating a new Condition Combination

Follow the steps shown in the screenshot.

	S Leven Deck B0/7 Reac Male with Party B0/7 Reac Male with Party B0/7 Reac Male with Party	BOUT/Ap - Kandun 10.11.2.000	•
1st: Double-click on 'Conditional Channels' in Project Tree	Anne (Constant) (	10.07 and the function of the large state of the condition of the large state of the larg	Antice of a second
2nd: Click on the dropdown arrow beside 'Add condition'		B mmm, [Å] with lowests [Å] conservationers, [B] (Stimmager), [B] mmm.] (j) (Mmm, [A] (Mmm, [	Alument dana      Alu
3rd: Choose 'Conditional combination'	New Cerdinal Danets B Selay Cerdinal Danets Cerdingsifies Trac Cerdingsifies Trac Cerdingsifies Trac Cerdingsifies Trac Cerdingsifies Trac	0.1000 ()         0.0000 () <t< td=""><td>• ×</td></t<>	• ×

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



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				£
Combine multiple conditions.				JX
Name:				
condComb				
Output configuration:				
Constant TRUE/FALSE				ĸ
Constant TRUE/FALSE				5
Blinking Pulsing				
Toggling output				
<	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 7.8 condition channel window.

## 8.5 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 prop Setup the up and dow		and the maximum c	ount of steps.					-+
Source for signal Up:						_	Edge:	
睅 🛃 page_up					1	$\sim$	Falling	$\sim$
Source for signal Down							Edge:	
睅 🛃 page_dn					1	$\sim$	Falling	$\sim$
Maximum count of ste Signal source: Constant: Display switch does no Measurement Sheet:							12	2
								~
		< Back	Next >	Fini	sh		Canc	el .:

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

Measurement label	Function
name	page or brightness value
name_ <b>dn</b>	input condition for decrement
name_ <b>up</b>	input condition for increment
Example:	
🙆 displayPage	C80 Logger
🖉 displayPage_dn	📮 C80 Logger
🖾 displayPage_up	C80 Logger

## 8.6 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.

mer configuration			
Specify timer properties and a set of	control signals.		<u> </u>
Properties	Control signals		
Mode:	Start timer:		Edge:
Count down 📐 🗸	🔛 🙆 cond_start	🥒 🗸	Falling ~
Count down Count up	Stop timer (optional):		Edge:
10.00 🔷 s	E cond_stop		Falling ~
Measurement sheet	Reset timer (optional):		Edge:
~	🔛 🛃 cond_reset	e 🖉 🖉	Falling $\sim$
	Use timer expiration to reset timer		

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

Measurement label	Function
name_ <b>time</b>	actual timer value
name_ <b>trig</b>	trigger set by timer alarm
In this example, the module is named "Time	r_Module". Resulting channels are:

Timer_Module_time	■ C70
Timer_Module_trig	C70

# 8.7 GPS Trigger Module

The GPS Trigger Module triggers depending on GPS-position, like the GPS-laptrigger.

There are 50 GPS trigger points for parameter application of latitude/longitude coordinates, as well as 10 macro-based coordinates.

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.

-			
n.			
GPS positions (Paramet	er based) Detection range (N	lacro based)	
Latitude [DD]	Longitude [DD]	Detection range [m]	^
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	
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	
0.0000000	0,0000000	20,00	
0.0000000	0,0000000	20,00	
0.0000000	0,0000000	20,00	
0,0000000	0.00000000	20,00	~
	Latitude [DD] 0,00000000 0,00000000 0,00000000 0,00000000	GPS positions (Parameter based)         Detection range (M           Latitude [DD]         Longitude [DD]           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,00000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000           0,0000000         0,0000000	GPS positions (Parameter based)         Detection range (Macro based)           Latitude [DD]         Longitude [DD]         Detection range [m]           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           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           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           0.0000000         0.0000000         20.00           0.0000000         0.0000000         20.00           0.0000000         0.0000000         20.00           0.00000000         0.0000000         20.00<

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 - Add New		×
GPS Trigger configuration Specify GPS Trigger configuration.		9
Fudge Factor:	GPS positions (Parameter based) Detection range (Macro based)	
Measurement sheet	20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00         20.00	m       m       m       m       m       m       m       m       m       m       m       m       m       m
	< Back Next > Finish C	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_ <b>lat</b>	interpolated gps latitude
name_ <b>long</b>	interpolated gps longitude
name_ <b>ptrig_150</b>	trigger output of parameter based trigger (n)
name_ <b>pdist_150</b>	distance to trigger of parameter based trigger (n)
name_ <b>mtrig_110</b>	trigger output of macro based trigger (n)
name_ <b>mdist_110</b>	distance to trigger of parameter based trigger (n)
name_ <b>macro_lat_110</b>	stored latitude for macro based trigger (n)
name_macro_long_110	stored longitude for macro based trigger (n)
Example:	
GPS_Trigger_mdist_2	© C70
GPS_Trigger_mtrig_2	🖻 C70
GPS_Trigger_pdist_2	C70
GPS_Trigger_ptrig_2	© C70
GPS_Trigger_macro_lat_2	@C70
GPS_Trigger_macro_long_2	C70

### 8.8 CPU Load Limits

As all microprocessors, the two processors of the MS 7.8 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 7.8 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 7.8 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 7.8 resets due to complex configuration setups, please consider reducing the demands on the MS 7.8 adapting the influencing factors mentioned above.

## 9 CAN Configuration

The MS 7.8 has 5, of which 3 FD fully configurable CAN bus(es).

- Baudrate 125 kbaud to 1 Mbaud
- 11 Bit or 29 Bit identifiers
- Input configuration: Read messages from CAN bus and convert to MS 7.8 measurement/display variables. CAN bus supports row counter configuration.
- Output configuration: Write RaceCon measurement variables to CAN messages; output frequency and row counter are configurable, CAN gateway functionality (transfer from one bus to another).

## 9.1 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 in wiring harness
- All devices connected to the bus must use identical data rate
- Configuration of bus data rate in the 'CAN messages overview' menu. To access the menu, double-click on one of the CAN bus items of the project tree



#### Row Counter Concept

- Re-use (multiplex) of message identifiers
- One byte of message contains row counter
- 7 bytes payload remaining
- Position of row counter is configurable



## 9.2 CAN input

### 9.2.1 Input configuration

Click with the right mouse button on the desired CAN bus to open the CAN bus dropdown menu.



### 9.2.2 Create new CAN Input channel

- 1. Double-click on any CAN bus item, to open the "CAN messages overview".
- 2. Select 'Add CAN-IN' and choose the desired CAN bus for the new input channel.



3. A CAN channel configuration window opens.

New CAN-IN messag	ge				X
New CAN-IN mes Configure the ne	ssage ew CAN-IN message and ar	optional multip	lexer.		5
Name:					
p_oil					
Description					
engine oil pressure					
CAN ID:	0	hex		Extended	
Timeout:	0	ms	Default value:	0	raw
Measured Value					
Value:			Raw:		
		none			
Use Multiplexer					
Representation:	Byte	-	Value:	0	
Start:	0	3	Length:	1	
Туре	Unsigned	-	Endianes:	Big	
Data					
Representation:	Byte	•			
Start:	0		Length:	1	
Туре	Unsigned	•	Endianes:	Little	
0 1	2	3	4 5	6 7	
	I	1	1 1		
Conversion		(D);			
Factor:	1,0		Minumum:	0.0	none
Offset:	0.0	none	Maximum:	255.0	none
Unitgroup:	none			Adjust automatically	
Unit:	none				
Measurement Shee Select one, or ente		•	The CAN-IN mes specified sheet.	ssage will be added for measuring i	in the
				ОК	Cancel

4. Insert the name and description of the channel.

5. Click 'OK' when done.

The channel is listed in the Data window.

CAN Bus 1	s overview		CAN Bus 2			CAN Bus 3		
Baudrate:	1 MBaud			[ A MD and			1 MBaud	•
		•	Baudrate:	1 MBaud	•	Baudrate:		
AN Resistor:	off	Ψ	CAN Resistor:	off	•	CAN Resistor:	off	Ψ
AN Out start delay:	0 ms		CAN Out start delay:	0	ms	CAN Out start delay:	0	ms
AN Out rate limit:	0 mes	sages/ms	CAN Out rate limit:	0	messages/ms	CAN Out rate limit:	0	messages/ms
AN Bus 4								
audrate:	1 MBaud	•						
N Resistor:	off	-						
AN Out start delay:	0 ms							
AN Out rate limit:	0 mes	ssages/ms						
N configuration fill	evel							
	CAN In IDs					CAN Out IDs 0 / 12		
	CAN In chann	els 1 / 500				CAN Out channels 0 /	400	
<i>,</i>								
	Add CAN-OUT 🔹 📄 E	dit 🔜 De	lete					
	Add CAN-OUT • 📄 E CAN ID 💌 0x0	dit 🔜 De Start Bi		▼ ( 8	irid 💌 Multij	plexer Value  Type CAN In		N Bus N Bus 1

#### CAN channel configuration



### 9.2.3 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 bargraph.



- 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 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.



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

#### Conversion to physical value



a) Enter factor (gain) for conversion to physical value.

b) Enter offset for conversion to physical value.

- c) Select type of physical value.
- d) Select unit of physical value.
- e) Enter minimum physical limit of the channel. (for manual setup)
- f) Enter maximum physical limit of the channel. (for manual setup)

g) Check the box to automatically adjust the limits of the channel.

#### CAN analyzer functionality

..

This functionality is only available, if a MSA-Box (I or II) is used to connect the MS 7.8 to the PC. Choose the CAN bus that is connected to the MSA-Box to display the raw value and the converted physical value here.

measured value			
Value:		Raw:	
	bar		

#### Automatic creation of online measurement sheets

The CAN channel can be automatically inserted into a measurement sheet. Insert a name for a new sheet or select an existing sheet from the list box.

For an online view of the value measured by the MS 7.8, insert the channel in an online measurement sheet which is described in the chapter Setting up an online measurement [> 75].

Measurement Sheet	
Select one, or enter a new name:	The CAN-IN message will be added for measuring in the
	specified sheet.

### 9.2.4 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.



- 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.

CalibratoryMeasuring System Logger Dicplay ColibratoryMeasuring Tools Polder/Sheets Pri	DDU7.rlp - RaceCon V2.5.0.2002	_ = × 0-
State copy logy logy logy logy logy logy logy log	B Charge A3.	<u> </u>
Itesserenti Yafer 1	Drag + Drop	Babe dettit     Image: Control of the second s
		De and bel     Troncetor rour     Troncetor rour     Troncetor rour     Troncetor rour     Countestors: 190/Inc     United
Shout 2 Sheet 1		Offset:0 Data type:8 Bit unsigned

- 6. The measurement element displays the values of the assigned channel.
- 7. Connect PC to the vehicle and switch to 'Race Mode' by clicking 'F11' on the keyboard to display online data.

### 9.2.5 Import a CAN database (DBC) file

- 1. Right-click on CAN Input of desired bus (CAN1 or CAN2).
- 2. Select 'Import DBC file' from menu. A file browser opens.
- 3. Select DBC file to import and click 'OK' when done. A channel import window opens.

94 channels and 60	messag	ies availa	ble					channels to import:	
Name	Unit	ld	Size	RowCtr	RowVal	Descrit 🔺		aps	
🕒 ассх	g	777	8			Vector,		ath	
🕒 ассу	9	777	8			Vector		1	
🔜 accz	9	777	8			Vector	Then a	1	
activate_blip	flag	100	1			Vector	Add all		
activate_cut	flag	100	1			Vector,			
🕒 aps	%	779	8			Vector,			
🕒 ath	%	773	8			Vector,			
🕒 ax1_Bremse60	g	5C0	16			Vector	<- Remove	1	
ay1_Bremse60	9	5C0	16			Vector		-	
🔜 batt_u	٧	779	8			Vector	Remove all		
battlow_b		77A	1	0	5	Vector -			
<b>آ</b>									
		270 me	asureme	en tsin 16 (	CAN messi	aries recordiniz	ed 130 measu	rements skipped,	

- 4. Select desired channels on the left and use the 'Add' button to add them to import list.
- 5. Click 'OK' when complete. The channels are inserted in the Data window.

## 9.3 CAN output

### 9.3.1 Output configuration



### 9.3.2 Create a new CAN output message channel

- Double-click on any CAN bus item to open the "CAN messages overview".
- Select 'Add CAN-OUT' and choose the desired CAN bus for the new output channel.

	DDU10.rlp - RaceCon V2.5.5507.11 Windows	*	- a x Ø•
DUID Status Mode			
Project 0 x	De New Project DOU10 💌		Taalbax 9 🗙
	DD/10 CVM resolution         CVM fbs 1           Backdraft:         1198ed           Backdraft:         109ed           CVM Restor:         0           CVM Cut start dilay:         0           CVM Cut start dilay:         0           Disoldat::         0           CVM Cut start dilay:         0           Disoldat::         0           CVM Cut start dilay:         0           CVM	mesagelins CN Out nie Init:     o mesagelins     CN Out nie Init:     O mesagelins     CN Out Die 0/128	Options         Options           C 45-533         A           C 50-533         A           C 50-53         A           C 50-52         A           C 50-53         A           C 50-53         A           C 50-54         A           C 50-55         A <td< td=""></td<>
	Control 0, 500           And CANN         CAN GAN           And CANN         CAN GAN           And CANN         CAN GAN           CAN Gan         Statistic           CAN Gan         Length (Bel)           CAN Gan         Candon Control           CAN Gan         Candon Control           Control         Candon Control		VCU in MS2 Sport POB POLF1 PSUF1 Psychas ECU Custom ECU Prove control unit Prove control unit Pro
Deta Show all	0 × Brido / Status		= • × 0/0 ×
Name / Source Description •	Function • Used No information	Stoppel   SYS Log - Stopped	

- The 'New CAN-OUT message' window opens.

ew CAN-OUT messag	je					×
New CAN-OUT me Configure the CAN	<b>ssage</b> -OUT message and an optional multiplexer.					
Name:						
CAN Message						
Description						
CAN ID:	0	hex	Extended			
Grid:	100 ms 🔻	]	Trigger channel:		*	
			Trigger on:	Rising	•	edge
Use Multiplexer Representation:	Byte •	]	Value:	1	A V	
Start:	0		Length:	1	×.	
			Endianes:	Big	•	
📑 Add row 🔜 🛛	Delete row(s) 🔄 Add channel 📑 Add const	tant 🔄	🕽 Edit 🔄 Delete	Bit index inverted		
Byte 0 0 1 2 3 4 5	Byte 1 Byte 2 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1	Byte 3	<b>Byte 4</b> 5 6 7 0 1 2 3 4 5	Byte 5 6 7 0 1 2 3 4 5 6 7 0	Byte 6 E	l <b>yte 7</b> 3 4 5 6 7
				ſ	ОК	Cancel

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

(	New CAN-OUT mess	age				<b></b>
	New CAN-OUT m Configure the CA	essage N-OUT message and an optional multiplexe	г.			<b>(</b> )
	Name: CAN Message Description					
	CAN ID:	0	🚖 hex	Extended		
Definition of	Grid:	100 ms	•	Trigger channel:		<b>*</b>
CAN message				Trigger on:	Rising	▼ edge
-	Use Multiplexe	·				
	Representation:	Byte	-	Value:	1	
	Start:	0		Length:	1	
				Endianes:	Big	-
Content of	📑 Add row	Delete row(s) 🔄 Add channel 📑 Add	i constant	🔊 Edit 🔛 Delete	Bit index inverted	
message	Byte 0 1 2 3 4	0 Byte 1 Byte 2 5 8 7 0 1 2 3 4 5 8 7 0 1 2 3 4 5 8	Byte: 7 0 1 2 3 4	Byte 4 5 6 7 0 1 2 3 4 5	Byte 5 6 7 0 1 2 3 4 5 6 7 0 1	Byte 8 Byte 7 2 3 4 5 6 7 0 1 2 3 4 5 6 7
5						OK Cancel

 Click on 'Add channel...' or 'Add constant...', this opens the 'Add new CAN out channel' window.

	System	U10.rlp - RaceCon V2.5.5507.11 *	. o X
System Logger Display Calibration/Measuring Tools			
Image: Second	ad file from.		
Drotect	Configure the CAN-OUT messa	ige and an optional multiple Add new CAN out channel	X3
Control of the second of	None         Concessor           Concessor         Description           Galaxy         Concessor           Conce         Concessor           Concessor         Concessor           Concessor         Concessor           Concessor         Concessor           Concessor         Concessor	Alf and cold back thermal Control of the CNM out denormal Contro	Constant of the second se
Internet 6 x 2011 'Y standard • 13 • 00 Acceleration State – Devise Application	CAN 6 1 1		Concel Co
The application type of the datalogger	State:		Messgement Sources
teas		<ul> <li>× bio / Status</li> <li>Crrors A Warnings D Messages</li> </ul>	
tene         Image: Source         Description           affa         00003         Maketa Spaceta           affa         00003         Maketa Spaceta           affa         00003         Maketa Spaceta           affa         00003         Maketa Spaceta           affacta         00003         Maketa Spaceta           affacta         00003         Maketa Spaceta           affacta         00003         Maketa Spaceta           affacta         00003         Taggers the on-almost day           affacta         00003         Taggers the on-almost day           affacta         00003         00003		T         Trist         Salder         Nucceys           Lion         Janey Factory Register         1973-1982 - 1972-1982         1972-1982	
e II Resdy	,		el cleared or state unknown + 🔳 New Project/20010 🚥 🚥

- Select the desired measurement channel and specify the message settings.

The measurement channel is now assigned to the CAN message.

### 9.3.2.1 Add CAN out constant

To send a constant value on the CAN, perform the following steps:

- 1. Create a new CAN output message or edit an existing message.
- Click small arrow beside 'Add channel...' and select 'Add constant...'. The 'Add new CAN Out constant' window appears.
- 3. Define the name of the constant, the required value in hex and define the CAN channel settings.

ame: an Test_100	e message and an optional multiplexer.					
ame: an Test_100						
anTest_100						-
escription						
CAN ID: 100		🔹 hex	Extended			
DLC: 8		bytes	Trigger channel:		~	
arid: 100 m	ms	~	Trigger on:	Rising	~	edge
Use Multiplexer						
Representation: Byte			Value:	1	-	
Start: 0		-	Length:	1		
			Endianes:	Little	~	

4. Click 'OK' when done.

### 9.3.2.2 Adding CAN out counter

To send a counter value on the CAN, perform the following steps:

- 1. Create a new CAN output message or edit an existing message.
- 2. Click small arrow beside 'Add channel...' and select 'Add counter...'. The 'Add new CAN out counter' window appears.
- 3. Define the name of the counter, define the CAN channel settings.
- 4. Click 'OK' when done.

Add new Count	er							
Specify the prop	erties of the C	CAN out Counte	er.					
Name:								
counter1								
Representation:	Byte	~						
Start:	ß	-		Length:	[	1		2
Right shift:	0	-		Endianes:	[	Little		
Counter start:	0	-		Counter end:		255		
0 1	2	3		5	6		7	
	- Î	Ť	Ť	ĭ	Ĭ		í	
Ľ – –								

### 9.3.2.3 Adding CAN out checksum

To send a checksum on the CAN, perform the following steps:

- 1. Create a new CAN output message or edit an existing message.
- 2. Click small arrow beside 'Add channel...' and select 'Add checksum...'. The 'Add new CAN out checksum' window appears.
- 3. Define the name of the checksum, the algorithm, the byte which should be covered by the checksum and define the CAN channel settings.

Add new CAN out cor tant	×
Add new Checksum	
Specify the properties of the CAN out Checksum.	
Name:	
Please enter a name for the CAN out checksum	
Position: 0	
0 1 2 3 4 5 6 7	
Checksum type: CRC8 (8H2F)	~
Select bytes the checksum should be computed from (7 bytes selected)	
0 1 2 3 4 5 6	7
ОК	Cancel

4. Click 'OK' when done.

# 9.4 Multiplexer

#### Row counter concept

If certain channel messages are not time-critical and can be imported or exported slowly, you can use a multiplexer to put several channel messages on one message identifier.

- Re-use (multiplex) of message identifiers by splitting it into several rows.
- Every row is assigned to a unique value of the multiplexer.
- One byte of message contains row counter.

- 7 bytes payload remaining. A multiplexer does not have to consist of one byte only, it can consist of several bytes as well as single bits.
- Position of row counter is configurable.

To use a multiplexer perform the following steps:

- 1. Double-click on any CAN bus item to open the "CAN messages overview".
- 2. Select 'Add CAN-IN' and choose the desired CAN bus for the new input channel.
- 3. Check the box 'Use Multiplexer' and configure the multiplexer for the new CAN-IN channel.

System Logger Display Collication/Mean	atha Toola We New CA	AN-IN message				- ×		<b>0</b> -
DEUID Race Mode volte Protection Shet	Now	r CAN-IN message anfigure the new CAN-IN mess	age and an optional mult	iplexer.		S		
Status Mode Protect Security	Name: CANCh							
	et COULO X Descrip					- H		Topbox 0 ×
• • • • • • • • • • • • • • • • •	Descrip	paon						Devices
DDU10	CAN messages overview CAN IC		these these		Extended		<b>C</b>	CAS-H3
Display     CAN Bus     CAN Bus     CAN Bus     CAN Bus     CAN Bus     CAN Bus	- I Manual	out: 0	* ms	Default value:	0 <u>*</u> raw		d •	0007 0005 0009
GAN Outputs     GAN Re     GAN Bus 2     GAN Data	setor: off Velue		none	Raw.			• • •	DDU-52 Plas
CAN Bus 4     CAN Ou     CAN Ou     CAN Ou     CAN Ou	Repres	ise Multiplexer	•	Value:	0		0 messages/ms	MS4 Sport
# I/O Channels - CAN Bus     Calibration Items Baudrat     Macros	e: 1 MBaud Start:		۵	Length:	1	- 1		MS15.1 MS15.2 MS5.0
A Math Channels     CAN Res     A Conditional Channels     CAN Data	istor: off Type Data		•	Endianes:	Big •	- 1		MSS.1 MSS.2 MSS.5
— S Group adjustments	t rate limit: Start	esentation: Byta	•	Length:	1	- 1		MS5.6
CAN cor	figuration fill level Type	Unsigned	•	Endianes:	Liffe •			MS7 MS3.8 MS24
	And CAN-C	1 2	1	1	f í	-		WS24 light WCU WX MS25 Sport
Show all     Multiple			÷ none/Bit	Minumum	0,0 ÷ non		CAN Bus CAN Bus 1	PDB PSU-F1 Bypass ECU
Name Sou No p_ol	Offset	e: 0.0	none	Maximum	255.0 👘 non		CAN Bus 1	Custom ECU
infor matio	Unitgr	roup: none	•		Adjust automatically	1		BB PECSO * Display Elements
	a production of the local division of the lo	urement Sheet						Measurement Elements Measurement Sources
Info / Status	Select	t one, or enter a new name:		<ul> <li>The CAN-IN mer specified sheet.</li> </ul>	ssage will be added for measuring in the			0 ×
Servors 🔥 Warnings 🕕 Messages								0/0 ×
T Time Sender Message					ОК С	ancel		
befo / Status GAN Log - Stopped SYS Log - Stopped								
Ready.							- all cleared or state unknown 🔹 🛄 New Pr	oject/DDU10/CAN Bus 1 🚥 🚥

- 4. To configure the multiplexer for a CAN-OUT channel, select 'Add CAN-OUT'.
- 5. Check the box 'Use Multiplexer' and click on the button 'Add row...' to split the message identifiers into several rows.
- 6. Click on one row and select 'Add channel' to assign a channel to the row.

s Mode				New CAN-OUT m	ressage				<b>—×</b>	
New Project DUL10 DUL10 CAR Burger CAR Burge	6 X	CAN Very any of the output of	S OVENNE I Milaud off I Milaud (off (off	New CAN-OU Configure the CAN Message Description CAN ID: Grid: Wure Malap Repferenze: Stert:	0 100 ms	e optional multipleser.	Extended Trigger channel: Trigger an: Value: Length:	[Rang	• • obp 8	Toshor <u>Decise</u> 2 Display CAG+40 DOU/3
Master Devices Measurement Container	۰ × No	CAN Out rate limit: CAN configuration fil Add CAN-IN- Name	CAU CAU	• 1 • 2	ALC DALL	Id channel Add constant Dire 2		Big Bit Index Inverted Dyte 5	•	NSS.6 NSS.6 NSS NSS.8 NS
,	infor matio n	Statistics & Math (	Thermels 🖉 Condition	1 Dames 🗃 ON	messeges 🐄 Necros 🕯	:Settings   🜒 Device info   😢 Err	or info 🛛 💼 Feetures	5 ×rf0	OK Cancel	Power control uni     PRX30     Display Eleme     Heasurement Lie     Meesurement Si
17.15										
rs 🚺 Warnings 🕕 Mess	ages									

- 7. The 'Add new CAN out channel' dialog opens.
- 8. Select a channel and configure it. To assign it to the row selected before, check the box 'Multiplexed'.
- 9. To move the channel message, change the "Start" value or click and hold the green field in the "Add new CAN out message" window.
- 10. Click 'OK' when done.

Add new CAN out ch	annel		
Add new CAN ou Specify the prop	t channel erties of the CAN out channel.		<u> </u>
Channel:			
💷 📑 b_pwr_good			•
8 Bit unsigned / little	endian		
Representation:	Byte		Multiplexed
Start:	4	Length:	2
Right shift:	0	Endianes:	Little
	Force quantization		
Factor:	1.0	Offset:	0,0
Туре:	Unsigned -		
0 1	2 3 4	5 6	7
			OK Cancel

- 11. The channel message is assigned to the selected fields.
- 12. Click 'OK' when done.

System Logger Display Cal	System Ibration/Measuring Tools Windows		DDU10.rlp - Racel	Con V2.5.5507.11 *				- *	× ×
DOULO Status									
		New CAN-OUT messa	ge						_
	DOULD R	New CAN-OUT me	ssage				~	Teolbax F	×
		Configure the CAP	N-OUT message and an optional	multiplexer.				Displays	
i Glogger	DDU10 CAN messages overview							CAS-M3	- îil
Display	CAN Bus 1	Name: CAN Message						DDU10	
CAN Bus 1 CAN Input_1	Baudrate: 1 MBaud	Description						DDU8	
CAN Dutputs	CAN Resistor: off	Description						DDU9 DDU-S2 Plus	
GAN Bus 2	CAN Out start delay:	CAN ID:	0	bix	Extended			EOUs	
CAN Bus 3	CAN Out rate Imit:	GAN D.	0	· Park	Elenoro			III MS3 Sport	
GAN Bus 4     Gomputed Channels	Own Obcrate write.	Grid:	100 ms	•	Trigger channel:		w.	E M54.6	
🐵 🐗 I/O Channels	CAN Bus 4					Rising		MS15 Sport MS15.1	**
- 🦷 Calibration Items	Baudrate: 1 MBaud							MS15.2	
- S Macros	CAN Resistor: off	Use Multiplexer			Value:	1		## MSS.0 ## MSS.1	
& Conditional Channels	CAN Out start delay:	Representation:	Byte	-	Value:		*	MS5.2	
<ul> <li>Group adjustments</li> </ul>		Start:	0	-	Length:	1	(A) (F)	MS5.5	
Master Devices     Measurement Container	CAN Out rate limit:				Endianes:	Big	•	<b># 1</b> 156	
I Measurement contailler	CAN configuration fil level	Add row	Delete row(s) Add channe	el 📑 Add constant 🗄	Edit. 🗟 Delete	Bit index inverted		M MS7	
		Dyte C	0,000	Dite 2 Dite 3	Dyte 4	Dyte 5 Dy	b 6	M 1924	
0M2 6 4		1 1	ana01 Dag		>	6 2 0 1 2 3 4 5 6 2 0 1 2 3	458701274587	MS24 light	
	Add CAN-IN • 🗟 Add CAN-OUT	2 2			2			X) MS25 Sport	
Show all	Name 🗠 💌 🤇	3 3			Cab_pwr_goo	d		P08	
Name / W Sout								🐺 Bypass ECU	
NO								Custom ECU     Power control unit	
infor						_	OK Cancel	BB PEX90	-
matio							UN Gailder	Display Elements Measurement Element	
<	Statistics A Nath Channels A Corre	tenal Channels 🛛 🔞 C	AN MASSAGES 🛛 🖉 MASSAGE 🗰 S	Settings 0 Device info	🕖 Error info 🛛 🔒 Fi	eatures info		Measurement Sources	
tufo / Status		_							
Serrors Warnings D Messages									υX
T., Time Sender Message									e. e.
Info / Status CAN Log - Stopped SYS Log - Stopped	1								
Roady.								r state unknown 🔹 No selection 🚥	-
# 10 Export and Import in RaceCon

You can perform an export or an import on almost any level in the project tree.

# 10.1 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.

Export displayed content to	_		×
Selected items below will be exported. Please click 'Export' to select a o	destination to store to.		۲
New Project Fuel Speed P DDU10 MS6 Logger MS6-ECU P Cemetry			
Select all Deselect all	🗌 Ex	port as patc	h file
	Export	Cancel	

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

# 10.2 Import in RaceCon

You can choose to import into the whole project or you can import into 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.

orted Project:	Current Project:		
egory: All			
r: Exact V Type a Name	Imported elements: 🔳 👔 Missing Links: 🤳 🁔		
<ul> <li>Fuel</li> <li>Laptrigger</li> <li>Speed</li> <li>DDU10</li> <li>Cogger</li> <li>CAN Bus 1</li> <li>CAN Bus 1</li> <li>CAN Input</li> <li>can1_0x200_Rx_timestamp_1ms</li> <li>can1_0x200_Rx_ub</li> <li>can1_0x200_Rx_timestamp</li> <li>can1_0x200_Rx_truetest_flowrate</li> <li>can1_0x200_Rx_trugger</li> </ul>		3	

- 4. Select channels to import.
- 5. Drag and drop the channel to 'CAN Input' of desired CAN bus on right hand side.
- 6. Click 'Finish'. If a measurement channel belongs to more than one source (e.g. MS 7.8 and MS 6), the 'Solve Label Ambiguity' window opens.

Importing from file dummy.rex(2.13.1.4)	— 🗆 X
Select for all ambigous objects the appropriate one.	•
Solve label ambiguity	
Ambigous Label	Target Label
Import File/DDU10/Logger/Logging1/New Group/accz	🚛 🔤 Current Project/MS6-ECU/accz
Import File/DDU10/Logger/Logging1/New Group/accy	
Import File/DDU10/Logger/Logging1/New Group/accx	V
	Do not link  Current Project/DDU10/Calibration Items/accx  Current Project/MS6-ECU/accx
	<back next=""> Finish Cancel</back>

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

# 11 Online Measurement and Calibration

- System status and diagnosis
- Check and calibrate sensors in the vehicle
- Live display of sensor values on the PC
- Use RaceCon for diagnosis, online measurement and calibration
- Communication interface: Ethernet
- Communication protocol: XCP

# 11.1 Setting up an online measurement

MS 7.8 supports online measurement of sensor values and diagnostic variables.

1. Expand 'Measurement Container' and 'Measurement Folder 1' in the Project Tree and double-click on 'Sheet1'. Alternatively, click on the 'Calibration/Measuring' tab to open the window directly. 'Sheet 1' opens in a new 'Calibration/Measuring' window.



- 2. Click on the 'Folder/Sheets' tab, which appears when you are in the 'Calibration/ Measurement' window, to create a new measurement folder.
- 3. Click on the 'Add' button for folders in the upper left corner.



In the menu for sheets, you will find buttons to add, delete and rename new sheets

4. To change between different sheets, click on the tabs on the bottom of the 'Calibration/Measuring' window.



Tabs to switch between sheets

To add an element to a measurement sheet, perform the following steps:

5. Drag a measurement element from the Toolbox and drop it on the measurement sheet.



6. Select the desired measurement channel from the 'Data' area and drop it on the measurement element.



If the MS 7.8 shows the green status, the value is displayed.

RaceCon offers different types of measurement elements:









Circular gauge

Measurement label

Temperature gauge

Vertical Bar graph style

Horizontal Bar graph style





Numeric indicator



Oscilloscope (Chart)

### 11.1.1 Automatic creation of measurement sheets

RaceCon can create measurement sheets automatically.

You can create and use measurement sheets with the MS 7.8 as well as with all other devices connected to RaceCon.



1. During the configuration of a measurement channel, select a measurement sheet from the list box or enter a name for a new measurement sheet.



Create Channel	
Set the unique name for th	e channel and add an optional description.
Name:	
brightness	
Description:	

2. To create the sheets, right-click on MS 7.8 and select 'Create measurement views...' from the MS 7.8 context menu.



The automatically created sheet is inserted in the Project Tree under 'Measurement Container' and 'Device Channels'. If the MS 7.8 is connected to RaceCon and the status is green, live values of the channels are shown.

### 11.1.2 Using the measurement sheets

- 1. When RaceCon is online, press the 'F11' key to switch from 'Design Mode' into 'Race Mode'. The measurement sheet is extended to full screen. The button for offset calibration is active.
- 2. Switch between different sheets using the tabs at the bottom of the window.
- 3. Press the 'Esc' key to return to 'Design Mode'.

<b>0,0000</b> G	SENSITI	400,000		Zuropani calibratur.
2490,0 mV	OFFSET	2500,000	mV	
2	MIN	-5,000	G	-
	MAX	5,000	G	
	ADJ_VAL	0,000		
	<b>0,0000</b> G	0,0000 G SENSITI 2490,0 mV OFFSET MIN MAX	0,0000 G SENSITI 400,000 2490,0 mV OFFSET 2500,000 MIN -5,000 MAX 5,000	2490,0 mV OFFSET 2500,000 mV MIN -5,000 G MAX 5,000 G

# 12 Error Memory

In this chapter "Error Memory", a lot of screenshots are created by way of example for DDU 8. Please consider this and replace the product name 'DDU 8' in this case with the name of your product.

# 12.1 Error memory representation in RaceCon

Bosch Motorsport devices feature an error memory. Information on errors can be visualized via RaceCon (online measurement) or can be transmitted via telemetry.



### 12.1.1 Accessing the memory

The error memory can be accessed as shown in the illustration:

	Calbration,Measuring T	System polis Winde	ws	-	DDU10_Te	t.rip - RaceCon I	/2.5.5.0 - Masterlicense Bosch *		⊖ × ⊘•
DDU30 Race Mode visible Protection Sh Iocustor Mode Project Security									
Project 0 ×	New Project	UU (N						Toobox	0 x
G dal New Project G Laptrigger G 44 DDU9								Devices Display [jenents Measurement Bements	
DDU10	Existing DOU 10 error							Measurement Sources	
👵 🚥 Logger	ML 😑						Clear	- Sensors	_
B Display	Location	Type	Duration	Active	DateTime	Occurrences	Description	Bosch Wizard	
CAN Bus 1	ANAD4	Open line	30,2	(A) True	1/4/2000 6 28 26 A	м	1 No further information avai-	Customized Sensor	
GAN Bus 2     GAN Bus 3	ANAD6	Open line		Co True	1/4/2000 6:28:26 A		1 No further information avai	<ul> <li>Analog sources</li> </ul>	
E CAN Bus 4	ANA07	Open line	29,4	C True	1/4/2000 6:28:26 Al	M	1 No further information avai	Characteristic Curve	
Computed Channels	ANA09	Open line		True .	1/4/2000 6:28:27 Al	M	1 No further information avai	Multipoint Adjustment	
B- 29 1/0 Channels				-				Sensitivity/Offset	
Calibration Items								<ul> <li>Frequency sources</li> </ul>	
_ 🖏 Macros								Characteristic Curve	
- fr Math Channels								Revolution	
f_ Conditional Channels								Velocity	
Group adjustments								Computed sources	
Group								Adjustment channel	
Master Devices								Characteristic Curve	
B Measurement Container								Display Switch	
								Fuel	
								Gear Lookup Table	
								Hysteresis	
								C Laptrigger	
								PWM Out	
								Sensitivity/Offset	
	Start detection of	Frahle						Speed	
							-	C space	
	Statistics // Math	Channels j	Conditional Channels	CAN mess	ages 👼 Macros 🕴	🖬 Settings 📄 🕕 D	exice int	•	
Deta				4 × Info					
error_					Errors(1) 🔥 Warnin	gs(32) 🕕 Messa	ges(119)		52 🗙
🔁 🔤 Show all				Typ	e Time Seri	der	Message		
Name / • Source	Description			0		J10 - New Project	Successfully connected to device@themet/NCP		
	Desuptor			ő		J10 - New Project	EPK check successful. (EPK Device: DDU 30_BAS		
				ŏ		J10 - New Project	Device data matches the local data.		
		N	information	(i)		J10 - New Project	Calbration data successfully uploaded and initia	laed.	
		No	intormation	(i)	17:33:16 000	J10 - New Project	Successfully cleared the error memory.		
				۲	17:33:18 DDL	J10 - New Project	Start of cable breakage detection successful.		1.0
* III				Info	/Status CAN Log - n	unning			
leady.						-	DOUID, ANADHODen Inc), for 23.7 s + 177 herei	Secret DOLLO TRO Chapate	-



The memory is situated inside the device and is 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

The error memory is not cleared by a configuration download and is not cleared by a power cycle.

### 12.1.2 Clearing the error memory

There are two ways of clearing the error memory, both are shown in the following illustration:





# 12.2 Writing an Error

For the functional part of the MS 7.8 system (MS 7.8 -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.

# 12.3 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.

CLRERRMON	TDUE
	- IRUE
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)



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

System Logger Daplay Co System Logger Daplay Co DD0 Race Mode Visible Protection Site Status		System Windows	DDU10_Test.rk	) - RaceCon V2.5.5.0 - Mastericens	e Bosch * _ = = X
Import     Import       Import     Import	ANA05 Open ANA07 Open ANA09 Open Start detection of cable	b Duration Activ New 1143 Fa Iline 1135 Fa Iline 1135 Fa Iline 1131 Fa	Alex 114/2000 6/32/86 AM 144/2000 6/32 6/32 AM Idea 114/2000 6/32 5/3 AM Idea 114/2000 6/32 5/7 AM	1 No furth 1 No furth	Constructed Sensor     Constructed Senso
Data error		₽ ×	Info / Status	3) (i) Messages(123)	□ # × 157/157 ¥
Rame / Source	Description	No information	Type         Time         Sender           (1)         17:33:18         DDU10           (2)         17:35:13         DDU10           (1)         17:35:20         DDU10           (1)         17:35:20         DDU10           (1)         17:35:20         DDU10           (1)         17:35:20         DDU10	Message New Project Start of cable breakage New Project Lost connection to dew New Project Successfully connected New Project EPK check successful. () New Project Device data matches th New Project Calibration data succes	* detection successful. ce(Ethernet/XCP). to device(Ethernet/XCP). PK Device: DOUJ0_BASE_0401_TST4)
Ready.	•		LINTO / Status CAN Log - runnin		or 113, 1 s 🕶 🍕 New Project/DOU 10/1/O Channels 🥶 🚥 🚅

2 (at least one active error present in memory)

		System		DDU10_T	est.rlp - RaceCon ۱	/2.5.5.0 - Masterlicense Bosch *	_ = X
System Logper Display Cal DDU9 Race Mode visible Protection Smett Status Mode Protection Smett	bration/Measuring Too	ils Windows	-	-	-		@ •
Project P x	🚱 New Project 🗰 DDU	J10 🗙					Toolbox R 🗙
Bei New Project ■ Ø Laptrigger						-	Devices Display Elements
B DDU9	Existing DDU 10 errors					@	Measurement Elements
DDU10	MIL O					Gear	Measurement Sources
👜 🖬 Display							<ul> <li>Sensors</li> </ul>
CAN Bus 1		Type Durat		DateTime	Occurrences		Bosch Wizard
😥 🛄 CAN Bus 2		Open line	83,3 😵 True			<ol> <li>No further information avai</li> <li>No further information avai</li> </ol>	Customized Sensor
👜 . 🛄 CAN Bus 3		Open line	82,9 🥸 True 82,5 🐼 True	1/4/2000 6:28:26 1/4/2000 6:28:26		1 No further information avai	<ul> <li>Analog sources</li> </ul>
E CAN Bus 4		Open line Open line	82.1 A True	1/4/2000 6:28:27		1 No further information avai.	Characteristic Curve     Multipoint Adjustment
Computed Channels	00000	Opennine	02.1 🛃 1106	174/2000 0.20.27			Sensitivity/Offset
- 🦛 I/O Channels							<ul> <li>Frequency sources</li> </ul>
- Macros							Characteristic Curve
							Revolution
fr Conditional Channels							M Velocity
😑 🕙 Group adjustments							<ul> <li>Computed sources</li> </ul>
📉 Group							Adjustment channel
Master Devices							Characteristic Curve
🗓 - 👸 Measurement Container							Display Switch
							Fuel
							Gear Lookup Table
							Hysteresis
							Captrigger
							PWM Out
	Start detection of o	rable					Sensitivity/Offset Speed
	Starc detection on t	Laure					Speed
	Statistics ( Math C	hannels / /r Condit	onal Channels 🛛 🧕 CAN	messages Macros	Settings i D	evice info  🥹 Error info 📑 Features infi 🧃	·
Data			÷×	Info / Status			= + ×
error_				😮 Errors(1) 🔥 Warr	nings(32) 👔 Messa	ges(119)	152/152 🗙
📑 🔤 🔟 Show all				Type Time S	iender	Message	*
Name 🖉 💌 Source	<ul> <li>Description</li> </ul>			<ol> <li>17:33:10</li> </ol>	DU10 - New Project	Successfully connected to device(Ethernet/XCP)	
					DU10 - New Project	EPK check successful. (EPK Device: DDU10_BAS	_0401_TST4)
					DU10 - New Project	Device data matches the local data.	
		No info	ormation		DU10 - New Project	Calibration data successfully uploaded and initial Successfully deared the error memory.	zed.
					DU10 - New Project	Start of cable breakage detection successful.	
1				-			v
•	•			Info / Status CAN Log			
Ready.						DDU10, ANA04(Open line), for 78,0 s 👻 🌃 New F	roject/DDU 10/I/O Channels 🔤 🐽 🕫

# 13 Recording

## 13.1 Features

- Synchronized recording of MS 7.8 analog and digital input channels, MS 7.8 internal measurement channels, ECU data, Data from external sensor interfaces
- Up to two independent recordings
- Measurement rate 1 ms to 1 s
- Two global start conditions (thresholds)
- Up to 16 measurement conditions (fast-slow-switches)

# 13.2 Configuration of recordings

1. Expand the list of 'Loggers' by clicking on '+' in the MS 7.8 Project Tree.



 Double-click on 'Recording' in MS 7.8 Project Tree. The recording configuration is displayed in the Main Area.



- 3. To add measurement channels to a recording, click 'MS 7.8' in the MS 7.8 Project Tree. In the Data Area, the measurement channels are displayed.
- 4. Drag and drop desired measurement channels into recording group.

O			DDU7.rlp	RaceCon V2.5.0.2002					- a x
System Logger	Display Calibration, Neasuring	Tools							- چ
	🕤 🔁 Rename 🚺 🕞 Rename								
DDU7 Download Ad	id 🏟 Delete Add 📑 Delete	Add Delete							
	Kecorong uroup	Channel						-	
0007						4.8	Deta - DDU7	_	9
							Show all		
DDU7 configuration management							Show all	• Sou •	Description *
	il(s)   Delete channel(s)   🗄 Flat vi			▼ Condition			carid_dp_info_016	<ul> <li>S0L</li> <li>COU7</li> </ul>	carid stored in d
	Name on_japcounter	Source DDU7	Rate / True rate     10 ms	Condition	Telenetry     None		carid_dp_info_017	0007	carid stored in d
Concerns of the second state of the	on lapfuel	0007	10 ms		None		carid_dp_info_018	COU7	carid stored in d F
	cn_laptime	0007	10 ms		None		carid_dp_info_020	0007	carid stored in d
							carid_dp_info_021	0007	carid stored in d carid stored in d
	<b>A</b>				A		Carid_dp_info_023	COU7	carid stored in d
	- <b>-</b>				- <b>+</b>		carid_dp_info_024	0007	carid stored in d
	· · · · ·						carid_dp_info_025	0007	carid stored in d carid stored in d
					Recording p	ronerties	carid_dp_info_027	COU7	carid stored in d
					necoluting p	ropenties	carid_dp_info_028	0007	carid stored in d
							carid_dp_info_029	0007	carid stored in d carid stored in d
							carid_dp_info_031	0007	carid stored in d
							carid_dp_info_032	CCU7	carid stored in d
		Drag measure	ement				copyr_status_001	0007	rthaN rthaN
							Histon_astance	0007	Caronenory os
		channels into	aroun				cn_lapcounter	0007	Cardmemory lap
			group				🚍 on Japfuel 🚍 on Japtine	0007	Cardmemory for Cardmemory lap
							Ben statute de	Cooura	Contraction y ap
							Con_stateCard	0007	Cardmemory pro
							cn_stateSignalCM	C007	Cardmemory pro
							Cm_stateSignalSG	0007	Cardmemory pro
							disp_online_mn	0007	display online st +
							< = =		,
							n apcour		
							Provided by D (showed at 'D	JU7 stall	
							Cardmemory lap counter		5
							Quantisation: 1/nc		
							Limite:0255 Format:%1.0		
							Precision:0 Resolution:0		
Recording 🛄 Settings 🔂 Sta	itatics						Conversion:on lapcounter		-

5. To edit channel's settings, mark the channel(s) and click 'Edit Channel'. An 'Edit Recording Channels' window opens.



6. Click 'OK' when done.



#### NOTICE

If no condition is defined or condition is 'false', measurement channels are recorded at the value chosen in 'Rate'.

If the condition is 'true', measurement channels are recorded at the value chosen in 'True rate'.

#### Using fast block/slow block transmission

MS 7.8 telemetry uses available bandwidth of Telemetry Unit FM 40 (19,200 baud -> approx. 1,700 bytes/s). The bandwidth has to be divided into channel information to be transmitted high-frequently and low-frequently using the 'fast/ slow block' setting.

Channels are grouped into 8 blocks which are transferred each cycle:

- Fast block (Block 1) is transferred every cycle and used for a high-frequent transmission of channel information (e.g. speed, rpm).
- Slow blocks (Block 2...n) are transferred every n-th cycle and used for a low-frequent transmission of channel information (e.g. tire pressure, oil temperature).



If the maximum bandwidth of a block is reached, a warning will be displayed. To fix this problem you can view the allocation of the channels and data rate in the 'Statistics' tab of the Main Area. See chapter 'Recording statistics [> 90]' for more information.

# 13.2.1 Adding a recording

MS 7.8 supports up to two independent recordings.

To add a recording, select 'Add Recording' from the context menu of the Logger in the MS 7.8 Project Tree.

Project	<b>д</b>	×
🖃 📲 New Project		
bDU7		
i logger i logger i Open		
🚛 📄 Display 🛛 Add recording		
Export		
🚞 Compu 🌛 Import	- 1	
😥 🛷 🎲 I/O Cha Image: Calibrat Properties		
👼 Macros	_	
$f_x$ Math Channels		
$f_{\mathbf{x}}$ Conditional Channels		
🕙 Group adjustments		
CCP Master		
🗄 🖷 Measurement Container		

Maximum two recordings are possible. In the device software the 2nd recording is reserved for scruteneering data. This recording is invisible (protected).

### 13.2.2 Adding a recording group

Recording channels can be grouped.

To add a new group, select 'Add group' in the context menu of the recording. The groups can be renamed to 'Gearbox', 'Aero', 'Engine', etc.



### 13.2.3 Global settings

To display the global MS 7.8 settings, select the 'Settings' Tab.



a) Choose setting for outing counter mode:

- For testbench (without lap trigger) select 'Testbench'.
- For racetrack (with lap trigger) select 'Racetrack'.

b) Choose your WinDarab version. In V6 the file is encrypted by WinDarab. In V7 you can enter an optional self created password in the 'Encryption' field shown in f).

c) Recording Type (Engine or Chassis).

d) Statusblock configuration file for custom Statusblock definition.

e) Choose or create the condition to start recording.

- f) If selecting WinDarab V7 in b), enter a password hint and a password (optional).
- g) Setting for automatic fragmentation. Do not change!

## 13.2.4 Recording statistics

The tab 'Statistics' shows the channels' allocation and their current data rate related to the transmission frequency of the MS 7.8 and the whole transmission system.

The overview helps to detect bandwidth bottlenecks of channels. Bandwidth bottlenecks can be solved by changing the 'fast/slow block' setting for each channel.

The data rate of the whole system is often less than the data rate of the MS 7.8 and limits the overall transmission speed.



### 13.2.5 Recording diagnosis

The channel 'statectrl\_ok' of the MS 7.8 can be used for online monitoring of recording status.

Bit	Value	Name
0	1	RECORD
1	2	DATAOK
2	4	BLKOK
3	8	-
4	16	-
5	32	-
6	64	STARTED
7	128	-

#### Content of status bits

Name	Bitset	Bit cleared
RECORD	Measurement data is re- corded.	No measurement data will be stored because meas- urement thresholds are not reached.
DATAOK	Received data without error.	Discarding received data because of wrong timestamps. Check wiring of SYNC signal.
BLKOK	All measurement blocks have been set up cor- rectly.	Some measurement blocks have not been set up correctly.

Name	Bitset	Bit cleared
STARTED	A measurement has been set up.	A measurement is not set up. Either no recording configuration has been found or logger software
		upgrade is not activated.

# 13.2.6 Displaying online recording diagnosis ('statectrl\_ok')

- 1. To add a Recording Diagnosis element to a measurement sheet, change to page "Calibration/Measuring" and drag a 'Bit-LED' element from the Toolbox and drop it on measurement sheet.
- 2. Drag channel 'statectrl\_ok' from the Data Area and drop it on the 'Bit-LED' element.



The 'Bit-LED' element shows the state of received channel data in bit-representation. A green highlighted channel means 0, a red highlighted channel means 1.

- Measurement correctly initialized, but recording threshold(s) not reached: 254
- Measurement correctly initialized, MS 7.8 is recording data: 255
- Values less than 254 indicate an error state
- 'statectrl\_ok' can be linked to an alarm on the display. See chapter ''Alarm' display element' for details.

### 13.2.7 Further measurement labels

These additional measurement labels may help you diagnosing the state and operation of the data logging in more detail. There are a few more, but these are usually enough. Please refer to statectrl\_ok, mentioned in more detail in chapter 'Recording diagnosis'.

Measurement label	Function
card_part1_size	Size of the first logging data partition in MB.
card_part2_size	Size of the second logging data partition in MB. Atten- tion, second logging can also be stored on first parti- tion, depending on chosen settings (Logger -> Set- tings).
ftp_UserLoggedIn	This measurement allows to monitor for active FTP connections. RaceCon (WinDCP) and WinDarab may not connect in parallel.
meas_globcond_m01 / _m03	State of the global logging start condition for first / second logging. TRUE means data is actively recorded.
meas_rate_m01 / _m03	Incoming measurement data rate (first / second log- ging) for further processing. Does not include com- pression. Active when meas_globcond_m0x is TRUE but may also be active while meas_globcond_m0x is FALSE, if a pretrigger time is configured. In that case data is transferred to the pretrigger buffer, but not necessarily written to storage medias.
meas_cnt_ecu / _fde	Processed data blocks for first / second logging. This does not ensure writing the data to a storage media, e.g., if pretrigger is configured and meas_globcond is FALSE.
meas_cnt_int / _forked	Processed data blocks per media (internal / USB).
meas_compression_m01 / _m03	Compression factor for first / second logging. For ex- ample, factor 2.0 means incoming data can be reduced to half the size, before data is written to storage me- dias.
meas_pretrig_buf_size_ecu / _fde	Size of data buffered in pretrigger, e.g., while global logging condition is FALSE. Data will be forwarded to storage medias when logging condition becomes TRUE.
meas_backend_buf_size_ecu / _fde	Size of data buffered (for first / second logging) for processing by different storage medias (intern / USB). It is possible, that e.g., internal storage has processed the data already, while USB is still busy writing the data blocks. Data is removed from the buffer as soon as all medias have processed it.
meas_write_rate_intern_001 / _002	Effective data write rate to internal storage media, after compression, for first / second logging.
meas_write_rate_usb_001 / _002	Effective data write rate to USB storage media, after compression, for first / second logging.

# 13.3 Event logging

Event Logging implements the possibility to observe a channel if short spikes are expected. With Event Logging, every occurrence of a user defined threshold (more complex conditions are possible) leads to an event being raised. It is listed in a table along with its time stamp, its ID and even with a text string freely definable in RaceCon.

Events are stored as text in logging data and displayed in WinDarab like Darab-Events. Possible use cases are error entry, etc.

Configuration in RaceCon:

Project 🕂 🗴	💿 New Project 🛛 🖙 MS6 Lo	igger 🗙	
- Mew Project	MS6 Logger Events		
Hand MS6 Logger	🖉 Add Event 🚀 Edit I	Event 🐔 Delete Events	
😥 📾 Logger	Active Name	V Description	<ul> <li>Trigger Channel</li> </ul>
CAN Bus 1     CAN Bus 2	TemperatureHig	gh Chip temperature is critical high	B_tempHigh
E- CAN Bus 2		Edit Event	×
Computed Channels			
- 👦 Events		Edit Event	
- 📮 Calibration Items		Fill out all required fields to edit the selected event.	
_		Name	
		TemperatureHigh	
Properties P ×		Description	
🔠 🖞 🛛 🍸 standard 🔹 💷 🗸 🧭		Chip temperature is critical high	
<ul> <li>Event properties</li> </ul>		Category	
Description Chip temperature is critical hig Name TemperatureHigh		Warning	~
Name Temperaturenign		Trigger Channel	-
		Ingger Charnier	✓
Name		Edge	
		Rising	~
	🔁 Statistics 🏾 🅼 Math Cha		
Data		200	▲ ms
Starts with			
F Show all			OK Cancel
Name A V Source	V Description		- Curicer

Display in WinDarab:



Name         Centor         Centor         Computer/Source           ● Ober difficit events         ● <t< th=""><th>💁 = 💁 🥪</th><th></th><th></th><th></th><th></th><th></th></t<>	💁 = 💁 🥪					
	Name		•	Creator	Computer/Source	Desc.
Φ DumpeFLen_bump         Φ         0         KAM7FH         ABTZ0KEI           ▲ 6 Genbox         0         -	User defined events	œ	0			
			0			
⊕ \$\mu\$         0         KAM/FH         ABTZ0KEI           ▲ \$\mu\$         \$\mu\$         \$\mu\$         \$\mu\$           ● \$\mu\$         \$\mu\$         \$\mu\$         \$\mu\$	IDamperFL_on_bump	۲	0	KAM7FH	ABTZOKEI	
> \$YNC         0           Φ sync_issue         KAM7FH         A8720KL1	A Gearbox		0			
© sync_issue KAM7FH ABTZOKL1	Shift_2-3	۲	0	KAM7FH	ABTZOKEI	
	SYNC		0			
A MISE Logger 5	@ sync_issue			KAM7FH	ABTZ0KL1	
	🖌 🌩 MS6 Logger		5			
© Test_event_2 RaceCon MS6 Logger	@ Test_event_2			RaceCon	MS6 Logger	

# 13.4 Data Logger and USB recording

#### Default settings: Target Partition Partition 1 & USB Recording 1 Internal Memory & USB

Data from **Recording 1** and **Recording 2** are stored both into the Internal Memory and additionally on the USB stick in copy.

To download the data from the Internal Memory of the logger, the Data Logger must be selected in WinDarab and the data will be downloaded in parallel.

#### Alternative setting:



**Recording 1** is stored on the Internal Memory and additionally on the USB stick in copy. To download this data, the Data Logger must be selected in WinDarab.

**Recording 2** is stored on only the Internal Memory. To download this data, the Long Term logger must be selected in WinDarab.

# 13.5 USB recording

This function requires the installation of Software Upgrades. Look into the datasheet of your device, to see which upgrades are available for your device.

Software Upgrade DATA\_USB enables USB recording. To activate Software Upgrade DATA\_USB, enter the license key as described in the chapter 'Feature activation' [> 41].

For USB recording, Software Upgrade FULL\_LOG\_1 should also be enabled.

#### Wiring harness

Bit	Value
USB_Device_Power	Power (red)
USB_Device_DP	D+ (green)
USB_Device_DN	D- (white)
USB_Device_Gnd	GND (black)

For further information, see the pinlayout of the device.



Colors matching a standard USB cable

#### Storage device

The recording function can be used with a dedicated Bosch Motorsport USB device. The USB device must be preformatted with the Bosch File System (BFS) in RaceCon before first use.

To format the USB device with the Bosch File System (BFS), do the following steps:

In RaceCon, select 'Tools' - 'Extras' and choose 'Format USB stick'.

Press 'Format'.

An USB device is recognized by Windows as a 'storage medium', but it can only be initialized with RaceCon and read with WinDarab.

### 13.5.1 Recording data on USB device

- 1. Plug an USB device to MS 7.8.
- 2. Prepare a recording configuration in RaceCon.
- 3. Power on the system and connect with RaceCon to the vehicle.
- 4. Download the configuration to the MS 7.8.
- 5. Record measurement data. If an USB device is present, the MS 7.8 stores the data in parallel on the internal memory and the USB device.
- 6. Power off the system.
- 7. Remove USB device from the vehicle.
- 8. Start the WinDarab software.



- 9. Click on the 'Import/Export' icon.
- 10. Select 'Data logger CXX/DDUX/MSX and click 'OK' when done. The 'Read measurement data' dialog opens.



11. Click on 'Settings' tab and select the option 'Flash Card/USB Stick'.

Settings Current Import Recent Import	
Import sources	Common options
FlashCard / USB-Stick	Delete ARP cache entry after ping to device failed.
✓ Device	Force password, if not set by recording configuration:
Burst	V New
Export file: One file for each lap	
Save files in: D:\daten	Import latest files first
Save files in: D:\daten	
Save files in: D:\daten Subfolder template:	

12. Activate 'Apply changes'.

Insert the USB device into the PC. Data transmission from device starts automatically. Measurement files are stored automatically in the base folder.

🏘 Data Logger Import						
Settings Current Import Recent Import						
Data source: FTP 23.06.2015 12:11:11				Network DDU7 - 10.10	.0.207	18 ms
Name	Size (MB)					
FTP 23.06.2015 12:11:11	0.0		0.0	Connecting		
						Import
V Auto Scroll Show all files						Import
🏘 Data Logger Import						
Settings Current Import Recent Import						
Name	Size (MB)	Succe	55			

- 13. Click 'Close' when transmission has finished.
- 14. Click on the Start button and choose 'Open measurement file'.
- 15. Select the measurement files from the storage folder.
- 16. Click on 'Open'.
- 17. Click in 'New Desktop' to open a new measurement data window.
- 18. Drag the desired measurement channel from the Channel list and drop it into the measurement data window. The measurement channel's graph is displayed



For more detailed descriptions and instructions, refer to the WinDarab V7 manual.

### 13.5.2 USB device handling hints

#### Using the USB device

Always plug the USB device into vehicle before power up to ensure that all measurement data is stored on the USB device.

If the USB device is plugged in after recording has started, only the current data is saved. Data recorded on the MS 7.8 before the USB device is plugged in will not be saved.

#### Removing the USB device

Always power off the system before unplugging the USB device!

### 13.5.3 Troubleshooting

When no data on the USB device is recorded:

Configure the measurement label **usb\_mediastate** on a RaceCon measurement view or on a MS 7.8 display page.

The value of **usb\_mediastate** reflects the operating condition of the USB bus:

State	Description
0: Wait: Device not found	The USB device is not found (also: waiting for re-plug stick). No USB device inserted. USB device is defect. No electrical connection or wiring harness problem. USB software upgrade not activated (Purchase of unlock code needed).
1: Wait: Device detected	An USB device is found, but not yet installed.
2: Ok: Media installed	The USB device is found and is operational (idle). This does not imply that recording data is written!
4: Stop: Device unplugged	The USB device has been removed. The MS 7.8 performs a restart when an USB device is re- plugged in.
5: Error: Media error	The communication to the USB device broke down. The USB device is defect. The USB device is not supported by MS 7.8.
6: Error: Media corrupt	The USB device is not in valid BFS format. (Hint: Re-format the USB device in RaceCon.)

# 14 Lap Trigger

# 14.1 Lap trigger (timing beacon)

#### Why do we need a lap trigger (timing beacon)?

- Vehicle lap time measurement
- Calculation of lap-dependent functions (lap fuel consumption, min/max values)
- Calculation of lap distance dependent functions
- Control of data logging system

#### Types of Systems

- GPS based (low cost, low precision)
- IR based (low cost, high precision, limited reliability)
- RF (microwave) based (high precision, high reliability)

#### IR and RF based Systems consists of

- Transmitter (trackside unit)
- Receiver (in-vehicle unit)



### 14.1.1 Electrical trigger signal

In MS 7.8 all sources of measurement channels can be used as trigger signal.

- Analog input
- Digital input
- CAN input

Signal (measurement channel) properties

Low active signal (Bosch triggers): Trigger releases if signal is below the threshold.



High active signal (other manufacturer's triggers): Trigger releases if signal is above the threshold.



Two types of trigger signal:

- Main trigger (end-of-lap at start/finish line)
- Sub-trigger (segment time, optional, not applicable with GPS lap trigger)

#### Bosch standard:

- Main trigger 20 ms, low active (Recommendation for RaceCon "Detection Time" setting: 15 ms, Setting must be a slightly shorter period than the signal length of the trigger to avoid a missed trigger due to the update rate)
- Sub trigger 40 ms, low active (Recommendation for RaceCon "Detection Time" setting: 30 ms)

### 14.1.2 GPS Lap trigger

The GPS lap trigger uses a GPS signal to trigger the lap timer. To function this timer an external GPS sensor (see GPS Sensor) has to be connected to the device and a detection point with a detection range has to be defined in RaceCon.

The GPS detection point is defined by the latitude and longitude. The easiest way to get the latitude and longitude of a finishing line is due to a web mapping program such as google maps. With google maps, simply left-klick on the spot where you want to set the detection point. The information about the latitude and longitude will show up, in general the latitude is given at first. You should insert at least five decimal places for sufficient precision.



Photo: Google Maps

The detection range defines the radius of a circle around the detection point in which the lap trigger can be set. The lap trigger will be set as soon as the distance between the car and the detection point has reached its smallest peak. By this function an imaginary finishing line is calculated inside of the detection circle.

The imaginary finishing line can only be calculated if all channel sources are defined correctly. The latitude and longitude channel sources are mandatory for the functionality. Missing direction or speed source lowers the precision of the system.



Note

The configuration of the sensor update rate and the detection range must insure to receive a valid GPS point in the detection range, despite the occurring vehicle speed near the detection point.

### 14.1.3 Prevention of false triggers

- Race track topology and transmitter location frequently cause false triggers.
- Software functionality prevents acceptance of false triggers.
- Minimum vehicle speed for acceptance of trigger prevents false triggers while vehicle is stationary in the pits.
- Time based re-trigger protection prevents false triggers due to signal reflections on Home Straight.
- Lap distance based retrigger protection prevents false triggers due to track topology.

### 14.1.4 Forced triggers

Lap distance based insertion of 'forced trigger'.

Under race conditions, trigger signals are sometimes missed. Software functionality introduces 'forced trigger'.

### 14.1.5 Setting up a lap trigger

- 1. Click 'Measurement Sources' in Toolbox.
- 2. Drag 'Laptrigger' into 'System Overview'. Do not drop it on 'MS 7.8'!



#### A 'Laptrigger Wizard' window opens.



- a) Change signal device, if desired.
- b) Change signal channel, if desired.
- c) Choose signal threshold. See chapter 'Electrical trigger signal' for details.

d) Define threshold of input channel signal when trigger is released. Only possible, if no digital source is selected as signal source.

e) Define presettings for trigger. See chapter 'Lap trigger presettings' for details.

f) Define condition settings; change signal for vehicle speed, define speed settings. See chapter 'Distance based retrigger protection' and 'Distance based forced trigger' for details.

g) Define settings for main trigger. See chapter 'Lap timing' for details.

h) Define settings for counddown timer. See chapter 'Countdown timer' for details.

i) Define settings for sub trigger. See chapter 'Segment timing' for details.

j) Define settings for a GPS lap trigger. See chapter 'GPS lap trigger' for details. Only applicable if the signal source is set to 'GPS lap trigger'.

Click 'Finish' to complete the operation. A pre-configured lap trigger window opens.

	Stalker Project 🐻 Laphrigger 💌
	Laptrigger configuration
Drocat values for lan sounter	
Preset values for lap counter	General Presettings Conditions Trigger Countdown Segment timing Lap counter start value:
and outing counter	1. taps
Minimum laptime that a new	Outing counter start value:
best laptime' is accepted	Lap time threshold:
	Lap time best preset:
Preset value for 'best laptime'	100,0 ± s
	Configuration
	Laptrigger configuration
hange signal for vehicle speed,	General Presettings Conditions Trigger Countdown Segment timing
desired.	Speed source:
	₩ The speed
iter minimum speed for	Mn. speed: 20 (b) km/h
igger release.	Track distance:
efine settings for distance	4000 🖄 m
	20 👘 %
ased retrigger protection.	800 m
	Max. distance:
	120 👌 %
- fine and in the distance	
efine settings for distance	
ased forced trigger.	
	Configuration
	Laptrigger configuration
efine settinas for lan timina	
	General Presettings Conditions Trigger Countdown Segment timing Detection time:
	Detection time:
nain trigger).	Detection time: 13 mm retrieved to time:
nain trigger).	Detection time:
nain trigger).	Detection time:
nain trigger).	Detection time:  Sector time:
nain trigger).	Detection time:
nain trigger).	Detection time:
Define settings for lap timing main trigger). Define settings for sub trigger.	Detection time:
nain trigger).	Detection time:
nain trigger).	Detection time:
nain trigger).	Detection time:

		Ø
	Laptrigger configuration	0
Define settings for countdown	General Presettings Conditions Trigger Countdown Segment timing	
	Mode:	
timer.	None V	
	Start time: 120 <sup>(h)</sup> s	
	140/ <u>(x.)</u> 5	
	Configuration	
	Laptrigger configuration	Ø
Define settings for segment	General Presettings Conditions Trigger Countdown Segment timing	
Define settings for segment	Mode:	
timing.	None	
	Lap segment distance from main trigger:	
	Nr. Segment distance (m)	
	@ Configuration	

Only applicable for a GPS Laptrigger

Define the latitude and longitude of the GPS detection point.	Laptrigger configuration           General         Presettings         Conditions         Trigger         Countdown         Segment timing         GPS           Decimal lattude:         49,3277740           Decimal longitude:         49,3277740	00 ≥0
Define the detection range around the detection point.	8,555470 Laptrigger detection range: CPS channel sources: Longitude sources: Longitude sources: Dengitude sources:	20 🗇 DD 20 💬 m
Define the channel sources for Longitude, Latitude, Direction and Speed.	Lethide source: Constraints of direction Constraints of direction Constraints of the constraints Constraints of the constraints Constr	
	C Configuration	

### 14.1.6 Lap trigger channel diagnosis/counter reset

To display a quick lap trigger channel diagnosis and to reset counters use the diagnosis page in RaceCon. Any 'Laptrigger\_xxx' channel can be displayed.

Double-click on any 'Laptrigger\_xxx' channel in the Data Area. Example: 'laptrigger\_lapdist\_dls'

A diagnosis window opens in Main Area.



#### Lap trigger diagnosis scheme



### 14.1.7 Lap trigger presettings

When the reset buttons on the diagnosis page are activated, these values are used.



# 14.2 Counting outing/laps/fragments



#### Functionality

- Power ON: system + measurement is initialized but not yet started

- Global start condition fulfilled: recording starts
- Reception of valid lap trigger: recording of lap completed, new lap starts
- Power OFF or Global start condition not fulfilled: recording of lap completed, system shutdown

The system is counting:

#### Outing:

 The outing counter is incremented with each power cycle when at least one valid lap (not by forced lap trigger) was recorded

#### Lap:

- Leaving the pits to lap trigger
- Lap trigger to lap trigger
- Enforced lap trigger (see Distance based forced trigger [▶ 108])

#### Fragment:

- Test bench operation
- Power cycle on track or box (e.g. engine stalled)
- File fragmentation size [MB], time [sec]

#### Channels for display

To display counters use the following channels:

Channel	Function
Laptrigger_outcnt_dls	Outing counter
Laptrigger_lapctr_dls	Lap counter
Fractr	Fragment counter

#### Counting in WinDarab

To automatically name recorded files use filename templates in WinDarab dialog:

Filename template	Function
[outing]	Value of outing counter
[lap]	Value of lap counter
[fragment]	Value of fragment counter

[###03] indicates: 'always use 3 digits with leading zeros'.

# 14.3 Lap timing

There are different possibilities to adjust the lap trigger to the timing situation.

The detection time defines the minimum time the input signal changes its state. E.g. a low active signal needs to be below the threshold for min. 15 ms to release the trigger.

#### Channels for display

To display lap times use the following channels:

Channel	Function
Laptrigger_lapctr_dls	Number of completed laps

Channel	Function
Laptrigger_laptime_dls	Running laptime
Laptrigger_laptime_best_dls	Laptime of best lap
Laptrigger_laptimeold_dls	Laptime of last lap completed
Laptrigger_laptimeseg_dls	Segment time of last segment
Laptrigger_lapctr_dls	Number of completed laps

# 14.3.1 Time based retrigger protection

Trigger is locked for 5 s after main trigger was received.

To deactivate time based retrigger protection, set 'Retrigger lock time' to 0 ms.

Define settings for lap timing	Laptrogor configuration	
(main trigger).	Detection time:	
Define settings for sub trigger.	Retroger lock time: 3000 🛱 ms	
	Use intermediate trigger     Detection time:	
Not applicable with a GPS lap trigger.	- 30 ( <u>m</u> ) ms	
	Retrigger lock time: 5000 (2) ms	
	Configuration	



### 14.3.2 Distance based retrigger protection

Trigger is locked until configured min distance (i.e. 80 %  $\rightarrow$  3200 m) of track distance (i.e. 4000 m) has been covered. To deactivate distance based retrigger protection, set min distance to 0 %.

	25
	Laptrigger configuration U
Change signal for vehicle speed,	General Presettings Conditions Trigger Countdown Segment Imming
if desired.	Speed source:
	and a speed .
Enter minimum speed for	Min. speed:
	20 👷 km/h
trigger release.	Track distance:
	4000 🖗 m
Define settings for distance	Mn. dstance:
	20 * %
based retrigger protection.	800 m
55 1	Enforce laptrigger
	Max. distance:
	120 👘 %
	4800 m
Define settings for distance based forced trigger.	
	Computation



### 14.3.3 Distance based forced trigger

After a missed main trigger, a forced trigger is inserted, if the configured max. distance (i.e. 120 %  $\rightarrow$  4800 m) of the track distance (i.e. 4000 m) has been reached. In this case, the channel 'Laptrigger\_distlap\_dls' starts at the delta between the max. distance and the track distance (i.e. 800 m).

To deactivate distance based forced triggers, uncheck box.





# 14.4 Segment timing

Segment timing is the calculation of elapsed time for parts of laps (segments).

Segments are defined:

- based on sub-trigger signals (additional transmitters)
- based on distance travelled

Times for segments are compared to:

- Last lap completed
- Fastest lap
#### Channels for display

To display segment times use the following channels:

Channel	Function
Laptrigger_lapdiff	Time difference between finished lap and last lap
Laptrigger_lapdiffb	Time difference between finished lap and best lap
Laptrigger_lapseg_dlast	Difference of lap segment time compared to last lap
Laptrigger_lapseg_dbest	Difference of lap segment time compared to best lap

### 14.4.1 Sub trigger mode

Using main trigger (20 ms pulse) at Start-Finish-Line. 3 sub triggers (40 ms pulse) positioned at 1,000 m, 2,000 m and 3,000 m.

To deactivate sub trigger mode uncheck box.

- Guna antikina a fan Ian Ainsia a	Laptrager configuration
efine settings for lap timing	General Presettings Conditions Trigger Countdown Segment timing Detection time:
	15 🖉 ms
	Retrigger lock time: S000 💮 ms
efine settings for sub trigger.	Use intermediate trigger
ot applicable with a GPS lap trigger.	Detection time: 30 (2) ms
	Retrigger lock time: 5000 🖓 ms
Config	guration



The sub trigger mode cannot be used with the GPS lap trigger.

## 14.4.2 Distance mode

Using main trigger (20 ms pulse) at Start-Finish-Line.

Set 'Mode' to 'Distance' and enter desired segment distances.

Segment time is automatically calculated at each segment. Time difference to last lap and fastest lap is automatically calculated at each segment.

To deactivate distance mode set 'Mode' to 'None'.





# 14.5 Countdown timer

Some race classes require a minimum time spent in the pits. An additional lap trigger Tx is configured as a segment trigger positioned at pit entry. The trigger signal starts a timer countdown.

The current value of the timer is stored in the variable **Laptrigger\_cntdown\_dls** which can be displayed.



### 14.6 Automatic GPS Track Detection

With the GPS lap trigger, an automatic track detection can be activated by checking the highlighted box in the lap trigger configuration at the GPS tab.

Activating this functionality will overwrite the GPS trigger point coordinates and the track length with the values of a detected racetrack. The coordinates and the track length will be grayed out in the tool.

The function will compare the current GPS position with the coordinates of the known Racetracks list and use the closest GPS trigger point. If there are track variants with different track length, the system will adapt itself to the correct variant, if it is in the known racetrack list, after ~three detected laps. Please note that the track length needs to be quite accurate, within +/- 100 m, to adapt itself to another variant.

	Presettings	Conditions	Trigger	Countdown	Segment timing	GPS	Known Racetracks			
Decir	mal latitude:									GPS Track detection
								49,32777400 🜲	DD	Override Track distance & position
Decir	nal longitude:									L
								8,56584700 🜲	DD	
Lapt	rigger detectio	on range:								
								30 🜩	m	
<b>e</b>	gps_lat									~
Longiti	ude source:									
	gps_long									~
0	rection source	:								
GPS di		tion								~
GPS di	gps_direct									
GPS di	gps_direct eed source:									

The known Racetrack list can be found in the lap trigger configuration menu within the Known Racetracks tab. It contains a built-in list and a user-defined list. Each track can be activated or deactivated with the checkbox to manually set the variant if needed.

User defined tracks can either be added from scratch with the Add Track button or with the Copy Track button as a modified version of a built in track. Both buttons will open the same Edit Race Track menu.

In the menu a track name, length and the coordinates of the detection point is required. The coordinates can be pulled from the GPS tab with the button "Get values ..." or sent to the GPS tab with the button "Set values ...". This allows an easy interaction with the manual GPS lap trigger mode.

The user-defined tracks will be part of the project. If the tracks are required in another project, the lap trigger module can be ex-/imported into another project.

trigger configuration	Ø
eneral Presettings Conditions Trigger Countdown Segment timing GPS Kind Bulltin Racetradis Active Track U Line Rock Park Magny cours Misano Monza	own Racetrads User defined Racetrads Active Track Nurburgring NordsdNeife Edit Track Remove Track(s)
Ningbo Speedpark     Nogaro     Notkurgring     Oschereleben     Copy	Edit RaceTrack 'Nürburgring Nordschleife'  Specify Racetrack properties The GPS position indicates the position of the start-finish line.
Paul Ricard     Pau-Vile     Portimao circuit     Portiand Int Raceway     Rededuling	Track Name:         Nutburging Nondecharfe         Get values from Laptrigger's           Track length:         25378 + m         GPS definition           GPS Latitude:         50,33401400 + DD         DD
Road America       Rodrigham       Sepang       Shanghai       Silverstone       Sloveskaring	GPS Longitude: 6,94527800
<ul> <li>✓ Slovakiaring</li> <li>✓ Snetterton 300</li> </ul>	

Following signals are assigned to the function:

Laptrigger_trackdet_id	Signal will show the track name from the Racetracks list as an enumeration or can show the ID number as raw value. The enu- merated name will also be visible in the log- ging.
Laptrigger_trackdet_laplen	Track length of the used track variant
Laptrigger_trackdet_lat	Latitude GPS coordinate of the used GPS trigger point
Laptrigger_trackdet_long	Longitude GPS coordinate of the used GPS trigger point

## 14.7 Predicted Laptime

The predicted laptime function allows to compare the current lap- and segment time with the predicted time of an expected lap. Additionally, the function can estimate the laptime of the current lap. This functionality is integrated in the laptrigger module in RaceCon.

### 14.7.1 Setting up the predicted laptime

To use the predicted laptime function you need to set up a laptrigger as described in the chapter Lap Trigger [> 99]. Under the ribbon "Segment timing", you need to choose your segmentation mode which can either be distance or intermediate trigger based.

	Lantrion	er configuration		Ū —
Distance or Intermediate Trigger	Genera Mode: Dista	al Presettings Conditions Trigger I : nce se predated laptime	Countdown Segment timing GPS	•
Enter your segment time and distance	Lap s	egment lengths and times Segment length (m) 500	Segment time (s) 44,800	
	2	1.000	93,200 135,600	
Enter your				
expected laptime	Entire	e lap time:		164,500 🔺 s

For the distance mode, you need to check on an old lap or estimate how long it takes to travel the segment distance. Please enter those values into input field. The values can also be copied and pasted to the input field from an excel sheet as a normal text. In the intermediate trigger, you just need to set the expected time the driver takes to reach the segment trigger.

Note

Please note that the segment time and length is always measured from the start line or where the main lap trigger is set.

### 14.7.2 Functionality and channel outputs

Following output channels are generated by the predicted laptime function.

Laptrigger_lapdiff_pred_dls	Laptime difference between the predicted and the last laptime
Laptrigger_lapsegdiffpred_dls	lagseg difference between the last segment and the predicted segment
Laptrigger_Lapcurrpred_dls	Estimated laptime of the current lap, based on the predicted laptime and the predicted segment deviations

The channel Laptrigger\_lapdiff\_pred\_dls is updated as soon as the main lap trigger is received. Both other channels are updated as soon as the next segment distance is travelled, or the next intermediate trigger is received.

# 15 Firmware

# 15.1 Firmware and configuration

MS 7.8 holds 2 types of data:

Firmware: The software (PST program file) of the MS 7.8.

Configuration: The default parameters for controlling the output of the MS 7.8.

# 15.2 Firmware update

Firmware updates are performed via XCP. Following standards are supported:

- ASAM MCD-1 (XCP); Version 1.5.0; Date: 2017-11-30
- ASAM MCD-2 MC (ASAP2 / A2L); Version 1.7.1; Date: 2018-01-30

Additional files for firmware update (like ProF-Scripts for INCA) will be provided by BOSCH.

# 16 Cloning the Unit

Chapter left intentionally blank

# 17 Fuel Consumption Calculation

# 17.1 Setting up fuel consumption calculation and tank management

- 1. Select 'Measurement Sources' in Toolbox.
- 2. Drag 'Fuel' element and drop it on the vehicle in System Overview. Do not drop it on the MS 7.8!



#### A 'fuel consumption wizard' opens.

Select a fuel consumption sour	ce channel for computing the fuel consumption.	0
General		
Configure on device		
Tank capacity	80.0 🚔 👔	
Fuel consumption calculation		
Mode	Using fuel consumed	
Fuel input	Fuelcons X 0,001 Adaption factor to fm	n]] 🚽
Consumption correction factor Remaining laps calculation	1,000	
Remaining laps calculation Mode	Last lap's consumption	
Remaining laps calculation		
Remaining laps calculation Mode	Last lap's consumption	
Remaining laps calculation Mode Target lap consumption	Last lap's consumption	
Remaining laps calculation Mode Target lap consumption Reset fuel consumption	Lastlap's consumption	
Remaining laps calculation Mode Target lap consumption Reset fuel consumption Mode	Last lap's consumption	
Remaining laps calculation Mode Target lap consumption Reset fuel consumption Mode Reset signal source	Last lap's consumption 3.0 → 1 By RaceCon	

- a) Change device for fuel calculation, if desired.
- b) Enter tank capacity of vehicle.
- c) Choose calculation mode:

- using fuel consumed (summed-up fuel consumption)
- using fuel flow rate (momentary fuel consumption)

d) Choose input channel and enter adaption factor. Use adaption factor to adapt value of input channel to:

- 1ml per inc for summed-up fuel consumption
- 1ml/s per inc for momentary consumption

e) Enter factor to correct calculated consumption in device vs. 'real' consumption of vehicle, if required.

f) Choose method to calculate remaining laps with fuel in tank, if desired:

- using fuel consumption of last lap completed
- using target lap consumption (entered in the field 'Target lap consumption')

g) Choose values to initiate a reset of fuel consumption, if desired:

- Manually using RaceCon
- On 'power down' (assuming that the tank is filled each time the ignition is turned off)
- By signal source as input channel (e.g. a switch connected to input pin)

Press 'Finish' when done.

### 17.2 Fuel consumption diagnosis/counter reset

To display a fuel consumption diagnosis and to reset counters, use the diagnosis page in RaceCon.

Double-click on any 'fuel\_xxx' channel in channel list.

A diagnosis window opens in Main Area.

	Fuel - Computes the fuel consumption.		
	Text circl place for Alexit metal me	Hourmonts       Total consumption       Fuel consumption       I       Fuel remaining       I       Last lap's consumption	Button to reset total fuel consumption (Reset with RaceCon only) Button to reset fuel consumption manually
Settings overview	Cologramma Bireckyeen,ds (s)	Current lap's consumption - I Laps remaining -	(Can also be triggered )



Measurement label	Function
Fuel_fuelcons_dls	Running fuel consumption, starting at '0'
Fuel_fuelrem_dls	Remaining fuel in tank, starting at tank capacity
Fuel_fuellap_dls	Fuel consumption for current lap, starting at '0'
Fuel_fuellapold_dls	Fuel consumption of last lap completed
Fuel_laprem_dls	Remaining laps with fuel in tank

# 18 RaceCon Shortcuts

The table shows important shortcuts simplify controlling the MS 7.8 in RaceCon.

Shortcut	Function
General navigation	
F1	Open RaceCon help
F2	Rename selected object
F3	Select Data Area
F4	Select Project Tree
F5	-
F6	Start the data comparison
F7	Start dataset manager
F8	Toggle WP/RP
F9	Start measurement
CTRL + F9	Start recording
F10 or Alt	Go to menu bar
F11	Toggle display to fullscreen 'Race Mode'
F12	Enlarge main screen
CTRL + Tab	Switch between opened windows
Project Tree	
Plus (+) at numeric pad or right cursor	Expand selected node
Minus (-) at numeric pad or left cursor	Close selected node
Star (*) at numeric pad	Open all nodes
DEL	Delete seleted object
Display page, measurement	page
Cursor	Move selected display element one grid unit in chosen direction
SHIFT + cursor	Enlarge/reduce selected display element one grid unit
Tab	Switch between display elements

# 19 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.







The wiring diagram is also available as a separate document at Bosch Motorsport website on the MS 7.8 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.



# 21 Pinlayout

The pin layout is also placed at Bosch Motorsport homepage on the MS 7.8 product page. Please find item "Pin Layout". Most of MS 7.8 functions to pin relations may be modified to projects demands. Please see details in the function description SWITCHMATRIX. Bosch Motorsport tests check the defined connections of the pin layout

5 cp c. c.							
Analog	Inputs						
S	C	А	L	I/O Type	SIG_NAME	LEAD	DESCRIPTION
27				analog input	I_A_ANA01	AWG24	universal input 0-5V - pull up switchable
2				analog input	I_A_ANA02	AWG24	universal input 0-5V - pull up switchable
21				analog input	I_A_ANA03	AWG24	universal input 0-5V - pull up switchable
29				analog input	I_A_ANA04	AWG24	universal input 0-5V - pull up switchable
3				analog input	I_A_ANA05	AWG24	universal input 0-5V - pull up switchable
20				analog input	I_A_ANA06	AWG24	universal input 0-5V - pull up switchable
47				analog input	I_A_ANA07	AWG24	universal input 0-5V - pull up switchable
46				analog input	I_A_ANA08	AWG24	universal input 0-5V - pull up switchable
12				analog input	I_A_ANA09	AWG24	universal input 0-5V - pull up switchable
28				analog input	I_A_ANA10	AWG24	universal input 0-5V - pull up switchable
53				analog input	I_A_ANA11	AWG24	universal input 0-5V - pull up switchable
38				analog input	I_A_ANA12	AWG24	universal input 0-5V - pull up switchable
45				analog input	I_A_ANA13	AWG24	universal input 0-5V - pull up switchable
37				analog input	I_A_ANA14	AWG24	universal input 0-5V - pull up switchable
7				analog input	I_A_ANA15	AWG24	universal input 0-5V - pull up switchable
8				analog input	I_A_ANA16	AWG24	universal input 0-5V - pull up switchable
13				analog input	I_A_ANA17	AWG24	universal input 0-5V - pull up switchable
6				analog input	I_A_ANA18	AWG24	universal input 0-5V - pull up switchable
14				analog input	I_A_ANA19	AWG24	universal input 0-5V - pull up switchable
1				analog input	I_A_ANA20	AWG24	universal input 0-5V - pull up switchable
19				analog input	I_A_ANA21	AWG24	universal input 0-5V - pull up switchable
	60			analog input	I_A_ANA22	AWG24	universal input 0-5V - pull up switchable
	46			analog input	I_A_ANA23	AWG24	universal input 0-5V - pull up switchable
	28			analog input	I_A_ANA24	AWG24	universal input 0-5V - pull up switchable
	54			analog input	I_A_ANA25	AWG24	universal input 0-5V - pull up switchable
	39			analog input	I_A_ANA26	AWG24	universal input 0-5V - pull up switchable
	38			analog input	I_A_ANA27	AWG24	universal input 0-5V - pull up switchable
	47			analog input	I_A_ANA28	AWG24	universal input 0-5V - pull up switchable
	61			analog input	I_A_ANA29	AWG24	universal input 0-5V - pull up switchable
	55			analog input	I_A_ANA30	AWG24	universal input 0-5V - pull up switchable
	48			analog input	I_A_ANA31	AWG24	universal input 0-5V - pull up switchable
	62			analog input	I_A_ANA32	AWG24	universal input 0-5V - pull up switchable
	53			analog input	I_A_ANA33	AWG24	universal input 0-5V - pull up switchable
	45			analog input	I_A_ANA34	AWG24	universal input 0-5V - pull up switchable, Voltage devider switcha
	37			analog input	I_A_ANA35	AWG24	universal input 0-5V - pull up switchable, Voltage devider switcha
			14	analog input	I_A_ANA50	AWG24	universal input 0-5V - pull up switchable

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	FUNCTION
	pedal a (fixed)
	throttle 1a (fixed)
	throttle 2a (fixed)
	tamb
	tfuel
	pbrake_f
	pbrake_r
	poil
	pwat
	pclutch
	utint
	pfuel
	toil
	tmot2
	tmot
	prail
	pedal b (fixed)
	throttle 1b (fixed)
	throttle 2b (fixed)
	prail2
	toil2
	gear
	pcrank
	pgear
	pservo
	shiftupsw
	shiftdnsw
	sdam_fl
	sdam_fr
	sdam_rl
	sdam_rr
	steer
	р1
hable to 0-26V	tgear
hable to 0-26V	tservo
	spare

nalog	Inputs							
S	С	А	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION	FUNCTION
	9			analog input	I_A_ANA51	AWG24	universal input 0-5V - pull up switchable	spare
	64			analog input	I_A_ANA52	AWG24	universal input 0-5V - pull up switchable	
		39		analog input	I_A_ANA53	AWG24	universal input 0-5V - pull up switchable	
		48		analog input	I_A_ANA54	AWG24	universal input 0-5V - pull up switchable	
5				analog input	I_A_ANA36_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
10				analog input	I_A_ANA37_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
11				analog input	I_A_ANA38_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
17				analog input	I_A_ANA39_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
25				analog input	I_A_ANA40_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
26				analog input	I_A_ANA41_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
34				analog input	I_A_ANA42_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
4				analog input	I_A_ANA43_PCYL	AWG24	fast analog input 0-5V - pull up switchable	cylinder pressure recognition
44				analog input	I_A_ANA44_FADC	AWG24	analog input 0-5V, pull up switch., time or angular synchronism measurement	up21
64				analog input	I_A_ANA45_FADC	AWG24	analog input 0-5V, pull up switch., time or angular synchronism measurement	up21_2
43				analog input	I_A_ANA46_FADC	AWG24	analog input 0-5V, pull up switch., time or angular synchronism measurement	up22
59				analog input	I_A_ANA47_FADC	AWG24	analog input 0-5V, pull up switch., time or angular synchronism measurement	up22_2
52				analog input	I_A_ANA48_FADC	AWG24	analog input 0-5V, pull up switch., time or angular synchronism measurement	spare
36				analog input	I_A_ANA49_FADC	AWG24	analog input 0-5V, pull up switch., time or angular synchronism measurement	spare
51				thermocouple	I_A_TEXH1P	twisted pair (AWG24), shielded	Thermocouple 1 +	utexh
58					I_A_TEXH1N		Thermocouple 1 -	
65				thermocouple	I_A_TEXH2P	twisted pair (AWG24), shielded	Thermocouple 2 +	utexh2
60					I_A_TEXH2N		Thermocouple 2 -	
35					G_C_SENSSCR			
	19				G_C_SENSSCR			

Combine	Combined Analog/Digital Inputs							
S	С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION	FUNCTION
	21			analog / dig / SENT input	I_AD_ANADIG01	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	mapsw
	22			analog / dig / SENT input	I_AD_ANADIG02	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	pitspeedsw
	29			analog / dig / SENT input	I_AD_ANADIG03	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	launchsw
	30			analog / dig / SENT input	I_AD_ANADIG04	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	tcsw
	31			analog / dig / SENT input	I_AD_ANADIG05	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	wetsw
	40			analog / dig / SENT input	I_AD_ANADIG06	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	chressw
	49			analog / dig / SENT input	I_AD_ANADIG07	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	spare
	56			analog / dig / SENT input	I_AD_ANADIG08	AWG24	selectable universal input 0-5V / digital input 0-12V / SENT - pull up switchable	spare

Further In	puts						
S	С	Α	L	I/O Type	SIG_NAME	LEAD	DESCRIPTION
			43	digital input	I_F_DIG01P_HALL_IND	twisted pair (AWG24) shielded	hall or inductive sensor selectable

#### FUNCTION

CRANK\_1+

Further	Inputs							
S	С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION	
			44		I_F_DIG01N_HALL_IND			
			10		I_F_DIG02P_HALL_IND			
			19	digital input	I_F_DIG02N_HALL_IND	twisted pair (AWG24) shielded	hall or inductive sensor selectable	
			37	digital input	I_F_DIG03_HALL	AWG24	hall sensor	
			3	digital input	I_F_DIG04_HALL	AWG24	hall sensor	
			11	digital input	I_F_DIG05_HALL	AWG24	hall sensor	
			6	digital input	I_F_DIG08_HALL	AWG24	hall sensor	
			47	digital input	I_F_DIG07P_HALL_IND	twisted pair (AWG24) shielded	hall or inductive sensor circuit selectable	
			46		I_F_DIG07N_HALL_IND			
			8	digital input	I_F_DIG08P_HALL_IND	twisted pair (AWG24) shielded	hall or inductive sensor circuit selectable	
			7		I_F_DIG08N_HALL_IND			
		46		digital input	I_F_DIG09_HALL_DF11	AWG24	hall or DF11 sensor selectable	
		38		digital input	I_F_DIG10_HALL_DF11	AWG24	hall or DF11 sensor selectable	
		54		digital input	I_F_DIG11_HALL_DF11	AWG24	hall or DF11 sensor selectable	
		47		digital input	I_F_DIG12_HALL_DF11	AWG24	hall or DF11 sensor selectable	
			21	digital input	I_S_LAPTRIG	AWG24	laptrigger input	
			57	digital input	I_S_ENGRUN	AWG24	digital input, pull down	

Outputs	5							
S	С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION	FUNCTION
		12		lowside switch 4A	O_S_LS01	AWG20		SHIFT_UP
		34		lowside switch 4A	O_S_LS02	AWG20		SHIFT_DN
		17		lowside switch 3A	O_S_LS03	AWG20		WGC_INC
		59		lowside switch 3A	O_S_LS04	AWG20		WGC_DEC
		6		lowside switch 3A	O_S_LS05	AWG20		CAMCTRL_IN
		51		lowside switch 3A	O_S_LS06	AWG20		CAMCTRL_IN2
		43		lowside switch 3A	O_S_LS07	AWG20		CAMCTRL_OUT
		65		lowside switch 3A	O_S_LS08	AWG20		CAMCTRL_OUT2
		19		lowside switch 2.2A or INJ1	O_S_LS09	AWG20	to be used as low side switch or high imp. Injectors, no freewheeling, runs only with engine	
		52		lowside switch 2.2A or INJ2	O_S_LS10	AWG20	speed	
		18		lowside switch 2.2A or INJ3	O_S_LS11	AWG20		
		60		lowside switch 2.2A or INJ4	O_S_LS12	AWG20		
		10		lowside switch 2.2A or INJ5	O_S_LS13	AWG20		
		53		lowside switch 2.2A or INJ6	0_S_LS14	AWG20		
		27		lowside switch 2.2A or INJ7	O_S_LS15	AWG20		
		61		lowside switch 2.2A or INJ8	O_S_LS16	AWG20		
		5		lowside switch 2.2A or INJ9	0_S_LS17	AWG20	to be used as low side switch or high imp. injectors or control of external HDEV 9-12, no free-	
		44		lowside switch 2.2A or INJ10	O_S_LS18	AWG20	wheeling, runs only with engine speed	
		25		lowside switch 2.2A or INJ11	O_S_LS19	AWG20		

FUNCTION
CRANK_1-
CRANK_2+
CRANK_2-
CAM_1
CAM_2
CAM_3
CAM_4
TURBO_1+
TURBO_1-
TURBO_2+
TURBO_2-
WHEEL1
WHEEL2
WHEEL3
WHEEL4
LAPTRIGGER
Engine Switch

Outputs							
S	C	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION
		45		lowside switch 2.2A or INJ12	O_S_LS20	AWG20	
		11		lowside switch 2.2A	O_S_LS21	AWG20	
		36		lowside switch 2.2A	O_S_LS22	AWG20	
		35		lowside switch 2.2A	O_S_LS23	AWG20	
		64		lowside switch 2.2A	O_S_LS24	AWG20	
		26		lowside switch 1A	O_S_LS25	AWG20	
		4		lowside switch 3A	O_S_LSH1	AWG20	Lambda Heater Output
		58		lowside switch 3A	O_S_LSH2	AWG20	Lambda Heater Output
	26			MSV controller	O_P_MSV1P	AWG20	
	35				O_P_MSV1N	AWG20	
	18			MSV controller	O_P_MSV2P	AWG20	
	11				O_P_MSV2N	AWG20	
		66		H-Bridge 8.5A	O_S_HBR1P	AWG20	for EGAS
		62			O_S_HBR1N	AWG20	
		63		H-Bridge 8.5A	O_S_HBR2P	AWG20	for EGAS
		57			O_S_HBR2N	AWG20	
		2		H-Bridge 8.5A	O_S_HBR3P	AWG20	
		1			O_S_HBR3N	AWG20	
		40		H-Bridge 8.5A	O_S_HBR4P	AWG20	
		31		H-Bridge 8.5A	O_S_HBR4N	AWG20	
	34			High Pressure Injection	O_P_INJ1P	AWG20	High Pressure Injection +
	25				O_P_INJ1N	AWG20	High Pressure Injection -
	58			High Pressure Injection	O_P_INJ2P	AWG20	High Pressure Injection +
	59				O_P_INJ2N	AWG20	High Pressure Injection -
	52			High Pressure Injection	O_P_INJ3P	AWG20	High Pressure Injection +
	44				O_P_INJ3N	AWG20	High Pressure Injection -
	5			High Pressure Injection	O_P_INJ4P	AWG20	High Pressure Injection +
	4				O_P_INJ4N	AWG20	High Pressure Injection -
	10			High Pressure Injection	O_P_INJ5P	AWG20	High Pressure Injection +
	17				O_P_INJ5N	AWG20	High Pressure Injection -
	51			High Pressure Injection	O_P_INJ6P	AWG20	High Pressure Injection +
	43				O_P_INJ6N	AWG20	High Pressure Injection -
	6			High Pressure Injection	O_P_INJ7P	AWG20	High Pressure Injection +
	27			<u> </u>	O_P_INJ7N	AWG20	High Pressure Injection -
	2			High Pressure Injection	O_P_INJ8P	AWG20	High Pressure Injection +
	1				O_P_INJ8N	AWG20	High Pressure Injection -
		50		Ignition	O_P_IGN01	AWG20/AWG24	selectable int. ignition power stage or ignition driver
		3		Ignition	O_P_IGN02	AWG20/AWG24	
		33		Ignition	O_P_IGN03	AWG20/AWG24	
		9		Ignition	O_P_IGN04	AWG20/AWG24	
		-			0		

FUNCTION	
MIL	
FUELPUMP	
WGC_INC2	
WGC_DEC2	
MAINRELAY	
LAM_1_HEATER	
LAM_2_HEATER	
MSV_1P	
MSV_1N	
MSV_2P	
MSV_2N	
EGAS_1P	
EGAS_1N	
EGAS_2P	
EGAS_2N	
HBRIDGE_3P	
HBRIDGE_3N	
HBRIDGE_4P	
HBRIDGE_4N	
INJ_1P	
INJ_1N	
INJ_2P	
INJ_2N	
INJ_3P	
INJ_3N	
INJ_4P	
INJ_4N	
INJ_5P	
INJ_5N	
INJ_6P	
INJ_6N	
INJ_7P	
INJ_7N	
INJ_8P	
INJ_8N	
IGN_1	
IGN_2	
IGN_3	
IGN_4	

outputs								
S	С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION	FUNCTION
		24		Ignition	O_P_IGN05	AWG20/AWG24		IGN_5
		8		Ignition	O_P_IGN06	AWG20/AWG24		IGN_6
		42		Ignition	O_P_IGN07	AWG20/AWG24	selectable int. ignition power stage or ignition driver	IGN_7
		16		Ignition	O_P_IGN08	AWG20/AWG24		IGN_8
		7		Ignition	O_P_IGN09	AWG24	ignition driver cyl 9-12	IGN_9
		20		Ignition	O_P_IGN10	AWG24	ignition driver cyl 9-12	IGN_10
		13		Ignition	O_P_IGN11	AWG24	ignition driver cyl 9-12	IGN_11
		14		Ignition	O_P_IGN12	AWG24	ignition driver cyl 9-12	IGN_12
			29	DIAG_MUX	O_A_MUX1	AWG24 shielded	PushPull driver, Diagnosis Multiplexer (KS1A, eng. speed, int. Signals)	MUX_OUT_CH1
			30		O_A_MUX2	AWG24 shielded	PushPull driver, Diagnosis Multiplexer (KS1B, cam speed, int. Signals)	MUX_OUT_CH2
			38		O_A_MUX3	AWG24 shielded	PushPull driver, Diagnosis Multiplexer (KS2A, cam speed, int. Signals)	MUX_OUT_CH3
			39		O_A_MUX4	AWG24 shielded	PushPull driver, Diagnosis Multiplexer (KS2B, cam speed, int. Signals)	MUX_OUT_CH4
			31		O_A_MUX5	AWG24 shielded	PushPull driver, Diagnosis Multiplexer (MF1, MF2, MF combined, cam speed, int. Signals)	MUX_OUT_CH5
		37			G_C_ACTSCR			

Commu	inication	I.							
S	С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION		
			48	CAN Bus 1	BI_CAN1_H	CAN-Ltg	up to 1Mbit/s, switchable Terminator		
			56		BI_CAN1_L				
			62	CAN Bus 2	BI_CAN2_H	CAN-Ltg	up to 1Mbit/s, switchable Terminator		
			55		BI_CAN2_L				
			12	CAN-FD Bus 3	BI_CAN3_H	CAN-Ltg	up to 8Mbit/s, switchable Terminator		
			13		BI_CAN3_L				
			1	CAN-FD Bus 4	BI_CAN4_H	CAN-Ltg	up to 8Mbit/s, switchable Terminator		
			2		BI_CAN4_L				
			15	CAN-FD Bus 5	BI_CAN5_H	CAN-Ltg	up to 8Mbit/s, switchable Terminator		
			16		BI_CAN5_L				
			66	Gigabit Ethernet	BI_GETH_D1+_TX+	Ethernet Ltg. (CAT6), shielded to G_C_COMSCR	1000 Mbit/s		
			61		BI_GETH_D1TX-				
			65		BI_GETH_D2+_RX+				
			54		BI_GETH_D2RX-				
			64		BI_GETH_D3+				
			60		BI_GETH_D3-				
			59		BI_GETH_D4+				
			53		BI_GETH_D4-				
			26	100 Mbit Ethernet	BI_ETH1_RX+	Ethernet Ltg. (CAT5), shielded to G_C_COMSCR	100 Mbit/s		
			25		BI_ETH1_RX-				
			18		BI_ETH1_TX+				

FUNCTION
CAN_1_H, Motronic, Powerbox, HPI and ABS control functions
CAN_1_L
CAN_2_H, external ECU / gearbox control
CAN_2_L
CAN_3_H, measurement purposes
CAN_3_L
CAN_4_H, measurement purposes
CAN_4_L
CAN_5_H, measurement purposes
CAN_5_L
GETH_0P (Application Interface)
GETH_0N (Application Interface)
GETH_1P (Application Interface)
GETH_1N (Application Interface)
GETH_2P (Application Interface)
GETH_2N (Application Interface)
GETH_3P (Application Interface)
GETH_3N (Application Interface)
ETH1RX+
ETH1RX-
ETH1TX+

nication						
С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION
		17		BI_ETH1_TX-		
		35	100 Mbit Ethernet	BI_ETH2_RX+	Ethernet Ltg. (CAT5), shielded to G_C_COMSCR	100 Mbit/s
		34		BI_ETH2_RX-		
		36		BI_ETH2_TX+		
		27		BI_ETH2_TX-		
		42	100 Mbit Ethernet	BI_ETH3_RX+	Ethernet Ltg. (CAT5), shielded to 100 Mbit/s	100 Mbit/s
		41		BI_ETH3_RX-	G_C_COMSCR	
		50		BI_ETH3_TX+		
		49		BI_ETH3_TX-		
		51	USB	BI_USB_DP	USB Ltg.	USB interface, supply 5V/500mA
		45		BI_USB_DN		
		58		G_R_USBGND		
		52		O_V_USB5V		
		9	LIN Bus	BI_LIN	AWG24, shielded	LIN interface
		22	TIMEBASE	<b>BI_TIMESYNC</b>	AWG24	Timesync line between Bosch devices
		23				
		24				
		32				
		33				
		40		G_C_COMSCR		
		nication C A	C     A     L       17     35       34     36       34     36       27     42       42     41       50     49       51     50       49     51       58     52       9     22       23     24       32     33	C       A       L       I/O Type         17       17       17         35       35       100 Mbit Ethernet         36       27       100 Mbit Ethernet         27       27       100 Mbit Ethernet         42       100 Mbit Ethernet       42         50       42       100 Mbit Ethernet         50       50       50         49       50       50         51       58       58         52       9       LIN Bus         52       23       TIMEBASE         23       24       33	C         A         L         I/O Type         SIG_NAME           17         BL_ETH1_TX-         BL_ETH1_TX-         BL_ETH2_RX+           35         100 Mbit Ethernet         BL_ETH2_RX-           34         36         BL_ETH2_RX-           36         100 Mbit Ethernet         BL_ETH2_RX-           36         100 Mbit Ethernet         BL_ETH2_RX-           36         100 Mbit Ethernet         BL_ETH3_RX-           42         100 Mbit Ethernet         BL_ETH3_RX-           41         100 Mbit Ethernet         BL_ETH3_RX-           50         100 Mbit Ethernet         BL_ETH3_RX-           51         USB         BL_USB_DP           81_USB_DN         58         G_R_USBGND           52         0_V_USB5V         0_V_USB5V           9         LIN Bus         BL_IIN           24         24         24         24           32         33         33	CALI/O TypeSIG_NAMELEAD17BL_ETH1_TX-BL_ETH1_TX-Hernet Ltg. (CAT5), shielded to G_C_COMSCR35100 Mbit EthernetBL_ETH2_RX+Hernet Ltg. (CAT5), shielded to G_C_COMSCR36BL_ETH2_TX+BL_ETH2_TX+37100 Mbit EthernetBL_ETH2_TX-42100 Mbit EthernetBL_ETH3_RX-42100 Mbit EthernetBL_ETH3_RX-50BL_ETH3_TX+50BL_ETH3_TX+51USBBL_USB_DP52S253USB Ltg.54G_R_USBOND52S153UN Bus54BL_UN55AWG24, shielded56S157S258S1_LIN59LIN Bus50S1_LIN51S352S353S1_LIN54S1_LIN55S1_LIN56S1_LIN57S158S1_LIN59S150S151S352S153S154S155S155S156S157S158S159S159S150S151S152S153S154S155S155S155S1

Supply	Supply						
S	С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION
			63	Supply In	V_UBAT	AWG20	ECU Processor Supply
			5	Supply In	V_DYNPWR	AWG20	ECU Supply
		28		Supply In	V_DYNPWR	AWG20	ECU Supply
		30		Supply In	V_DYNPWR	AWG20	ECU Supply
	13			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
	15			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
	32			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
	33			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
	36			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
	41			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
	42			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
	50			Supply In	V_DYNPWR_BOOST	AWG20	ECU Booster Supply
			4	Ground In	G_DYNGND	AWG20	DYN Ground
	3			Ground In	G_DYNGND	AWG20	DYN Ground
		22		Ground In	G_DYNGND	AWG20	DYN Ground
		29		Ground In	G_DYNGND	AWG20	DYN Ground

FUNCTION
ETH1TX-
ETH2RX+
ETH2RX-
ETH2TX+
ETH2TX-
ETH3RX+
ETH3RX-
ETH3TX+
ETH3TX-
USB_DP
USB_DN
USB_GND
USB_5V
LIN
SYNC
reserved for future communication
interfaces

#### FUNCTION

Supply							
S	С	Α	L	I/О Туре	SIG_NAME	LEAD	DESCRIPTION
		32		Ground In	G_DYNGND	AWG20	DYN Ground
		56		Ground In	G_DYNGND	AWG20	DYN Ground
	7			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	8			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	9			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	12			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	14			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	16			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	20			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	23			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
	24			Ground In	G_DYNGND_BOOST	AWG20	ECU Booster Ground
		15		Ground In	G_DYNGND_IGN	AWG20	ECU Ignition Ground
		21		Ground In	G_DYNGND_IGN	AWG20	ECU Ignition Ground
		23		Ground In	G_DYNGND_IGN	AWG20	ECU Ignition Ground
		41		Ground In	G_DYNGND_IGN	AWG20	ECU Ignition Ground
		49		Ground In	G_DYNGND_IGN	AWG20	ECU Ignition Ground
		55		Ground In	G_DYNGND_IGN	AWG20	ECU Ignition Ground
			20	Ground In	G_ECUGND	AWG20	ECU Ground
24				Supply Out	O_V_SENS_1	AWG24	switchable sensor supply 5V / VBAT, 400mA
9					O_V_SENS_2		switchable sensor supply 5V / VBAT, 400mA
	66				O_V_SENS_3		switchable sensor supply 5V / VBAT, 400mA
	63				O_V_SENS_4		switchable sensor supply 5V / VBAT, 400mA
42					O_V_SENS_5		switchable sensor supply 5V / VBAT, 400mA supply for APS1
50					O_V_SENS_6		switchable sensor supply 5V / VBAT, 400mA supply for APS2
56					O_V_SENS_7		switchable sensor supply 5V / VBAT, 400mA supply for THR1
48					O_V_SENS_8		switchable sensor supply 5V / VBAT, 400mA supply for THR2
16				Ground Out	G_R_SENS_1		sensor ground
15					G_R_SENS_2		
	65				G_R_SENS_3		
	57				G_R_SENS_4		
41					G_R_SENS_5		sensor ground Supply GND for APS1
49					G_R_SENS_6		sensor ground Supply GND for APS2
63					G_R_SENS_7		sensor ground Supply GND for THR1
57					G_R_SENS_8		sensor ground Supply GND for THR2
18					G_R_PCYL		reference ground for cylinder pressure inputs

	FUNCTION
1	
2	
1	
2	

21 | Pinlayout

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The primary ANTLR guy:

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

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SVHC Substance	CAS Number
Lead	7439-92-1
1, 2-dimethoxyethane; ethylene glycol di- methyl ether (EGDME)	110-71-4

### 22.4 Norms

#### **Product Safety**

EN IEC 62368-1:2020+A11:2020

Materials
REACH - Nr. 1907/2006
EMC
UNECE10:rev.6/AMD1:2020
KS-C9990:2017
ISO11452-2
ISO11452-4
ISO10605
ISO7637-2
ISO7367-3
ISO16750-2
US FCC: Title 47, Part 15 Subpart B
ICES-003
Testing
SAEJ1211

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