



# Vehicle Control Unit MS 50.4P

Manual

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# Content

1	Preparation	4
2	Warnings and Safety Instructions	5
3 (	Onboard Network Concept	6
4.1	Technical Data Description of Device Status LEDs	<b>7</b> 9
4.2	Upgrades	10
5	Pinlayout	12
6	Mechanical Drawing	18
7 :	System Configuration Tool RaceCon	19
8	First Steps	20
8.1	5	20
8.2		21
8.3		26
8.4		28
8.5		31
8.6	Color indication	32
9	Project Configuration	34
9.1	Math Channels	34
9.2	Conditional Functions	35
9.3	Conditional Channels	37
9.4	Condition Combination	39
9.5	Display Switch Module	41
9.6	Timer Module	42
9.7	GPS Trigger Module	42
9.8	CPU Load Limits	44
10	CAN Configuration	45
10.1	CAN Bus Trivia	45
10.2	CAN input	46
		52
10.4	Multiplexer	55
11		58
		58
11.2	Import in RaceCon	58
12	Analog and Frequency Inputs	60
12.1	Analog inputs	60
		61
		74
12.4	Hysteresis	75
13	Power Stages	79
14 (	Online Measurement and Calibration	80
14.1	Setting up an online measurement	80
14.2	Online calibration of measurement channels	85

14.3	Online calibration of multipoint adjustment channels	87
15 E	rror Memory	89
15.1	Error memory representation in RaceCon	89
15.2	Information on errors available from the error memory	91
15.3	Analog Input Diagnosis	95
16 R	Recording	97
16.1	Features	97
16.2	Configuration of recordings	97
16.3	Event logging	104
16.4	Data Logger and USB recording	105
16.5	USB recording	105
16.6	High speed logging	109
17 L	ap Trigger	112
17.1	Lap trigger (timing beacon)	112
17.2	Counting outing/laps/fragments	118
17.3	Lap timing	119
17.4	Segment timing	121
17.5	Countdown timer	123
17.6	Automatic GPS Track Detection	124
17.7	Predicted Laptime	125
18 G	SPS Sensor	127
18.1	GPS (Global Positioning System)	127
18.2	Protocol	127
	Sensor recommendation	
18.4	Measurement labels	130
18.5	GPS troubleshooting	131
19 T	elemetry System LTE 65	133
19.1	Software setup	133
19.2	Telemetry channels with special functionality	134
19.3	Setting up car in WDServer	135
19.4	Loading the telemetry data	139
20 F	irmware	140
20.1	Firmware and configuration	140
20.2	Firmware update	140
21 0	Cloning the Unit	141
	uel Consumption Calculation	142
	Setting up fuel consumption calculation and tank management	142
22.2	Fuel consumption diagnosis/counter reset	143
23 R	RaceCon Shortcuts	145
24 L	egal	146
24.1	Legal Restrictions of Sale	146
24.2	REACH Statement	146
24.3	Open Source Software (OSS) Declaration	146
25 C	Disposal	164

## 1 Preparation

Use the VCU MS 50.4P only as intended in this manual. Any maintenance or repair must be performed by authorized and qualified personnel approved by Bosch Motorsport.

Operation of the VCU MS 50.4P is only certified with the combinations and accessories that are specified in this manual. The use of variant combinations, accessories and other devices outside the scope of this manual are only permitted when they have been determined to be compliant from a performance and safety standpoint by a representative from Bosch Motorsport.

Read the manual carefully and follow the application hints step by step. Do not hesitate to contact us, contact data can be found on the last page of this document.

### Important information on Electromagnetic Conformity

To avoid unwanted interference with the environment (people, animals, electronic devices) or unwanted harm to the environment, it is mandatory that the user of the VCU MS 50.4P carries out an appropriate analysis to determine the electromagnetic interaction the VCU MS 50.4P may have with its individual installation environment.

#### Disclaimer

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

Please retain this manual for your records.

#### Note

In this document, many screenshots are created by way of example for a display. Please consider this and replace the product names with the name of your device.

# 2 Warnings and Safety Instructions

The classification of the warnings and safety instructions is carried out by the respective signal word (Danger, Warning, Caution) next to the warning symbol.

#### Danger

5
Anger
Nature and source of danger
Consequences
Warning of death or serious physical injury, which are sure to occur if ignored.
Warning
Nature and source of danger
Consequences
Warning of death or serious injury, which can occur if this is not observed.
Caution
Nature and source of danger
Consequences
Warning of slight bodily injury in case of Disregard.
Notice
NOTICE
Nature and source of danger
Consequences

Warning of damage to equipment in case of ignoring.

## 3 Onboard Network Concept

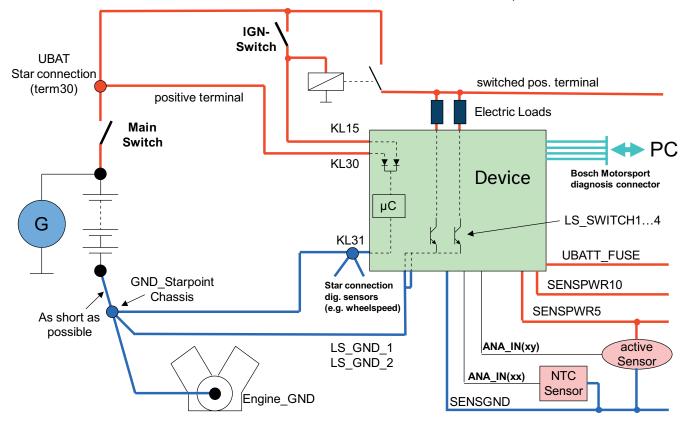
Please ensure that you have a good ground installation. That means:

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

The following notations for power signals are used:

- KL 15 is a switched battery rail controlled by the IGN-switch
- KL 30 is an unswitched battery positive rail (same as battery positive terminal)
- KL 31 is an unswitched ground rail (same as battery negative terminal)

Be careful to observe current limits of wires and connector pins!



#### Note

This schematic is not device specific. Please see the section Technical Data for the specifications of your device.

## 4 Technical Data

The VCU MS 50.4P (Performance) is a highly powerful processing / logging unit for race applications.

Based on our broad base of platform function, we support you with customized VCU functions for a tailor-made solution.

In addition, you can quickly develop your individual customer software based on MAT-LAB/Simulink to significantly speed up algorithm development (automatic code and documentation generation) – including extensive simulation capabilities.

#### Application

11	
Processor for customer code	866 MHz Dual Core
Processor for logger	866 MHz Dual Core
Configurable math channels	
User configurable CAN in/out messages	
Online data compression	
Internal logger	
- 1,500 channels	
- FULL_LOG_1 (4 GB memory on Partiti	on 1) enabled
- PERF_LOG_1 (16 GB memory on Parti	tion 1) optional
- FULL_LOG_2 (4 GB memory on Partiti	on 2) enabled
– High Speed Logging Package (Sampl	ing rate 5 μs) optional
- DATA_USB (Data copy to USB flash d	rive) enabled
Logging rates	
- Usage of all features: 800 kB/s	
<ul> <li>Primary logging use case: &gt;1,500 kB/</li> </ul>	s
- Logging data download rate: up to 7.	.5 MB/s
LTE Ethernet telemetry support	
RS232 interface for GPS	
Customer Code Area CCA	
Provides the option to run customer deve	eloped software code on Bosch device
Multi CCA	
Enables the use of an extra core to utilize ning a second customer model	more computing power in the device for run-

#### Mechanical Data

Size	166 x 121 x 41 mm
Weight	≤ 660 g
Protection classification	IP67
3 motorsport connectors, 198 pins in total	
Max. vibration	Vibration profile 1 (see Downloads or www.bosch-motorsport.com)
Operating temperature internal	0 to 85°C

Operation outside the temperature limits can be tested on request during the manufacturing tests.

#### **Electrical Data**

Supply voltage

5 to 18 V

#### Inputs

20 Analog channels 0 to 5 V, 0.5 % precision between 0.2 and 4.8 V, switchable pull-up

8 Digital PWM inputs f\_max=30 kHz Hall-type speed measurement possible, Switchable pullup 2.15 kOhm, (required for Hall), Tooth count differential\*

4 Digital PWM inputs f\_max=30 kHz Hall- and DF11 type speed measurement possible, Fixed pullup 2.15 kOhm (required for Hall), Tooth count differential\*

4 universal Thermocouple

1 Bosch Laptrigger

1 TimeSync master and slave (specific to Bosch measurement system)

Internal measurements:

- 1 x ambient pressure
- 1 x ECU temperature
- 20 x supply voltage
- 20 x supply current
- 1 x battery voltage (external VCU supply)
- 1 x external VCU supply current
- 4 x HS output current
- 1 x 3-axis acceleration plus roll/pitch/yaw rate

#### Outputs

2\* x PWM High side; 7.5 A each, PWM, 50 Hz

- 4\* x PWM Low side; 2.2 A each, PWM, 10 kHz
- \*can be enhanced by Upgrade I/O Package

#### Sensor Supplies and Screens

5* x 12 V, 400 mA each
5* x Switchable 5 V/12 V, 400 mA each
4 A max overall current on all 12 V 2 A max overall current on all 5 V
12 V $\pm$ 1 % precision on the pin 5 V $\pm$ 0.1 % precision on the pin
20 x Sensor ground
*can be enhanced by Upgrade I/O Package

#### Adaptation and Documentation

Function documentation	Automatically created during code genera- tion
MatLab code generation	Support for customer own MatLab function development

#### Software Tools (free download)

. ,	
Data Analysis tool WinDarab 7	
System Configuration tool RaceCon	Logger configuration, calibration, and on- line measurement
Connectors	
Connector LIFE (red) AS018-35PN	Mating connector AS618-35SN (not in- cluded)
Connector SENS-A (yellow) AS018-35PA	Mating connector AS618-35SA (not in- cluded)
Connector SENS-B (blue) AS018-35PB	Mating connector AS618-35SB (not in- cluded)

#### Communication

3 Ethernet 100 Mbit

4 CAN (+4 with Upgrade I/O Package)

1 LIN

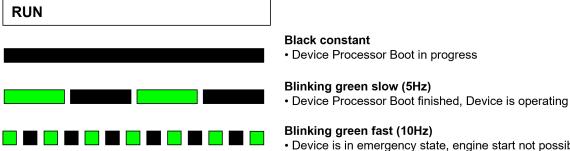
1 USB

1 RS232 interface for GPS or Telemetry, switchable depending on SW version

1 Time sync synchronization Ethernet

### 4.1 Description of Device Status LEDs

The VCU MS 50.4P 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:



- Device is in emergency state, engine start not possible.
- Flashed firmware is not running properly. Please flash new firmware.

LOG		Recorded Data	Telemetry
	Amber constant <ul> <li>No measurement configuration on Logger</li> </ul>	No	No
	<ul> <li>Blinking green slow</li> <li>Measurement configuration loaded</li> <li>Start condition(s) not fulfilled</li> </ul>	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)
	<ul> <li>Blinking amber fast</li> <li>Measurement configuration loaded</li> <li>Measurement setup error (external device missing)</li> <li>Start conditions fulfilled, Logger is recording data</li> </ul>	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		

### Green constant

All internal Power Supplies of the Device available

# 4.2 Upgrades

### I/O Package

Communication
4 CAN
Inputs
4 Analog channels 0 to 5 V, 0.5 % precision between 0.2 and 4.8 V, switchable pull-up
4 Digital PWM inputs f_max=30 kHz Hall-type speed measurement possible, Fixed pullup 2.15 kOhm (required for Hall), Tooth count differential**
4 LVDT, 5 pin configuration, excitation frequency 1 to 20 kHz, excitation voltage 0 to 5 V (rms)
Outputs

4 "TTL" Digital output, 10 kHz, PWM, 25 mA each

2 PWM High side; 7.5 A each, PWM, 50 Hz

4 PWM Low side; 2.2 A each, PWM, 10 kHz

#### **Power Supplies**

5 x12 V, 400 mA each

5 switchable 5 V/12 V, 400 mA each

\*\* The tooth count differential between any two of the PWM inputs is available two measure e.g. shaft torsion.

### PERF\_LOG\_1

Increase logging Partition 1 from 4 GB to 16 GB memory

#### High Speed Logging Package

6 ANA

0 to 5 V, 200 kHz logging rate

#### CCP/XCP\_MASTER

Enables CCP/XCP master functionality to request data from foreign devices via CAN/CCP protocol, XCP over Ethernet (UDP) or XCP via CAN. (ASAP2 file from ECU manufacturer required)

# 5 Pinlayout

Connector LIFE (red), Mating connector AS618-35SN

Pin	I/O	Signal	Level, Power
LIFE 01	I/O	BI_CAN7_H	0 to 5 V
LIFE 02	I/O	BI_CAN7_L	0 to 5 V
LIFE 03	I	I_DIGIN04_HALL_DF11	0 to 5 V
LIFE 04	I	I_DIGIN09	0 to 5 V
LIFE 05	I/O	BI_CAN8_H	0 to 5 V
LIFE 06	I	I_DIGIN10	0 to 5 V
LIFE 07	I/O	BI_CAN4_H	0 to 5 V
LIFE 08	I/O	BI_CAN4_L	0 to 5 V
LIFE 09	I/O	BI_LIN	0 to 12 V
LIFE 10	1	I_DIGIN02_HALL_DF11	0 to 5 V
LIFE 11	I/O	BI_CAN8_L	0 to 5 V
LIFE 12	I/O	BI_CAN3_H	0 to 5 V
LIFE 13	I/O	BI_CAN3_L	0 to 5 V
LIFE 14	I.	I_DIGIN13	0 to 5 V
LIFE 15	I/O	B_D_RS232_RX	12 V
LIFE 16	I/O	B_D_RS232_TX	12 V
LIFE 17	I/O	B_D_ETH2TXN	ETH
LIFE 18	I/O	B_D_ETH2TXP	ETH
LIFE 19	1	I_DIGIN14	0 to 5 V
LIFE 20	G	GND	GND
LIFE 21	I	I_S_LAPTRIG	0 to 5 V
LIFE 22	I/O	BI_TIMESYNC	0 to 5 V
LIFE 23	I/O	B_D_SERCOS2RXN	ETH
LIFE 24	I/O	B_D_SERCOS2RXP	ETH
LIFE 25	I/O	B_D_ETH2RXN	ETH
LIFE 26	I/O	B_D_ETH2RXP	ETH
LIFE 27	I/O	B_D_ETH3TXN	ETH
LIFE 28	G	G_USB_SCR	GND, 2 A fused
LIFE 29	I	I_DIGIN15	0 to 5 V
LIFE 30	I/O	BI_CAN5_H	0 to 5 V
LIFE 31	I/O	BI_CAN5_L	0 to 5 V
LIFE 32	I/O	B_D_SERCOS2TXN	ETH
LIFE 33	I/O	B_D_SERCOS2TXP	ETH
LIFE 34	I/O	B_D_ETH3RXN	ETH
LIFE 35	I/O	B_D_ETH3RXP	ETH
LIFE 36	I/O	B_D_ETH3TXP	ETH
LIFE 37	I	I_DIGIN03_HALL_DF11	0 to 5 V
LIFE 38	I/O	BI_CAN6_H	0 to 5 V
LIFE 39	I/O	BI_CAN6_L	0 to 5 V

LIFE 40GG_COMSCRGND, 2 A fusedLIFE 41I/OB_D_SERCOS1RXNETHLIFE 42I/OB_D_SERCOS1RXPETHLIFE 43II_DIGIN01_HALL_DF110 to 5 VLIFE 44GG_DIGINGND, 2 A fusedLIFE 45I/OBI_USB_DNUSBLIFE 46II_DIGIN110 to 5 VLIFE 47II_DIGIN120 to 5 VLIFE 48I/OBI_CAN1_H0 to 5 VLIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPUSBLIFE 51I/OB_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 42I/OB_D_SERCOS1RXPETHLIFE 43II_DIGIN01_HALL_DF110 to 5 VLIFE 44GG_DIGINGND, 2 A fusedLIFE 45I/OBI_USB_DNUSBLIFE 46II_DIGIN110 to 5 VLIFE 47II_DIGIN120 to 5 VLIFE 48I/OB_D_SERCOS1TXN0 to 5 VLIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPETHLIFE 51I/OB_D_SERCOS1TXPDot 0 to 5 VLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 43ILDIGIN01_HALL_DF110 to 5 VLIFE 43GG_DIGINGND, 2 A fusedLIFE 44GB_USB_DNUSBLIFE 45I/OB_USB_DNUSBLIFE 46II_DIGIN110 to 5 VLIFE 47II_DIGIN120 to 5 VLIFE 48I/OB_CAN1_H0 to 5 VLIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPUSBLIFE 51I/OB_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 44GG_DIGINGND, 2 A fusedLIFE 45I/OBI_USB_DNUSBLIFE 46II_DIGIN110 to 5 VLIFE 47II_DIGIN120 to 5 VLIFE 48I/OBI_CAN1_H0 to 5 VLIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPUSBLIFE 51I/OBI_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 45I/OBI_USB_DNUSBLIFE 46II_DIGIN110 to 5 VLIFE 47II_DIGIN120 to 5 VLIFE 48I/OBI_CAN1_H0 to 5 VLIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPETHLIFE 51I/OBI_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 46ILDIGIN110 to 5 VLIFE 47ILDIGIN120 to 5 VLIFE 48I/OBL_CAN1_H0 to 5 VLIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPETHLIFE 51I/OBLUSB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53ILDIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 47IL/DIGIN120 to 5 VLIFE 48I/OBI_CAN1_H0 to 5 VLIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPETHLIFE 51I/OBI_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 48       I/O       BI_CAN1_H       0 to 5 V         LIFE 49       I/O       B_D_SERCOS1TXN       ETH         LIFE 50       I/O       B_D_SERCOS1TXP       ETH         LIFE 51       I/O       BI_USB_DP       USB         LIFE 52       O       O_V_USB_VDD       float         LIFE 53       I       I_DIGIN08_HALL       0 to 5 V         LIFE 54       I/O       B_D_ETH1RXN       ETH
LIFE 49I/OB_D_SERCOS1TXNETHLIFE 50I/OB_D_SERCOS1TXPETHLIFE 51I/OBI_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 50I/OB_D_SERCOS1TXPETHLIFE 51I/OBI_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 51I/OBI_USB_DPUSBLIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 52OO_V_USB_VDDfloatLIFE 53II_DIGIN08_HALL0 to 5 VLIFE 54I/OB_D_ETH1RXNETH
LIFE 53       I       I_DIGIN08_HALL       0 to 5 V         LIFE 54       I/O       B_D_ETH1RXN       ETH
LIFE 54 I/O B_D_ETH1RXN ETH
LIFE 55 I/O BI_CAN2_L 0 to 5 V
LIFE 56 I/O BI_CAN1_L 0 to 5 V
LIFE 57 I I_DIGIN16 0 to 5 V
LIFE 58 O G_USB_GND float
LIFE 59 I I_DIGIN07_HALL 0 to 5 V
LIFE 60 I I_DIGIN06_HALL 0 to 5 V
LIFE 61 I/O B_D_ETH1TXN ETH
LIFE 62 I/O BI_CAN2_H 0 to 5 V
LIFE 63 V V_UBAT VBAT
LIFE 64 I I_DIGIN05_HALL 0 to 5 V
LIFE 65 I/O B_D_ETH1RXP ETH
LIFE 66 I/O B_D_ETH1TXP ETH

Connector SENS-A (yellow), Mating connector AS618-35SA

Pin	I/O	Signal	Level, Power
SENS-A 01	0	O_LSOUT6	VBAT / 2 A
SENS-A 02	0	G_SENSGND10	GND, 2 A fused
SENS-A 03	0	O_LSOUT7	VBAT / 2 A
SENS-A 04	0	O_HSOUT4	VBAT / 8 A
SENS-A 05	0	O_HSOUT4	VBAT / 8 A
SENS-A 06	0	G_SENSGND09	GND, 2 A fused
SENS-A 07	0	G_SENSGND17	GND, 2 A fused
SENS-A 08	0	O_HSOUT3	VBAT / 8 A
SENS-A 09	0	O_HSOUT3	VBAT / 8 A
SENS-A 10	0	O_LSOUT5	VBAT / 2 A
SENS-A 11	0	G_SENSGND08	GND, 2 A fused
SENS-A 12	0	G_SENSGND07	GND, 2 A fused

Pin	I/O	Signal	Level, Power
SENS-A 13	0	G_SENSGND16	GND, 2 A fused
SENS-A 14	0	G_SENSGND18	GND, 2 A fused
SENS-A 15	0	G_SENSGND19	GND, 2 A fused
SENS-A 16	0	O_LSOUT8	VBAT / 2 A
SENS-A 17	0	O_VSENS19_12V	12 V, 250 mA
SENS-A 18	0	O_VSENS20_12V	12 V, 250 mA
SENS-A 19	0	O_VSENS10_12/5V	5 V / 12 V, 250 mA
SENS-A 20	G	GND	GND
SENS-A 21	0	G_SENSGND20	GND, 2 A fused
SENS-A 22	G	G_ANASCR	GND, 2 A fused
SENS-A 23	1	I_THERM1_N	0 to 5 V
SENS-A 24	1	I_THERM1_P	0 to 5 V
SENS-A 25	0	O_VSENS08_12/5V	5 V / 12 V, 250 mA
SENS-A 26	0	O_VSENS16_12V	12 V, 250 mA
SENS-A 27	0	O_VSENS09_12/5V	5 V / 12 V, 250 mA
SENS-A 28	0	G_SENSGND06	GND, 2 A fused
SENS-A 29	1	I_THERM2_P	0 to 5 V
SENS-A 30	0	O_DIGOUT4	5 V / 25 mA
SENS-A 31	0	O_DIGOUT3	5 V / 25 mA
SENS-A 32	0	O_DIGOUT2	5 V / 25 mA
SENS-A 33	0	O_DIGOUT1	5 V / 25 mA
SENS-A 34	0	O_VSENS18_12V	12 V, 250 mA
SENS-A 35	0	O_VSENS07_12/5V	5 V / 12 V, 250 mA
SENS-A 36	0	O_VSENS06_12/5V	5 V / 12 V, 250 mA
SENS-A 37	0	O_VSENS17_12V	12 V, 250 mA
SENS-A 38	1	I_THERM2_N	0 to 5 V
SENS-A 39	I	I_ANA08_5V	0 to 5 V
SENS-A 40	1	I_ANA09_5V	0 to 5 V
SENS-A 41	I	I_ANA10_5V	0 to 5 V
SENS-A 42	1	I_ANA07_5V	0 to 5 V
SENS-A 43	I	I_LVDT4_SEC2N	-5 to 5 V
SENS-A 44	1	I_LVDT4_SEC_M	-5 to 5 V
SENS-A 45	0	O_LVDT4_PRI2	-5 to 5 V
SENS-A 46	G	G_SCR_LVDT4	GND, 2 A fused
SENS-A 47	I	I_ANA16_5V	0 to 5 V
SENS-A 48	I	I_ANA20_5V	0 to 5 V
SENS-A 49	I	I_ANA17_5V	0 to 5 V
SENS-A 50	I	I_ANA24_5V	0 to 5 V
SENS-A 51	I	I_LVDT4_SEC1P	-5 to 5 V
SENS-A 52	0	O_LVDT4_PRI1	-5 to 5 V
SENS-A 53	I	I_LVDT3_SEC_M	-5 to 5 V
SENS-A 54	G	G_SCR_LVDT3	GND, 2 A fused

Pin	I/O	Signal	Level, Power
SENS-A 55	1	I_ANA18_5V	0 to 5 V
SENS-A 56	T	I_ANA19_5V	0 to 5 V
SENS-A 57	1	I_ANA23_5V	0 to 5 V
SENS-A 58	1	I_LVDT3_SEC1P	-5 to 5 V
SENS-A 59	1	I_LVDT3_SEC2N	-5 to 5 V
SENS-A 60	0	O_LVDT3_PRI2	-5 to 5 V
SENS-A 61	1	I_ANA06_5V	0 to 5 V
SENS-A 62	1	I_THERM3_N	0 to 5 V
SENS-A 63	1	I_THERM3_P	0 to 5 V
SENS-A 64	0	O_LVDT3_PRI1	-5 to 5 V
SENS-A 65	1	I_THERM4_N	0 to 5 V
SENS-A 66	I	I_THERM4_P	0 to 5 V

Connector SENS-B (blue), Mating connector AS618-35SB

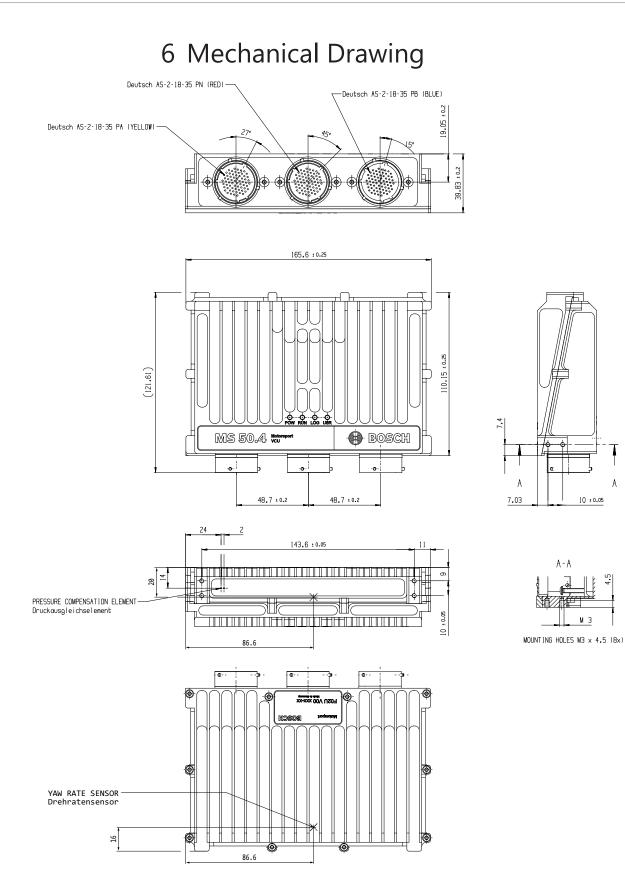
Pin	I/O	Signal	Level, Power
SENS-B 01	0	O_VSENS04_12/5V	5 V / 12 V, 250 mA
SENS-B 02	0	O_VSENS05_12/5V	5 V / 12 V, 250 mA
SENS-B 03	I	I_LVDT2_SEC1P	-5 to 5 V
SENS-B 04	0	O_VSENS02_12/5V	5 V / 12 V, 250 mA
SENS-B 05	0	O_VSENS03_12/5V	5 V / 12 V, 250 mA
SENS-B 06	0	O_VSENS15_12V	12 V, 250 mA
SENS-B 07	0	O_VSENS14_12V	12 V, 250 mA
SENS-B 08	I	I_LVDT2_SEC_M	-5 to 5 V
SENS-B 09	0	O_LVDT2_PRI1	-5 to 5 V
SENS-B 10	0	O_VSENS01_12/5V	5 V / 12 V, 250 mA
SENS-B 11	0	O_VSENS12_12V	12 V, 250 mA
SENS-B 12	0	O_VSENS13_12V	12 V, 250 mA
SENS-B 13	0	G_SENSGND02	GND, 2 A fused
SENS-B 14	1	I_LVDT2_SEC2N	-5 to 5 V
SENS-B 15	0	O_LVDT2_PRI2	-5 to 5 V
SENS-B 16	G	G_SCR_LVDT1	GND, 2 A fused
SENS-B 17	0	O_LSOUT2	VBAT / 2 A
SENS-B 18	0	O_VSENS11_12V	12 V, 250 mA
SENS-B 19	0	G_SENSGND04	GND, 2 A fused
SENS-B 20	0	G_SENSGND03	GND, 2 A fused
SENS-B 21	0	G_SENSGND01	GND, 2 A fused
SENS-B 22	0	O_LVDT1_PRI1	-5 to 5 V
SENS-B 23	0	O_LVDT1_PRI2	-5 to 5 V
SENS-B 24	1	I_LVDT1_SEC2N	-5 to 5 V
SENS-B 25	0	O_HSOUT1	VBAT / 8 A
SENS-B 26	0	O_HSOUT1	VBAT / 8 A
SENS-B 27	0	G_SENSGND11	GND, 2 A fused

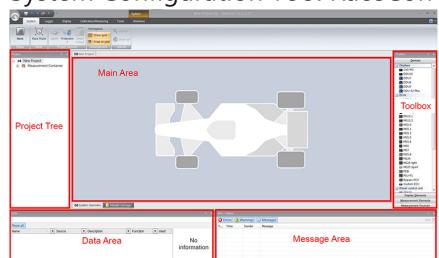
Pin	I/O	Signal	Level, Power
SENS-B 28	0	G_SENSGND05	GND, 2 A fused
SENS-B 29	V	V_UBAT	VBAT
SENS-B 30	G	GND	GND
SENS-B 31	G	G_SCR_LVDT2	GND, 2 A fused
SENS-B 32	I	I_LVDT1_SEC_M	-5 to 5 V
SENS-B 33	I.	I_LVDT1_SEC1P	-5 to 5 V
SENS-B 34	0	O_LSOUT1	VBAT / 2 A
SENS-B 35	0	G_SENSGND12	GND, 2 A fused
SENS-B 36	V	V_UBAT	VBAT
SENS-B 37	V	V_UBAT	VBAT
SENS-B 38	G	GND	GND
SENS-B 39	G	GND	GND
SENS-B 40	I.	I_ANA13_5V	0 to 5 V
SENS-B 41	I.	I_ANA21_5V	0 to 5 V
SENS-B 42	I.	I_ANA22_5V	0 to 5 V
SENS-B 43	0	O_LSOUT3	VBAT / 2 A
SENS-B 44	0	G_SENSGND13	GND, 2 A fused
SENS-B 45	V	V_UBAT	VBAT
SENS-B 46	G	GND	GND
SENS-B 47	I	I_ANA05_5V	0 to 5 V
SENS-B 48	I	I_ANA11_5V	0 to 5 V
SENS-B 49	I	I_ANA14_5V	0 to 5 V
SENS-B 50	I	I_ANA15_5V	0 to 5 V
SENS-B 51	0	O_HSOUT2	VBAT / 8 A
SENS-B 52	0	G_SENSGND14	GND, 2 A fused
SENS-B 53	0	G_SENSGND15	GND, 2 A fused
SENS-B 54	I	I_ANA01_5V	0 to 5 V
SENS-B 55	I	I_ANA02_5V	0 to 5 V
SENS-B 56	1	I_ANA_HSL2	0 to 5 V
SENS-B 57	T	I_ANA12_5V	0 to 5 V
SENS-B 58	0	O_HSOUT2	VBAT / 8 A
SENS-B 59	0	O_LSOUT4	VBAT / 2 A
SENS-B 60	I	I_ANA_HSL5	0 to 5 V
SENS-B 61	T	I_ANA_HSL4	0 to 5 V
SENS-B 62	T	I_ANA04_5V	0 to 5 V
SENS-B 63	I	I_ANA_HSL1	0 to 5 V
SENS-B 64	T	I_ANA_HSL6	0 to 5 V
SENS-B 65	I	I_ANA03_5V	0 to 5 V
SENS-B 66	1	I_ANA_HSL3	0 to 5 V

### Vehicle diagnosis connector

The Bosch Motorsport vehicle diagnosis connector is used as a standard interface to connect the vehicle to a PC e.g. via a MSA-Box II. Loom connector: AS012-35SN

Pin	Name	Description	Used for VCU MS 50.4P
Pin 1	Terminal 30	Permanent positive	+
Pin 2	Terminal 15	Switched positive	+
Pin 3	Terminal 31	GND	+
Pin 4	CAN High	Diagnostic CAN bus	
Pin 16	CAN Low	Diagnostic CAN bus	
Pin 10	K-Line	ECU diagnosis	
Pin 8	Ethernet RxD +	Ethernet interface	+
Pin 9	Ethernet RxD -	Ethernet interface	+
Pin 11	Ethernet TxD +	Ethernet interface	+
Pin 12	Ethernet TxD -	Ethernet interface	+
Pin 22	Screen	Cable screen	+





7 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

## 8 First Steps

Install the software required for the operation of the VCU MS 50.4P. It is developed for Windows system software. The following software versions are used in this manual:

- VCU MS 50.4P setup, configuration and calibration: RaceCon Version 2.6.
- Measurement data analysis: WinDarab V7

Set up the 100 Mbit ethernet connection to the VCU MS 50.4P.

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

## 8.1 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					
Serrors 🔥 Warnings 🕕 Messages(2)			2/2 🗙			
т	Time	Sender	Message			
<b>(i)</b>	12:16:09	RaceCon	Connected to MSA Box.			
<b>(i)</b>	12:16:09	RaceCon	MSA Box successfully connected.			
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 [▶ 21]". For the status color, see chapter "Color indication [▶ 32]".

#### 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 VCU MS 50.4P 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.

## 8.2 Setting up a new RaceCon Project

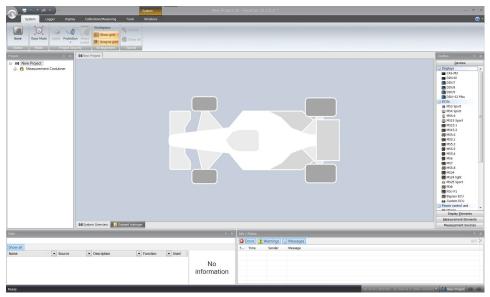
The following screenshot shows an overview of the RaceCon Main Screen with its areas. All (sub-) windows are resizable and dockable. You can find them under the 'Windows' tab.

System Logger Disp	System w Calibration/Measuring Tools Windows	New Project.	rlp - RaceCon V2.5.5.0 *	- a x
None Race Made Visible Prote	ton Shet			
Mora € New Reg ● M New Reg Project Tree	Main Area			Value     ●       ●     ●
Data Show all Name /  Source Resdy.	● Decorption ● Function Data Area	No information	Terror Without Distance Memory Distance Memory Memor	× + X 0/0

1. Start the RaceCon software.



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



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

Image: state	liev Projet - RasCar V2.5.5.0	- « x ©•
Project 0 x 04 New Project		Toobox 9 ×
😑 🛤 New Project	Create a new DDU10	Devices
Measurement Container     Measurement Container	Specify the program archive This creates the device defined in the program archive	Displays     CAS-M3     DU10     DU10     DU17
	ECU program archive:	DDUB DDU9 DDU-52 Plus C ECUS M M33 Sort
dia System Overview	· · · · · · · · · · · · · · · · · · ·	Measurement Elements
		Measugement Sources
Deta	e × Info / Status O Errors Marnings () Messages	× + × 0.0
Show all	T Time Sender Message	
Name / • Source • Description • Function	No information	The man advance of states process + 12 (we Prove -

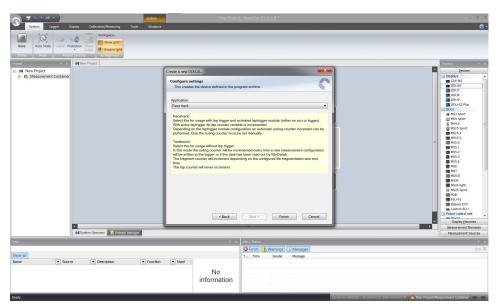
- 4. Download the firmware for your device:
  - from the RaceConnect project file share for PSU. This .pst file should be provided to RaceCon.
  - from www.bosch-motorsport.com for VCUs, DDUs, and Loggers.
  - You can get firmware for ECUs on request.

An information shows if the archive is valid or not.

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

	isplay Calibration/Measuring Tools	System Windows	New Project - RaceCon V2.5	i.5.0 *		_ a x
None Race Mode Visible Pri	Workspace:	11114,000		-		
Project V x	Git New Project					Tosibox # x
<ul> <li>Be 44 New Project</li> <li>a          ▲ Measurement Container     </li> </ul>		ECU program anchire: C.(Laken/SUAAABT)coat (1) The program cective is IP Address: 10 10.020 Contrained devices DUII0 Dualsahth CIC Supports - Logan (2 no. - 4 CAA) Inter - 2 Supports - 2 Supports - 2 Supports	ce defined in the program archive			Boost           CA140           CA240           CA240 </td
Data			0 × Info / Status			* x
-			🙆 Errors 🧘	Warnings i Messages		0,0 🗙
Show all			T Time	Sender Message		
Name Source	e 💌 Description 💌	Function 💌 Used 🗌	No			2
Ready.					No errors datected - all cleared or state unknown 💌	🛅 New Project/Measurement Container 🛛 📟

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



7. Click 'Finish'.

System Logger Display Colforation/Measuring	System New Project - RaceCon V2.5.5.0 *	- т х ()•
D0U10 Race Mode Visible Protection Sheet S		
Status Node Project Security Arrangement Project 0 x Set New Project		Toobox 0 ×
A We Project     ·································		• Ower         • Ower<
Deta	+ × Irfo/Status	* x
Show all	T_ Time Sender Message	0/0 ×
Name Source Description	Function     Used	
	No information	
Ready.		No errors detected - all cleared or state urknown 🐑 🌇 New Project/Neasurement Container 🚥 🚥

The VCU MS 50.4P is inserted into the project and RaceCon tries to connect to the device.

RaceCon detects configuration differences between the VCU MS 50.4P 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.

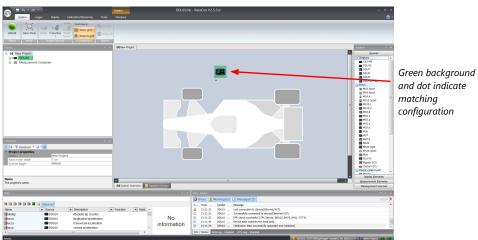


If the device turns red, you might need to do a firmware update on the device. For more information see chapter "Firmware update [▶ 140]".



The download starts and the VCU MS 50.4P carries out a reset.

After the reset, RaceCon reconnects to the VCU MS 50.4P. Local configuration on both the PC and VCU MS 50.4P match (indicated by green background and dot). The VCU MS 50.4P is now connected to RaceCon.



For further information on the color indication, see chapter "Color indication [> 32]".

### 8.3 Feature activation

- Optional software feature packages are available for the VCU MS 50.4P
- 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 VCU MS 50.4P does not work on any other VCU MS 50.4P.
- 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 'VCU MS 50.4P' in the Project Tree.
- 3. Click on the 'Features info' tab in the Main Area.

	A = + + +	System	DDU10_Test.rlp - RaceCo	n V2.5.5.0 - Masterlicense Bosch *	_ = X
	COULD COULD Status	Son,Messuring Tools Windows			@ -
1st: Double-click on DDU	Anges & S & S & S & S & S & S & S & S & S &	มา มา มา มา มา มา มา มา มา มา มา มา มา ม			Option         X           2         Options           3         Options           4         MSS Sport           4         MSS Sport           4         MSS Sport
2nd: Click on 'Features info'			navech 🛔 Clin rescopes 👘 76000 🖝 (1807a) 🕕 Dreck	etb (Office) of restore into	MS52     MS52     MS52     MS53     MS53     MS53     MS54     MS5     MS6     MS7     MS9     MS
	Data		4 × 1 bnfo/Statum		- • ×
			Crrons(1)	iges(30)	45/45 🗙
	Image:	transversal accele Format: % Conversion: 0, Data type: 16		Message Data usida canalida (by to response the device to scorestilly or observations) Secorestilly connected to device(ThermeNDO)). BY deal soccessful, (BY Nevez (DUD) (MSC 401) Device data states the lood data. Calibration data successfully uploaded and initialized.	

4. The 'VCU MS 50.4P features info' window appears.

	DDU 10 fe	atures info			
ECU ID 🗕	ECU ID	3950e778:	1d0fd540	Copy to clipboard	
	Stat	is/Unlock Orde	r informations		
		Name	Description		
Feature status —	6	CCP_MASTER	F02U V02 213-01, Enable device to be CAN Communication Protocoll Master		List of available
realare status			F02U V02 304-01, Full logging on first partition		features
			F02U V02 305-01, Enable full logging on second partition		jeutures
		USB_DATA	F02U V02 214-01, Enable data copy from logger to Bosch USB stick F02U V02 138-01, Enable Ethernet / LTE Telemetry		
			F02U V02 138-01, Enable Ethernet / LTE Telementy F02U V02 205-01, Enable additional input / output channels		
		10_241043			
	Î	Locked (	(disabled) 💣 Unlocked (acti	vated)	

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

CU ID 3950e778: Status/Unlock Orde	Copy to appoint
Name CCP_MASTER FULL_LOG_1 FULL_LOG_2	Description F02U V02 213-01, Enable device to be CAN Communication Protocoll Master F02U V02 304-01, Full logging on first partition
USB_DATA	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'.

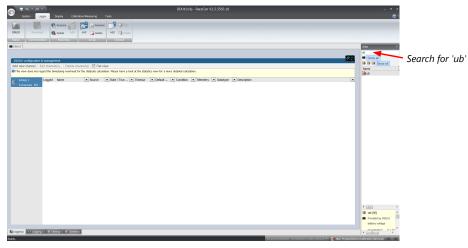
Status	/Unlock Orde	r informations	
	Name	Description	
6	CCP_MASTER	F02U V02 213-01, Enable device to be CAN Communication Protocoll Master	
Ð	FULL_LOG_1	F02U V02 304-01, Full logging on first partition	
Ð	FULL_LOG_2	F02U V02 305-01, Enable full logging on second partition	
Ð	USB_DATA	F02U V02 214-01, Enable data copy from logger to Bosch USB stick	
	ETHER_TELE	F02U V02 138-01, Enable Ethernet / LTE Telemetry	
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 VCU MS 50.4P.

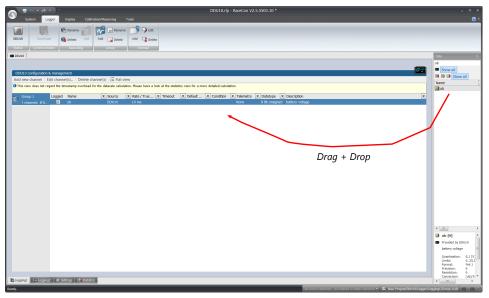
## 8.4 First recording (Quick Start)

This chapter explains the configuration of the recording of the battery voltage channel. See chapter 'Recording [> 97]' 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.



4. Click on the 'Download' button in the upper left corner. The configuration download starts and the VCU MS 50.4P 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.

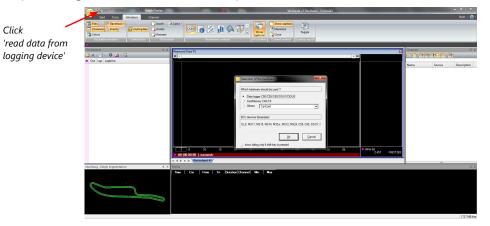
System         Logger         Dyper         <	Sydem DDU10.r	fp - ReoCon V2.550	_ = ×
Asset ( ) 2 ( ) 2 ( ) 4	M leve hoped Downloading data to DDU10 Data Download Data Soundad (velence page) to EC		Partie         0         2           Color 10         -         -           Color 10         -
The project's name.	del System Overview	< Trên / Switus	Measugement Sources
Image: Section 1         Image: Section 2         Image: Section 2         Image: Section 2           Image: Section 2         Image: Section 2         Image: Section 2         Image: Section 2           Image: Section 2         Image: Section 2         Image: Section 2         Image: Section 2           Image: Section 2         Image: Section 2         Image: Section 2         Image: Section 2           Image: Section 2         Image: Section 2         Image: Section 2         Image: Section 2	Punction Used I No information	Difference         Image           Torms         Seeder           Torms         Seeder           Torms         Seeder           Disting         Seeder	6/6 ×

5. Start the WinDarab software.

				W	inDarab v7 Developer - F	ormulas				
Start Tools	Windows									Style 🗸 🔞 🗸
Files Pracetrack Channels Acetrack Colors Dockable windows	Control Bars		🧭 👩 遂 🎶 ( Worksheet contro	captic	w Close	Toggle				
File Explorer	Q >									
								Channels	imimini	0 ×
Out Lap Laptime	<u></u>	1								2
		1						Name	Source	Descripti
			× Worksheet #1							
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Events Time Car From	To Duration Channel	Mer. Mer	_							. ψ X
- Cal Frida	to jouration charmer	Han Plan								
										1702 MD fees

- 6. Disconnect the VCU MS 50.4P 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.

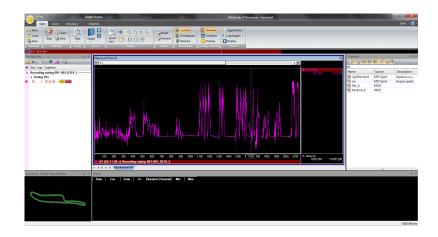
Click 'Apply changes' when done.

Data Logger Import			− □ × Choose you	ur Device / IF
ettings Current Import Recent Import			from dropo	lown list
Import sources	Common options			
FlashCard / USB-Stick	Delete ARP cache	entry after ping to device failed.		
Device	Force password, i	f not set by recording configuration:		
Burst		V New		
Device / IP:         VCU         10.10.0.210           Export file:         One file           Save files in:         C:\	v v	Import all on connect     Delete transferred files     Import latest files first		
Subfolder template:		✓ [a]+		
Filename template: [CardInfo]_out [outing]_la	p[lap]_frag[fragment]_[hour]_[n]	✓ [a]+		

- 9. Connect the VCU MS 50.4P 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 VCU MS 50.4P starts automatically. Measurement files are stored automatically in the folder defined under 'Settings'.

💐 Data Logger Import								
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							Im	port

- 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.

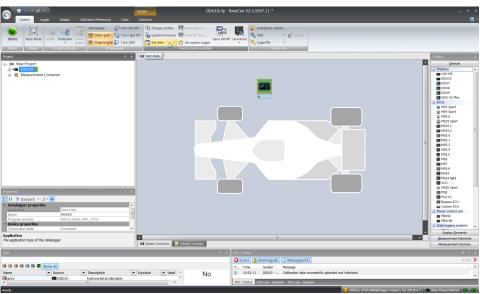


## 8.5 Set date and time

The VCU MS 50.4P 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 VCU MS 50.4P to the PC.
- 2. Click on the 'Set date' button in the 'System' tab menu.



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

Project P × Market New	v Proje
DDUI 🔂 Open	
Dis Create measuring views	
🛢 📮 Download configuration	
📲 🕼 Synchronize 🔸 🙋 Set Date & Time	
Current measuring media 🔸 🔮 with ECU	43
🖻 🔳 🖵 Create dataset 🖷 Change program archive	
PIN/SuperPIN 🕨 Update firmware	
Export Upload configuration	
	-1
Properties Clone ECU	<u> </u>
Adjustment data	<u>۱</u>
Co aje Rename	

- 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	<b>X</b>
Sets the date & time on a logger device. Use the 'set' buttons to configure the logger's recording da	te & 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

## 8.6 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.



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

|--|--|--|

C80 Logger C80 Logger C80 Logger C80 Logger C80 Logger

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

E New Project	🖃 📾 New Project
Laptrigger	🖶 🛥 DDU10 🎽
🚛 👸 Measurement Container	🗄 🎁 Measurement Container

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

set New Project     DU10     Measurement Container	Generation Services     Generation Services
	New Project     Datrigger     DDU9     DDU0

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

Existing DDU10 e	rrors		Existing DDU	10 errors	
MIL 😑			MIL C		
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 [> 91].

# 9 Project Configuration

## 9.1 Math Channels

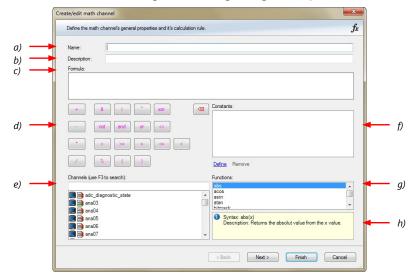
- Arithmetic and logical operations on up to 4 measurement channel(s)
- Numerical result
- Result can be used as input source for various display elements (numeric elements, alarms, bargraphs) and further calculations in the whole RaceCon project

#### Creating a new Math Channel

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

•				
	System         Logar         Degr           0007         Race Mode         Waller Resc           1007         Race Mode         House           1006         House         House		_	0
1st: Double-click on "Math Channels" in the Project tree 2nd: Click on	News         I w K           Image: Second	Al montal de anti-	Constant Section 2	• x
"Add channel"	* <u>- 11</u>		Sensitivety/Offset	
	1         Totandard         -         <	Definition         Test Series         Series         Test Series	8 X 1234 X	
	Properties - Helt Denvini B X 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Orman (Lag)         Amount (Proves 000 / MML (Proves		

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.

### 9.2 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.

		00001 D000.00 V25.0.2002	
	System Logger Disc	y Califration/Measuring Taols Windows	Ø -
	Status Mode Project	orby	
	Project # X	/ St. New Project / 🗋 0007 4 P	x Toobax 0 X
	- gal New Project	A menuloci a more	Devices
		100/7 reth dwmd cmfazzbon	Display Elements Measurement Elements
1st: Double-click	on 🗉 🗖 Display	Add ghrent_ / [/ [dt charest_ /_ [/ bitst chapsel]]	Measurement Sources
ISt. Double eller	CAN Bus 1	A Math channel.	<ul> <li>Sereore</li> </ul>
"Math Channels"	- 🗎 Computed Channels	In Conditional function.	Ecoch Wizerd Customized Sensor
i latif chamico	<li>a) 1/0 Channels</li> <li>b) Calibration Items</li>		Analog sources
in Project Tree	Macros	1 4 A statistical statisticae statisticae statistic	Characteristic Curve
	f. Math Channels		Multipoint Adjustment Sensitivity/Offset
	Group adjustments		Frequency sources
	CCP Mester     Measurement Container		Characteristic Curve
2nd: Click on	B- Measurement Container		Velocity
			Computed sources
the dropdown	Data - Math Channels 🛛 🕸 🗙		Adjustment channel Characteristic Curve
	Show all		El Fuel
arrow beside	None Sou		Gear Lookup Table
			Laptripper
'Add channel'			PWH Out
, laa enamet			Sensitivity/Offset
			C speed
	·		
3rd: Choose	Properties - Math Channels # X	🖀 Statistica 🖌 Marth Charmels 🔏 Conditional Charmels 🎒 CAN messages 🔩 Naccas 💷 Settings 🕕 Device Info 😵 Error Info 🏠 Realures Info	-
3rd. Choose	Tild   Teterderi a   11 a 🚱	0	
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for a strange 1	E Math channels properties	0 114651 0007-Ne BY desk scossful, BY Celevice 1007, BAGE 1977 )	
function'	Name Math Channels	11142:53 DDU7 - Ne Logger data matches the local data.	
-		114/6.13 D0/J <sup>-</sup> Ne Lost convection to device(Thermet(MOP).     114/6.14 D0/J <sup>-</sup> Ne Lost convection to device(Thermet(MOP).     114/6.14 D0/J <sup>-</sup> Ne Lost convection to device(Thermet(MOP).	
		(i) 11:42:14 DDU7-Ne DPK check successful. (DPK Device: DDU7_DMSE_0727 )	
	Can/ChangedProtectioeState	113-115 Altern - Ne No dwared source configured, skeping element      113-115 Altern - Ne No dwared source configured, skeping element      113-115 DUD7-Ne Loger data matchine the load data	

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

	1	Create/edit conditional function		
		Define the conditional function's gener	al properties and it's calculation rules.	fx
		Name:		
a)		p_br_front_mx		
		H:	Then:	
b)	-	p_br_front > 20	<pre>max (p_br_front, p_br_front_mx)</pre>	(d)
		Otherwise:	Reset value:	
c)		p_br_front_mx	10	e)
		If (p, br. front > 20) is TRUE, then return Reset value is used both the stand stand stand stand stand stand or when if-condition changes state from	(max (p_br_front_p_br_front_mx)), else return (p_br_front_mx). re first time efter power-up FALSE to TRUE < Back Next > Finish	Cancel

a) Enter the name of the conditional function.

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

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

Click 'Finish' when done.

The conditional function works the following way:

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

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

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

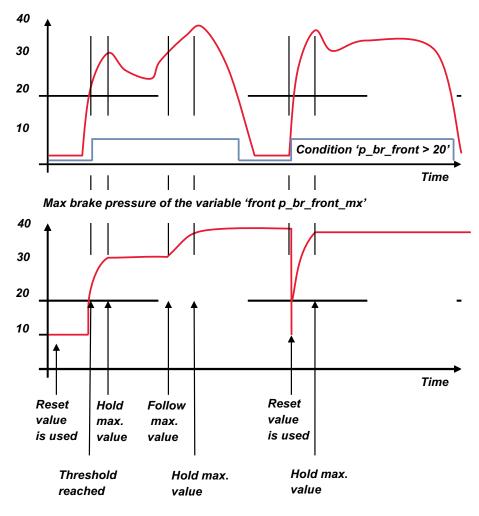
The reset value is always set for the new variable (entered in "Name"):

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

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

The conditional function is displayed in the VCU MS 50.4P math channel window.

#### Example: Setting up a condition for maximum front brake pressure Brake pressure 'front p\_br\_front'



- At power-up, the reset value (10) is used for 'p\_br\_front\_mx'.

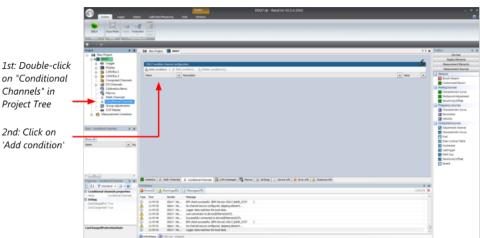
- 'p\_br\_front' rises to 30. As 'p\_br\_front' is > 20 (condition is TRUE), the condition 'max (p\_br\_front, p\_br\_front\_mx)' in the THEN window is triggered. The condition sets the bigger value as new value for 'p\_br\_front\_mx'. As 'p\_br\_front' (30) is bigger than 'p\_br\_front\_mx' (10), the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

# 9.3 Conditional Channels

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

#### Creating a new Conditional Channel

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



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

	Define the conditions general properties and the Select between single channel/value or multiple con		nparing mode. <b>fx</b>
	Name:		
-	Comparing mode © Constant	Range	Multiple (constant list)
	Input channel:	Operator: Constant value:	
	General settings	Output setting	
		ms Output mode:	Constant TRUE/FALSE -
	Turn off delay: 0	ms	

a) Enter the name of the conditional channel.

b) Select the comparing mode:

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

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

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

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

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

f) Choose the output setting of the result.

- Constant TRUE/FALSE: Result is as a constant with the value TRUE or FALSE.
- Blinking: Result is a blinking, if the condition is fulfilled.
- Pulse: Result is a short one-time pulse, if the condition is fulfilled.
- Toggling output: Result is a pulse that lasts until the next condition is fulfilled.
- Click 'Ok' when done. The conditional channel is displayed in the VCU MS 50.4P condition channel window.

### 9.4 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 VCU MS 50.4P project.

### Creating a new Condition Combination

Follow the steps shown in the screenshot.

		5 COUP de Bandon VI.5.5.000	•
		Taba	N Today & K
1st: Double-click on 'Conditional Channels' in Project Tree	Construction     C	The control or more a character of the control of t	Daplas Benerits Heasurement Denenis Heasurement Jourses
2nd: Click on the dropdown arrow beside 'Add	Data Continuel Darwin & X Data al Name \ 💽 Da		Compared starting Characteristic Chrise Characteristic Chrise Chrise Case Lookup Table Georgen Hell Cod Security (1979) Security Security Security Security
condition'	r r Properties Conditional Channels B K 20 31 V dandard - J - D	🖀 Salatas 🔏 init Dannis 🙊 Cadavad Quanda 🔯 Catemanges 🔩 Romes 💷 Sellinge 💷 Sellinge 💷 Sellinge 🔛 Sellinge Ale	
3rd: Choose 'Conditional	Canditional channels properties Name Canditonal Durvels     Canditonal Durvels     Defog     Canditonal Durvels	D transfer         Among All Jing Menagerilli         20112           Tare Mar         Sandar         Sandar           Jin Ulli Jing Markan, in Production of Distribution (Sandar) (Jold J17         1           Jin Ulli Jing Markan, in Production of Distribution (Sandar) (Jold J17         1           Jin Ulli Jing Markan, in Order Among Alling Alling Markan, in Order Among Alling Markan, in Or	
combination'	CanChangedProtectionState	1010         100-hc.         Isourity any entry it is notifier strict(y)         y           1010         100-hc.         Isourity any entry it is notifier strict(y)         y           1010         100-hc.         Isourity any entry it is notifier strict(y)         y           1010         100-hc.         Isourity any entry it is notifier strict(y)         y           1010         100-hc.         Isourity any entry it is notifier strict(y)         y           1010         100-hc.         Isourity any entry it is notifier strict(y)         y           1010         100-hc.         Isourity any entry it is notifier strict(y)         y           1010         100-hc.         Isourity any entry it isourity it isourity any entry	

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

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

a) Enter the name of the condition combination.

b) Create the condition combination in the window.

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

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

Create / edit condition combination		×
Create / edit condition combination		fr
Combine multiple conditions.		Jx
Name:		
condComb		
Output configuration:		
Constant TRUE/FALSE		ĸ
Constant TRUE/FALSE Blinking		7
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 VCU MS 50.4P condition channel window.

# 9.5 Display Switch Module

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

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

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

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

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

## 9.6 Timer Module

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

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

Timer Wizard - Add New X				
Timer configuration         Image: Description           Specify timer properties and a set of control signals.         Image: Description				
Properties Mode: Count down Count down Count up 10,00 s Measurement sheet	Control signals Start timer: Stop timer (optional): Cond_stop Reset timer (optional): Cond_reset Use timer expiration to reset timer	Edge: ✓ ✓ Falling ✓ Edge: ✓ ✓ Falling ✓ Edge: ✓ ✓ Falling ✓		
	< Back Next > Fi	nish Cancel		

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

Measurement label	Function
name_ <b>time</b>	actual timer value
name_ <b>trig</b>	trigger set by timer alarm

In this example, the module is named "Timer\_Module". Resulting channels are:

Timer_Module_time	C70
Timer_Module_trig	C70

# 9.7 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.

SPS Trigger configuration Specify GPS Trigger configuration.				5
Fudge Factor:	GPS positions (Parameter	based) Detection range (N	/acro based)	
	Latitude [DD]	Longitude [DD]	Detection range [m]	
Measurement sheet	0,0000000	0,0000000	20,00	
· ·	0,0000000	0.00000000	20,00	
	0,0000000	0,0000000	20,00	
	0.0000000	0.00000000	20.00	
	0,0000000	0.00000000	20,00	
	0,0000000	0.00000000	20,00	
	0,0000000	0.00000000	20,00	
	0,0000000	0.00000000	20,00	
	0,0000000	0,0000000	20,00	
	0,0000000	0.00000000	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	

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.

PS Trigger configuration		0
Specify GPS Trigger configuration.		
udge Factor: 1,000 🜩	GPS positions (Parameter based) Detection range (Macro based)	
	20,00	m
easurement sheet	20,00	m
· ·	20,00	m
	20.00	m
	20,00	m
	20,00	m

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

### 9.8 CPU Load Limits

As all microprocessors, the two processors of the VCU MS 50.4P 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 VCU MS 50.4P 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 VCU MS 50.4P 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 VCU MS 50.4P resets due to complex configuration setups, please consider reducing the demands on the VCU MS 50.4P adapting the influencing factors mentioned above.

# 10 CAN Configuration

The VCU MS 50.4P has 4 (plus 4 on request) 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 VCU MS 50.4P 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).

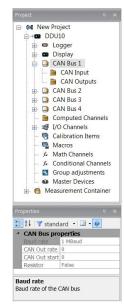
### 10.1 CAN Bus Trivia

#### 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

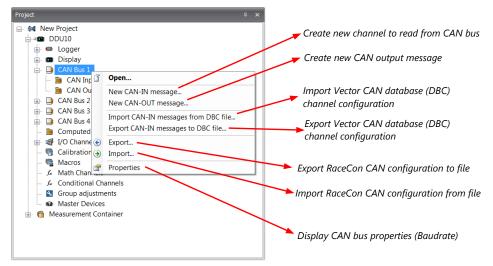
- Re-use (multiplex) of message identifiers
- One byte of message contains row counter
- 7 bytes payload remaining
- Position of row counter is configurable

		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0	0x100	0	💁 p_oil		💁 t_oil				
C	0x100	1	💁 s_dam_fl		💁 s_dam_fr				
0	0x100	2	💁 s_dam_rl		💁 s_dam_rr				
Mes: Id	sage	Row Counter	Payloa	d Area					

# 10.2 CAN input

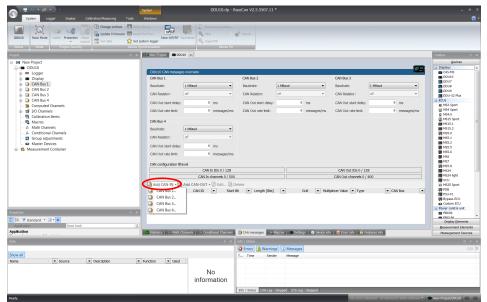
### 10.2.1 Input configuration

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



### 10.2.2 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.

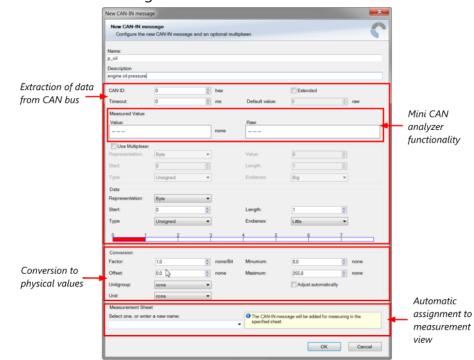
4. Insert the name and description of the channel.

New CAN-IN messa	ge					<b>—</b> ×
New CAN-IN me Configure the n	essage New CAN-IN message and a	an oj	ptional multip	olexer.		5
Name:						
p_oil						
Description engine oil pressure						
CAN ID:	0		hex		Extended	
Timeout:	0		ms	Default value:		raw
Measured Value	-				-	¥
Value:				Raw:		
			none			
Use Multiplexer				L		
Representation:	Byte	•		Value:	0	A V
Start:	0	▲ ▼		Length:	1	A V
Туре	Unsigned	•		Endianes:	Big	•
Data						
Representation:	Byte	•				
Start:	0	<b></b>		Length:	1	▲ ▼
Туре	Unsigned	•		Endianes:	Little	•
0 1	2	3		4 5	6 7	
Conversion						
Factor:		-	none/Bit	Minumum:		none
Offset:	0.0 😞	-	none	Maximum:	255,0	none
Unitgroup:	none	•			Adjust automatically	
Unit:	none	•				
Measurement She						
Select one, or ente	er a new name:			snecified sheet	ssage will be added for measu	ring in the
					ОК	Cancel

5. Click 'OK' when done.

The channel is listed in the Data window.

CAN Bus 1			CAN Bus 2			CAN Bus 3		
Baudrate:	1 MBaud	-	Baudrate:	1 MBaud	•	Baudrate:	1 MBaud	•
CAN Resistor:	off	Ŧ	CAN Resistor:	off	¥	CAN Resistor:	off	Ŧ
CAN Out start delay:	0 ms		CAN Out start delay:		ms	CAN Out start delay:	0	ms
CAN Out rate limit:	0 me	essages/ms	CAN Out rate limit:		messages/ms	CAN Out rate limit:	0	messages/ms
CAN Bus 4								
Baudrate:	1 MBaud	-						
CAN Resistor:	off	-						
CAN Out start delay:	0 ms							
CAN Out rate limit:	0 me	essages/ms						
CAN configuration fill	level					CAN Out IDs 0 / 128	3	
CAN configuration fill	evel CAN In ID	s 1 / 128						
CAN configuration fill						CAN Out channels 0 /	400	
	CAN In ID	nels 1 / 500	ete			CAN Out channels 0 / 4	400	
CAN configuration fil Add CAN-IN - ame	CAN In ID CAN In chan	nels 1 / 500	ete  Length [Bits]	•	Grid 💌 Multi	CAN Out channels 0 / 4	400 • CA	N Bus

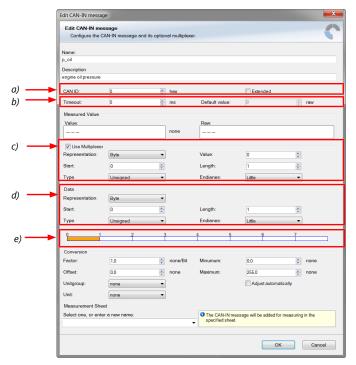


### CAN channel configuration

### 10.2.3 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.

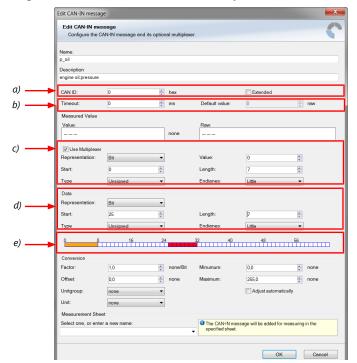
d) Enter data position, length and format.

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 VCU MS 50.4P 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		

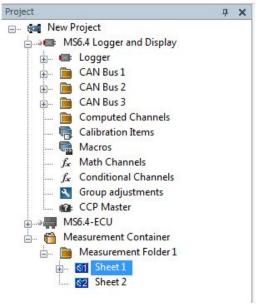
#### Automatic creation of online measurement sheets

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.

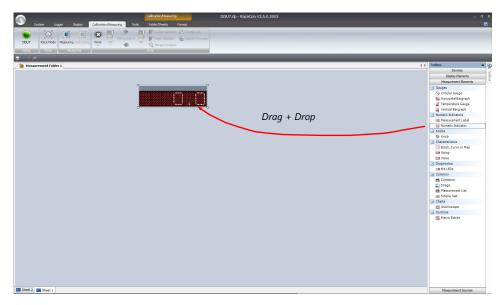
For an online view of the value measured by the VCU MS 50.4P, insert the channel in an online measurement sheet which is described in the chapter Setting up an online measurement [▶ 80].

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

### 10.2.4 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.

	Celbration/Measuring	DDU7.nlp - RaceCon V2.5.0.2002	
System Logger Display Calibration/Measuring Tools	Folder/Sheets Format		
D017         Race Mode         Measuring Recording         With WP         Image: Control of the WP         Image: Contro of the WP         Image: Control of the W			
B Measurement Folder 1		4 Þ	Data - Sheet 1 🔅 🖗
		Drag + Drop	terment Second Seco
			<ul> <li>m</li> <li>p_oil [bor]</li> <li>Provided by D007 (frowided to Data)</li> </ul>
			engine ol pressure p Quantisation: 1 (bar)/inc Limita:0.255 Format: 153.0 Factor: 1 Official
Sheet 2 Sheet 1			Data tvoe: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.

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

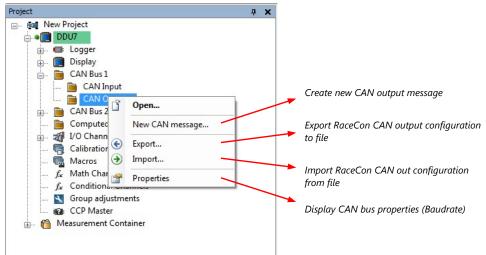
- 1. Right-click on CAN Input of desired bus (CAN1 or CAN2).
- 2. Select 'Import DBC file' from menu. A file browser opens.
- 3. Select DBC file to import and click 'OK' when done. A channel import window opens.

94 channels and 60	messag	ies availa	ble					channels to import:	
Name	Unit	ld	Size	RowCtr	Row/Val	Descrit 🔺		aps	
🌙 ассх	g	777	8			Vector,		ath	
🌙 ассу	g	777	8			Vector		1	
🌙 accz	9	777	8			Vector			
🜛 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	g	5C0	16			Vector			
🌙 batt_u	V	779	8			Vector_	Remove all		
🜛 battlow_b		77A	1	0	5	Vector -			
•						Þ			
<u>(</u>						▶		1	

- 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.

# 10.3 CAN output

### 10.3.1 Output configuration



### 10.3.2 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.

System Loger Display Calbration/Measuring Tools	System DDU10.rlp - R Windows	xeCon V2.5.5507.11 *				_ = ×
DUUI0 Status Mode						
Project # x	Del New Project DOULO ×					Teelbax 9 X
et New Project           Image: Second Secon	OF0192 OV Interceptor           Over the 1           Bandmitter           Bandmitter           OV Restard Bays           OV Cost Bath Gays           OV Restard Bays           OV	CAN Bis 2 Backete: 1.898ee CAN Resistor: dr CAN Out rate limb: CAN Out rate limb:	• • • ms • mesaget/ms	CAN Bus 3 Baudrate: CAN Resistor: CAN Out start delay: CAN Out rate limt:	LMmad of • ms • mesages/ms	Decise           Display         +           Cocie         +           Mission         +      <
	CAN In IDs 0 / 128 CAN In channels 0 / 500			CAN Out IDs 0 / 12 CAN Out channels 0 /		MS24 MS24 light
nyanna t a 1	Add CAN-IN Add CAN-OUT - Citic Do Name - CAN BUS 2. CAN BUS 3. CAN BUS 3. CAN BUS 4.	it 💌 Length (Bts) 💌		exer Value 💌 Type	V CAN Bus	VCU VH V
	Statistics 🖉 Math Channels 🖉 Conditional Channels	🙆 CAN messages 📃 🗟 Macros 🚺	Settings 🚺 Device info	🥹 Error info 🛛 🔒 Fe	atures info	Measurement Sources
Stor all Shore all source Decription •	Function Tubed No information	irfo / Status	essages			0/0 X
		Info / Status CAN Log - Stopped	SYS Log - Stopped			
Pandu						size and the relation of the

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

w CAN-OUT messa	ge				
lew CAN-OUT me Configure the CAN	ssage I-OUT message and an optional multiplexer.				
Name:					
CAN Message					
Description					
CAN ID:	0	hex	Extended		
Grid:	100 ms	•	Trigger channel:		Ŧ
			Trigger on:	Rising	▼ edge
Use Multiplexer					
Representation:	Byte	•	Value:	1	*
Start:	0	×	Length:	1	×
			Endianes:	Big	•
👌 Add row 📃	Delete row(s) 🛛 😫 Add channel 📑 Add c	onstant <table-cell></table-cell>	Edit 🗟 Delete	Bit index inverted	
Byte 0 0 1 2 3 4 1 1	Byte 1 Byte 2 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7	Byte 3 0 1 2 3 4 5	Byte 4	Byte 5 Byte 6 8 8 9 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7	Byte 7 0 1 2 3 4 5 6
				ОК	Cancel

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

	New CAN-OUT mess	ge				<b>X</b>
	New CAN-OUT m Configure the CA	essage N-OUT message and an optional multiplexe	r.			0
	Name: CAN Message Description					
	CAN ID:	0	🔹 hex	Extended		
Definition of	Grid:	100 ms	•	Trigger channel:		•
CAN message				Trigger on:	Rising	▼ edge
-	Use Multiplexer					
	Representation:	Byte	•	Value:	1	×
	Start:	0	-	Length:	1	-
				Endianes:	Big	-
Content of	📑 Add row 📃	Delete row(s) 😫 Add channel 📑 Add	constant	👌 Edit 🗟 Delete	Bit index inverted	
message	Byte 0 1 2 3 4 ▶ 1 1	Byte 1 Byte 2 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6	Byte: 7 0 1 2 3 4	Byte 4 5 6 7 0 1 2 3 4 5	Byte 5 Byte 6 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0	Byte 7 1 2 3 4 5 6 7
Ĵ						
					ОК	Cancel

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

	System	DDU10.rlp - I		. a x
System Logger Display Calibration/Measuring Tools	Windows	1		
B dans antes Eliza	a lla u	The second secon		
	d the local of	and the second s	X	
00010 Race Mode visible Protection Sheet	system looger	New CAN-OUT message		
	Sales and a state of the	New CAN-OUT message		
Direct D	Dig New P	Configure the CAN-OUT message and an	optional multiple Add new CAN out channel	
B 64 New Project			Add new CAN out channel	Devices
A-C DDUID		Nome: CAN Message	Specify the properties of the CAN out channel.	
i 🖶 👄 Logger	000	Description		CAS-H3
B Display	CANE	Lescoption		00010
CAN Bus 1     GAN Bus 2	Baud			COU8
	CAN	CAN ID: 0	tater a channel name to filter	0009 000-52 Plus
E CAN Bus 4	CANE	Grid: 100 ms	1000	US
- 🐚 Computed Channels			V Mutplesed II	MS3 Sport ::
style 1/0 Channels     Galibration Items	CAN			NS4.6
- m Calibration Items - Macros	CANE	Use Multiplexer	🖬 🗃 ads_diagnostic_state Endianes: Litte 🔹 🚇	MS15 Sport
- & Math Channels	Baude	Representation: Byte		NS15.1 NS15.2
<ul> <li>– &amp; Conditional Channels</li> </ul>		Start 0		N\$5.0
<ul> <li>Group adjustments</li> </ul>	CAN		Ctive: 0.0 6	NS5.1
Masurement Container Click here -	CAN			NS5.5
Click here -	CAN			NS5.6 NS6
	CAN O	Byte 0 Byte 1	9/62 9 1 2 3 4 5 6 7	M57
	CANE	▶ 1 1		M55.8 M524
Properties 0 x				MS24 Felt
1 1 standard • 1 •	344			VCU MS25 Sport
Application Race track	Name			HS25 Sport
Name DOULO .	nene			Display Elements
Application				easurement Elements
The application type of the datalogger	Statu:			Nessurgement Seurces
Data			International In	= • ×
			Concess Warnings (1) Messages	0/0 X
🗃 🗃 🗃 🗃 🖬 🖬 Show all			T., Time Sender Messoe	
	Function	Used A		
atta DDU10		=		
aBfc DDU10 Babsap DDU10 Absolute lap counter				
abstap DDU10 Absolute tap counter accx DDU10 longtudnal acceleration		No		
accy DDU10 transversal acceleration		information		
accz DDU10 vertical acceleration		information		
ADC_DIAGNOSTIC DDU10 Triggers the on-demand dage				
degnostic_state     DDU10     Signals if on demand degnosti     Badiust, data, nv. copy     DDU10     no description		*		
< II II			3/6 / Status CAN Log - Stapped SYS Log - Stapped	
Ready.			No errors detected - all cleaned or state uninvolve 💌 💌 New Pr	ajet/10.11 📾 🚥

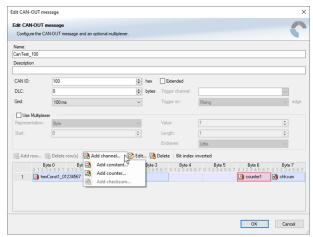
- Select the desired measurement channel and specify the message settings.

The measurement channel is now assigned to the CAN message.

### 10.3.2.1 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.
- 2. 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.
- 4. Click 'OK' when done.



### 10.3.2.2 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 Counter.			
Name:					
counter1					
Representation:	Byte	$\sim$			
Start:	ß	-	Length:	1	
Right shift:	0	-	Endianes:	Littl	e `
Counter start:	0	-	Counter end:	255	4
0 1	2	3	4 5	6	7

### 10.3.2.3 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.
- 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.
- 4. Click 'OK' when done.

Add new CAN out cortant X
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
OK Cancel

## 10.4 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.
- Check the box 'Use Multiplexer' and configure the multiplexer for the new CAN-IN channel.

DU10 Race Mode Value Protection Short	libration/Measuring Tools Wi								
<ul> <li>locked</li> </ul>		Name:	ssage ew CAN-IN message and an	optional multi	plexer.		S		
itatus Node Project Security		CANChannel							_
	Den New Project	Description							Toolbox 9
M New Project									Displays
🗄 🖨 Logger	DDU10 CAN messages overview	CAN ID:	0	hex		Extended		<b>CH</b>	CAS-M3
Display	CAN Bus 1	Timeout:	0	ms	Default value:	0 TOW			DDU10 0007
E CAN Bus 1	Baudrate: 1 Mileud	Measured Value					beat	-	COUS
CAN Input_1     GAN Outputs	CAN Resistor: off	Value:			Raw.			•	0009
CAN Bus 2				none					ECUS
E CAN Bus 3	CAN Out start delay:							0 ms	III MS3 Sport
🖶 🛄 CAN Bus 4	CAN Out rate limit:	Use Multiplexer	>					0 messages/ms	MS4 Sport MS4.6
<ul> <li>Ecomputed Channels</li> </ul>	CAN Bus 4	Representation:	Byte •		Value:	0			MS15 Sport
# I/O Channels     Calibration Items		Start	3		Length:	1			MS15.1
- 😋 Calibration items - 🖳 Macros	Baudrate: 1 MBaud								MS15.2
- & Math Channels	CAN Resistor: off	Туре	Unsigned •	1	Endienes:	Big •			M55.1
- & Conditional Channels	CAN Out start delay:	Data							MS5.2
<ul> <li>Group adjustments</li> </ul>		Representation:	ByN •						MSS.6
Master Devices     Measurement Container	GAN Out rate lmt:	Start	0		Length:	1			MS6
Measurement Container	CAN configuration fill level	Type			Endienes:	Litte •			MS7
		1300	Unsigned •	1	Citations.	une ·			MS24
		<u> </u>	2		4 5	6 7			MS24 light
• ×	Add CAN-IN Add CAN-								WCU WS25 Sport
	Name A	Conversion						· CAN Bus	A PDB
Show all	Multiplexer	Factor:	1.0 🕀	none/Bit	Minumum:	0.0 🗄 none		CAN Bus 1	PSU-F1
No No	p_ol	Offset	0.0	none	Maximum	255.0 none		CAN Bus 1	Custom ECU
									Pawer control unit
infor		Unitgroup:	rone ·	1		Adjust automatically			BB PEXSO
matio		Unit	none 💌						Display Elements Measurement Element
, n	Statistics 🔅 Math Channels 🔅	Measurement She	et.						Measurement Sources
/ 2mm		Select one, or ente	r a new name:		The CANHN me	ssage will be added for measuring in the			
					<ul> <li>specified sheet</li> </ul>				
Errors 👔 Warnings 🕕 Messages									
Time Sender Message						OK Ca	leon		
						UK US			
		<u></u>		_	_				
/ Status CAN Log - Stopped SYS Log - Stopped									

- 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.

us Mode	* x	De New Project 🕋 DOI	10 F	New CAN-OUT n	nessage				<b>—X</b> —	Toolbox
New Project DUUJ0 Course Con Bus Con Con Bus Con Bus		DOUTO CAN message CAN Bus 1 Baudrate: CAN Bus 1 CAN cut start delay: CAN Cut start delay: CAN Cut start delay: CAN Resizon: CAN Resizon: CAN dut start delay:		New CAN-OL Configure th Name: CAN Massage Description CAN ID: Grid: Use Multip Representation Start:	0 100 ms	n optional multiplease.	: Ebtended Trigger channet Trigger cn: Value: Length:	Finerg 1	• • • • • • • • • • • • • • • • • • •	Colors         Denotes           2) Deplays         C46-40           C46-40         DOU/9           D DOU/9         DOU/9           D Sold Sandy         HIS3 Sport           HIS5.6         HIS5.6           HIS5.6         HIS5.6
Master Devices Measurement Container	° × No	CAN Out rate limit: CAN configuration fil CAN configuration fil CA	CA CA	> 1 2		dd channel Add constant Dyfe 2. Dyf			• 	HISE     HISE
1	infor matio n	Statistics 2 Math (	hennels 🖉 🤌 Condition	ol Cherneis (19) OVI	e messages 📗 🗟 Hacros 📗	Settings 0 Device info 0	Error Info 📄 👸 Feature	siite .	OK Cancel	Big PBX90 Display Elerre Heasurement flo Measurement So
rs 🛕 Warnings 🕕 Mess me Sender Messz										

- 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.

	erties of the CAN out of	channel.			
Channel:					
📼 📑 b_pwr_good					•
8 Bit unsigned / little	endian				
Representation:	Byte	•		Multipl	exed
Start:	4		Length:	2	<b>A</b>
Right shift:	0		Endianes:	Little	•
	Force quantizat	ion			
Factor:	1.0	<u>A</u> <u>V</u>	Offset:	0.0	×
Туре:	Unsigned	•			
	2 3	4	5 6	7	

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

System Logger Display C	System Sibratori/Meesuring Tools Window	5	DDU10.rlp - RaceC	Con V2.5.5507.11 *	-	-	-	_ n : ©
Constant Containe     Constant Containe	Control of the second sec	None: CAN Manage Descripton GAN ID: GAN ID: GAS Representation: Best: Add row. Descripton Best: Add row. Descripton Best: 1 2 3 3	e control of an optimal of a second of a sec	hex     i     hex     i     fild     Add contant.     fild     Add contant.     Fild     Add contant.     Fild     Contant.	Dyte 4	a	• • • • • • • • • • • • • • • • • • •	Tests         Social           2000         2000           2000
Sele / Status  T Trine Sender Messages  T Trine Sender Message  Info / Status Crief Lag. Support Stric Lag. Support Stric / Status Crief Lag.	d l							e o Good or date unknown + The selection

# 11 Export and Import in RaceCon

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

## 11.1 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 destination	n to store to.		€
Image: Second state of the second s			
Select all Deselect all	🗌 Ехр	ort as pate	ch file
Б	(port	Cance	

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

## 11.2 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.

mported P	roject:		Current Project:		
Category:	All				
Filter:	Exact V Type a Name		Imported elements: 1 Missing Links:	1	
	ptrigger	î	✓ Image: weight wei		
© Sp → == DC			<ul> <li>Laptrigger</li> <li>Speed</li> <li>DDU10</li> </ul>		
+ 💷	Display		↓ ■ Logger ↓ ■ Display		
	CAN Input	U	CAN Bus 1     CAN Input	6	
	➡ can1_0x200_Rx_ana03 ➡ can1_0x200_Rx_timestamp_1ms ➡ can1_0x200_Rx_ub		CAN Input Can1_0x300_Rx_speed Can1_0x300_Rx_trigger		
	can1_0x300_Rx_fueltest_flowrate can1_0x300_Rx_speed		CAN Outputs		
	<pre>can1_0x300_Rx_trigger</pre> <pre> @ can1_0x301_Rx</pre>		► CAN Bus 3 ► CAN Bus 4		
	ean1_0x302_Rx can1_ext_0x201_Rx_apa03	-	<ul> <li>Computed Channels</li> <li>Events</li> </ul>		

- 4. Select channels to import.
- 5. Drag and drop the channel to 'CAN Input' of desired CAN bus on right hand side.
- Click 'Finish'. If a measurement channel belongs to more than one source (e.g. VCU MS 50.4P and MS 6), the 'Solve Label Ambiguity' window opens.

Importing from file dummy.rex(2.13.1.4)			$\times$
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			$\sim$
	Do not link Current Project/DDU10/Calibration Items/accx Current Project/MS6-ECU/accx	Const	
	< Back Next > Finish	Cancel	

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

# 12 Analog and Frequency Inputs

#### Analog inputs

- 0 to 5 V
- 12 bit A/D converter
- Switchable 3.01 kOhm pull-up resistor
- 10 kHz acquisition rate, up to 1 kHz recording rate
- Linear phase digital filter

### Frequency inputs

- 5 V Hall-effect type, 2.5 V trigger level (DF11 input with current interface or 5 V Halleffect input with 2.5 V trigger level)
- 20 kHz max. frequency
- 10 ms measurement window

# 12.1 Analog inputs

### 12.1.1 Measurements channels

For each analog channel, several 'subchannels' are available.

Data - New Pi	roject - DDU 7 - Input-cha	innels - ANA	\06 - f_wheel_fl		<b></b> д	x
<u>S</u> earch:						
Used	Name 🔺 💌	Source	<ul> <li>Description</li> </ul>	•		
	📑 f_wheel_fl	DDU7	Wheel force front left			
	📑 f_wheel_fl_fi	DDU7	Wheel force front left			
	💁 raw_f_wheel_fl	DDU7	Wheel force front left			
	💁 raw_f_wheel_fl_fi	DDU7	Wheel force front left			

Measurement labels with the characters 'raw' show the exact values in mV.

Measurement labels with the characters '\_fi' show filtered values.

The word 'name' in the table is a placeholder for the channel's name.

Measurement label	Function
raw_name	mV value of sensor
raw_name_fi	Filtered mV value of sensor
name	Physical value of sensor
name_fi	Filtered physical value

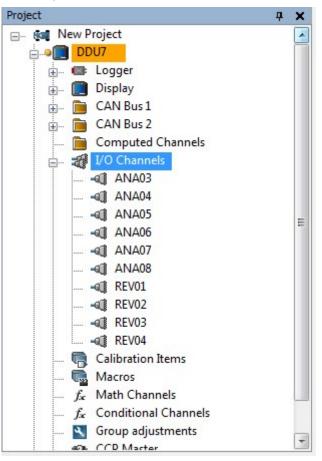
Filtered channels are routed through digital low pass filters:

- VCU MS 50.4P uses A/D converter oversampling and digital filtering to recording rate
- Digital filters eliminate 'out-of-band' noise
- Cut-off frequency automatically adjusted to recording rate
- Linear phase no signal distortion
- Latency compensation no filter delay in recorded data

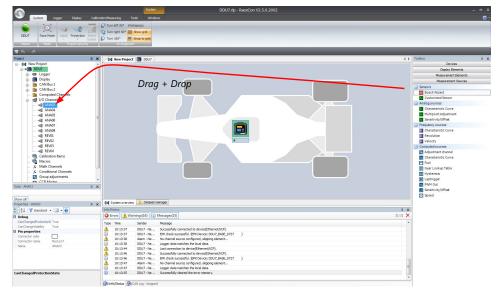
# 12.2 Configuring inputs

### 12.2.1 Configuring a predefined Bosch sensor with the 'Bosch Sensor Wizard'

- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. To expand the list of 'I/O Channels', click on '+' in the VCU MS 50.4P Project Tree.



3. Drag the "Bosch Sensor Wizard" from the Toolbox and drop it on the desired analog input channel in the VCU MS 50.4P Project Tree.



#### 4. The "Bosch Sensor Wizard" opens.

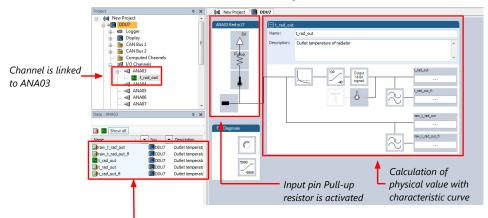
ĺ	Bosch Sensor Wizard					×	
1st: Choose the sensor´s category	Select Sensor Select a sensor, b	ased on the order number.				e	_
	Sensor category	TEMPERATURE SENSORS	✓ Calibration	on data			
2.1.7	Sensor group	NTC M12	• V P	ullup			
2nd: To narrow you				Ohm	°C		These calibration
choice, choose a	Order number			89	130		values will be used
type	0 280 130 026 B 261 209 160			113	120		
	F 02U V00 123-0	01		144	110		
3rd: Select the				186	100	-	
exact type				322	80	-	
chaet type				435	70		
				834	50		
		Sensor category TEMPERATURE SENSORS	_	1175	40		
				1707	30		
Opens sensor's		Sensor group NTC M12	_	2500	20		
datasheet		NIC MIZ		3792	10		
uulusneel		Open datasheet		5896	0		
							-
		< Bac	sk N	ext >	Finish	Cancel	

- Click 'Finish' when done. The "Create channel" window opens.
- 6. Enter the channel name and description.

Create Channel	
Set the unique name for the ch	annel and add an optional description.
Name:	
t_rad_out	
jt_rad_out	
Description:	
Outlet temperature of radiator	
	Ok Cancel

7. Click 'Ok' when done.

The channel is inserted into the VCU MS 50.4P Project Tree.



Available measurements for channel:

Measurement label	Function
raw_name	mV value of sensor
raw_name_fi	Filtered mV value of sensor
name	Physical value of sensor
name_ <b>fi</b>	Filtered physical value

### 12.2.2 Configuring a generic linear sensor

#### Example: Acceleration sensor 5 g

- From sensor data sheet - operating characteristics:

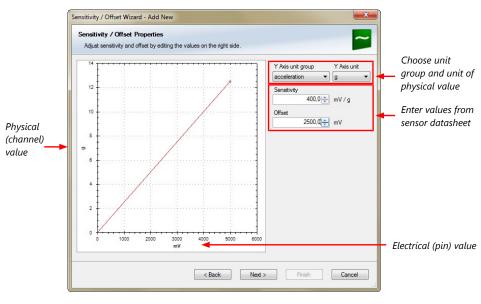
Dutput Signal	1.		2/2-C	2000	
Zero g (T <sub>A</sub> = 25°C, V <sub>DD</sub> = 5.0 V) <sup>(4)</sup>	VOFF	2.25	2.5	2.75	V
Zero g (V <sub>DD</sub> = 5.0 V)	VOFF	2.0	2.5	3.0	V
Sensitivity (T <sub>A</sub> = 25°C, V <sub>DD</sub> = 5.0 V) <sup>(5)</sup>	S	380	400	420	mV/g
Sensitivity (V <sub>DD</sub> = 5.0 V)	S	370	400	430.1	mV/g
Bandwidth Response	f_3dB	42.5	50	57.5	Hz
Nonlinearity	NLOUT	-1.0	-	+1.0	% FSO

- Sensitivity 400 mV/g, Offset 2,500 mV
- The sensor has a linear output signal with sensitivity and offset
- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. To expand the list of 'I/O Channels', click on '+' in the VCU MS 50.4P Project Tree.
- Drag the "Sensitivity/Offset" analog signal source from the Toolbox and drop it on the desired analog input channel in the VCU MS 50.4P Project Tree. A "Sensitivity/Offset Wizard" opens.
- 4. To activate the internal pullup-resistor, check the box. The internal pullup-resistor is used to get a 5 V signal at the analog channel of the VCU MS 50.4P. It allows you to use a push-button. The fixed value of the internal pullup-resistor is 3,010 Ohm. If using an additional external pullup-resistor, set up the overall resistance.

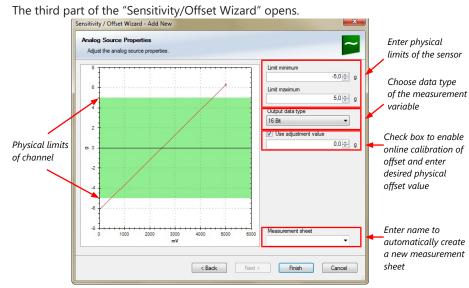
Pin Properties Configure the anal		-
Configure the anal	og pin properties.	
Pullup value:	3,01 kOhm	
	Pin Diagnosis & monitoring limits	
	Enabled Minimum: -5000 ∲ mV	
	Maximum: 5000 💭 mV	

5. Click 'Next' when done.

The second part of the "Sensitivity/Offset Wizard" opens.

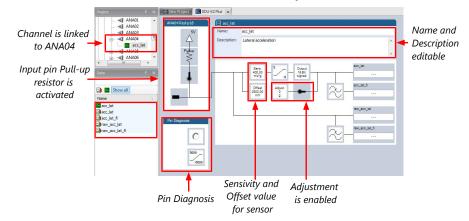


Click 'Next' when done. 6.



- 7. Click 'Finish' when done.
- Enter a channel name and a description. 8.
- Click 'OK' when done. 9.

The channel is inserted into the VCU MS 50.4P Project Tree.



Available measurements for channel:

Measurement label	Function
raw_name	mV value of sensor
raw_name_fi	filtered mV value of sensor
name	physical value of sensor
name_ <b>fi</b>	filtered physical value

Note

Working with automatically created measurement sheets is explained in chapter 'Setting up an online measurement [> 80]'.

### 12.2.3 Configuring a generic nonlinear sensor

#### Example: Thermistor 5 kOhm

- From sensor data sheet - resistance values over temperature:

PART NR.: 2381 640 502 HTCLE100E3502

Toper	RT	
[°C]	[Ω]	
-40	166 047	
-35	119 950	
-30	87 600	
-25	64 643	
-20	48 179	
-15	36 250	
-10	27 523	
-5	21 078	

Toper	RT
[°C]	[Ω]
0	16 277
5	12 669
10	9 936
15	7 849
20	8 244
25	5 000
30	4 030
35	3 267

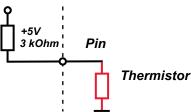
Toper	RT
[°C]	[Ω]
40	2 685
45	2 166
50	1 903
55	1 494
60	1 245
65	1 024
70	876
75	740

Toper	RT
[°C]	[Ω]
80	628
85	535
90	457
95	399
100	338
105	292
110	251
115	221

- The sensor has a nonlinear behavior

- Use characteristic curve for linearization

Input voltage is the ratio between pull-up resistor and thermistor \_



- 1. Click 'Measurement Sources' in the Toolbox.
- 2. To expand the list of 'I/O Channels', click on '+' in the VCU MS 50.4P Project Tree.
- 3. Drag the "Characteristic Curve" analogue signal source from the Toolbox and drop it on the desired analogue input channel in the VCU MS 50.4P Project Tree.

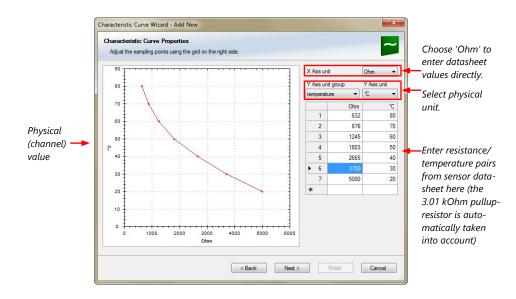
	System DDU7.rlp - RaceCon V2.5.0.2002	- r X
C		
		C      C    C
к <u>п</u> э		
21     <	Type Time Sender Message	

- 4. A "Characteristic Curve Wizard" opens.
- 5. To activate the internal pull up-resistor, check the box. The VCU MS 50.4P pull up-resistor is used to get a 5 V signal at the analogue channel of the VCU MS 50.4P. It allows you, to use a push-button. The fixed value of the internal pull up-resistor is 3,010 Ohm. If using an additional external pull up-resistor, set up the overall resistance.

Characteristic Curve W	/izard - Add New
Pin Properties Configure the analog	g pin properties.
Pullup value:	3.01 kOhm 🔹
	Pin Diagnosis & monitoring limits
	Enabled Minimum: -5000 mV
	Maximum: 5000 mV
	< Back Next > Finish Cancel
	4

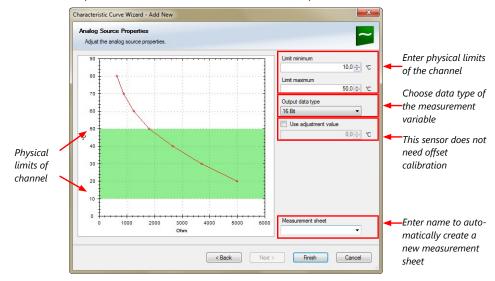
6. Click 'Next' when done.

The second part of the "Sensitivity/Offset Wizard" opens.



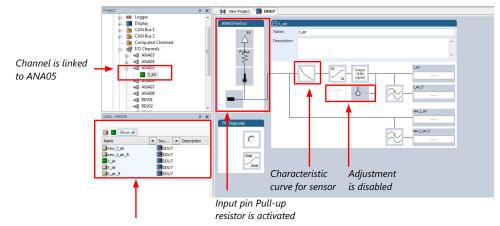
7. Click 'Next' when done.

The third part of the "Characteristic Curve Wizard" opens.



- 8. Click 'Finish' when done.
- 9. Enter channel name and description.
- 10. Click 'OK' when done.

The channel is inserted into the VCU MS 50.4P Project Tree.



Available measurements for channel:

Measurement label	Function
raw_name	mV value of sensor
raw_name_fi	filtered mV value of sensor
name	physical value of sensor
name_ <b>fi</b>	filtered physical value

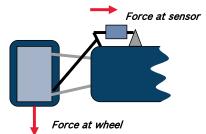
Note

Working with automatically created measurement sheets is explained in chapter 'Setting up an online measurement [▶ 80]'.

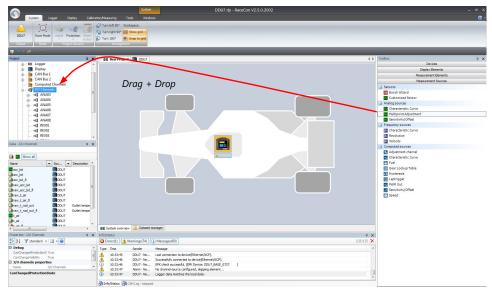
### 12.2.4 Configuring a multipoint adjustment

### Example: Measurement of wheel force

- Physical property 'wheel force' not directly measurable
- Load transfer through suspension kinematics
- Physical value at sensor position defined by vehicle
- Curve definition by online adjustment at vehicle



- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. Expand the list of 'I/O Channels' by clicking on '+' in the VCU MS 50.4P Project Tree.
- 3. Drag the 'Multipoint Adjustment' analog signal source from the Toolbox and drop it on the desired analog input channel in VCU MS 50.4P Project Tree.



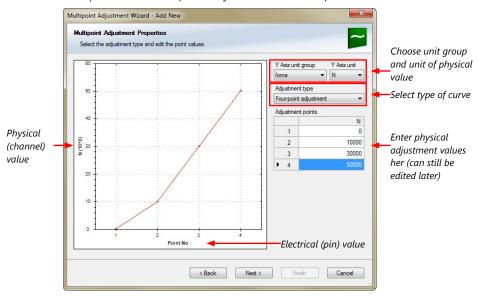
4. A 'Multipoint Adjustment Wizard' opens.

5. To activate the internal pullup-resistor, check the box. The internal pullup-resistor is used to get a 5 V signal at the analog channel of the VCU MS 50.4P. It allows you to use a push-button. The fixed value of the internal pullup-resistor is 3.01 kOhm. If using an additional external pullup-resistor, set up the overall resistance.

	ent Wizard - Add New
Pin Properties Configure the anal	log pin properties.
Pullup value:	3,01 kOhm -
	Pin Diagnosis & monitoring limits
	Enabled Minimum: -5000 - mV
	Maximum: 5000 🚖 mV

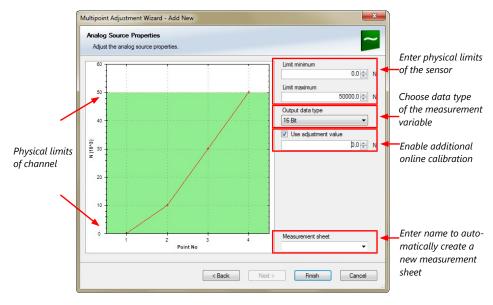
6. Click 'Next' when done.

The second part of the 'Multipoint Adjustment Wizard' opens.



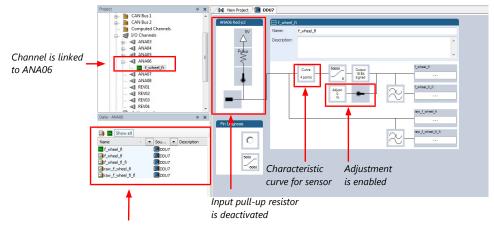
7. Click 'Next' when done.

The third part of the 'Multipoint Adjustment Wizard' opens.



- 8. Click 'Finish' when done.
- 9. Enter channel name and description.
- 10. Click 'OK' when done.

The channel is inserted into the VCU MS 50.4P Project Tree.



Available measurements for channel:

Measurement label	Function
raw_name	mV value of sensor
raw_name_fi	filtered mV value of sensor
name	physical value of sensor
name_ <b>fi</b>	filtered physical value

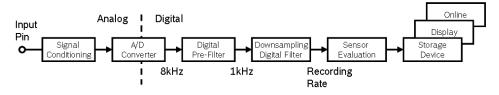
Online definition of the curve is covered in chapter 'Online calibration of measurement channels [> 85]'.

Note

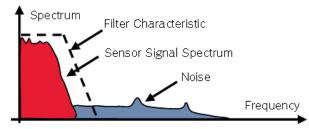
Working with automatically created measurement sheets is explained in chapter 'Setting up an online measurement  $[\triangleright 80]$ '.

### 12.2.5 Digital filter details

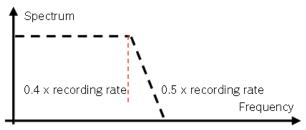
VCU MS 50.4P uses A/D converter oversampling and digital filtering to recording rate.



#### Digital filters eliminate 'out-of-band' noise



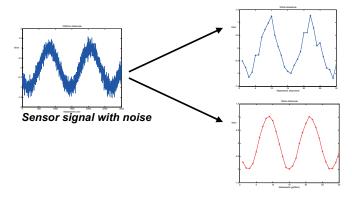
### Cut-off frequency automatically adjusted to recording rate



#### Example:

- 100 Hz recording rate (10 ms)
- <40 Hz pass band (>99 %)
- >50 Hz stop band (<1 %)</p>

#### Linear phase - no signal distortion



Recorded signal 100Hz (unfiltered)

Recorded signal 100Hz (filtered)

Latency compensation - no filter delay in recorded data

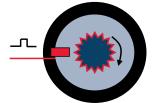
- Filtering is (smart) averaging over several samples
- Filtered signal is delayed with respect to real time signal

- VCU MS 50.4P filters have constant, frequency independent delay
- Delay (e.g. 22 samples at 10 ms) is corrected during recording
- No delay filtered vs. unfiltered in recorded data
- Correction is (of course) not possible for real time data (display, online, PWM out)
- Use filtered data for recording, use unfiltered data for real time

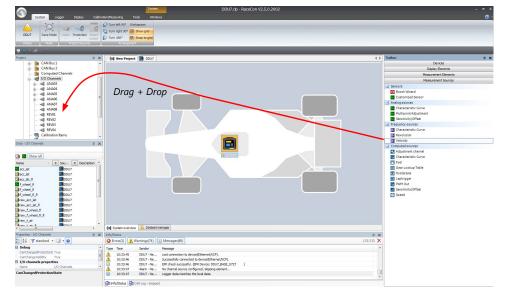
### 12.2.6 Configuring a frequency input

#### Example: measurement of wheel speed

- Pulse wheel attached to wheel
- Each passing tooth of pulse wheel triggers hall sensor
- Calculation of wheel speed with wheel circumference



- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. To expand the list of 'I/O Channels', click on the '+' in the VCU MS 50.4P Project Tree.
- 3. Drag the 'Velocity' digital signal source from the Toolbox and drop it on the desired 'REV' input channel in the VCU MS 50.4P Project Tree.



- 4. The 'Velocity Wizard' opens.
- 5. Select the sensor type. The VCU MS 50.4P works with Hall effect and DF11 sensors.

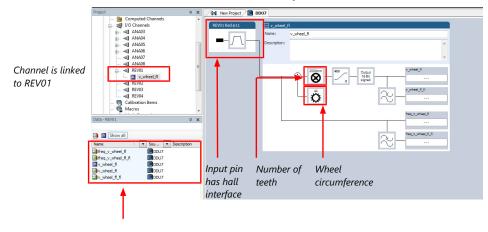
Pin Properties Configure the free	uency pin properties.				
Sensor type:	Halleffect				
		< Back	Next >	Finish	Cancel

- 6. Click 'Next'.
- 7. Define the settings for the sensor.

ocity Wizard - Add Ne	ew 📃 🚬	
elocity Properties Configure a frequency i	input to measure a linear velocity.	
Number of increments:	44 💌	Number of teeth on the pulse wheel
Wheel circumference:	2000 📩 mm	Circumference of wheel for speed calculation
Output data type:	[16 Bt 🔹	Choose data type of the measurement variable
Limit minimum:	□km/h	
Limit maximum:	400 👘 km/h	
Measurement sheet:		Enter name to automatically create a new measurement sheet
	< Back Next > Finish Cancel	

- 8. Click 'Finish' when done.
- 9. Enter the channel name and description.
- 10. Click 'OK' when done.

The channel is inserted into the VCU MS 50.4P Project Tree.



Available measurements for channel:

Measurement label	Function
raw_name	mV value of sensor
raw_name_fi	filtered mV value of sensor
name	physical value of sensor
name_ <b>fi</b>	filtered physical value

Note

Measurement of 'Revolution' is similar.

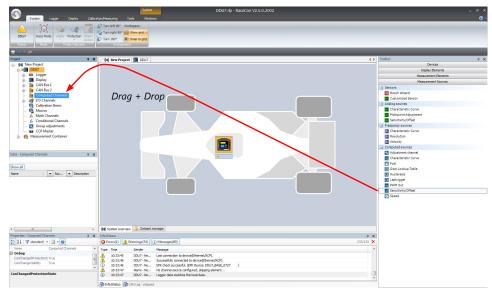
# 12.3 Configuring computed sources

Computed sources receive data from a measurement channel rather than an input pin.

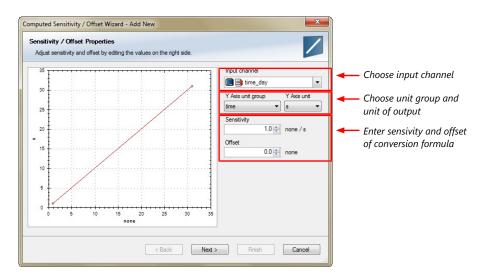
- Sensitivity/Offset calculation on input channel
- Characteristic curve calculation on input channel
- Computed vehicle speed
- Lap trigger (covered in a special separate section)

#### Example: Sensitivity/offset calculation on input channel

- 1. Click 'Measurement Sources' in the Toolbox.
- 2. Drag the 'Sensitivity/Offset' computed source from the Toolbox and drop it on 'Computed Channels' in the VCU MS 50.4P Project Tree.

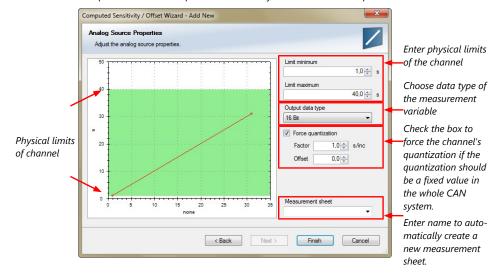


3. A 'Computed Sensitivity/Offset Wizard' opens.



4. Click 'Next' when done.

The second part of the 'Computed Sensitivity/Offset Wizard' opens.



- 5. Click 'Finish' when done.
- 6. Enter channel name and description.
- 7. Click 'OK' when done.

The channel is inserted into the VCU MS 50.4P Project Tree.

Note

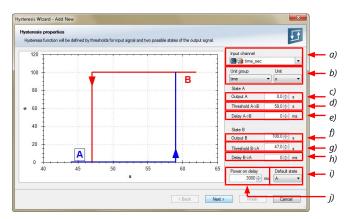
Working with automatically created measurement sheets is explained in chapter 'Setting up an online measurement [ $\triangleright$  80]'.

## 12.4 Hysteresis

The hysteresis function avoids the high-frequent switchover of the measurement channel value. The hysteresis can be adjusted for each input measurement channel individually and can be used for further processing.

- 1. Click 'Measurement Sources' in the Toolbox.
- 2. Drag the 'Hysteresis' computed source from the Toolbox and drop it on 'Computed Channels' in the VCU MS 50.4P Project Tree.

A 'Hysteresis Wizard' opens.



a) Choose input measurement channel.

b) Choose unit group and unit of output.

c) Enter output value of state A in the unit selected in b).

d) Enter threshold value when state changes from A to B.

e) Enter delay time when state changes from A to B.

f) Enter output value of state B in the unit selected in b).

g) Enter threshold value when state changes from B to A.

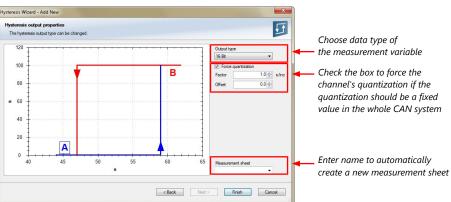
h) Enter delay time when state changes from B to A.

i) Enter time when the hysteresis function is activated after vehicle's startup.

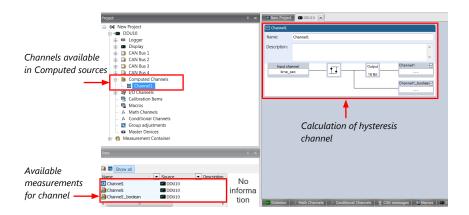
j) Enter the channel's state (A or B) at startup.

3. Click 'Next' when done.

The second part of the 'Hysteresis Wizard' opens.



- 4. Click 'Finish' when done.
- 5. Enter channel name and description.
- Click 'OK' when done. The channel is inserted into the VCU MS 50.4P Project Tree.



## 12.4.1 Special functionality: Vehicle speed

This functionality allows:

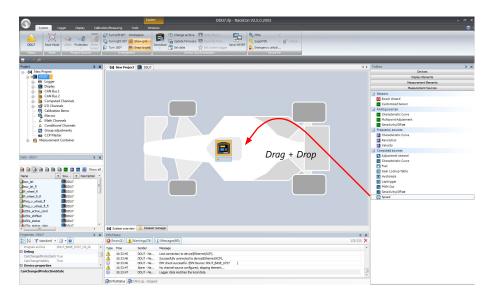
- high performance vehicle owners to measure wheel spin under acceleration and wheel slip/lock under braking.
- calculating vehicle 'speed over ground'.

#### Vehicle speed calculation function

- Calculating vehicle speed of 2 wheel drive: (Wheel speeds of non-driven axle as input)
  - Calculated speed is average of both speeds if speed difference between wheels <
    limit.</li>
  - Calculated speed is maximum of both speeds if speed difference between wheels
     > limit.
- Calculating vehicle speed of 4 wheel drive: (Wheel speeds of all wheels as input)
  - Calculated speed is speed of 2nd fastest wheel.

## 12.4.2 Setting up calculated speed

- 1. Click on tab 'System Overview'.
- 2. Click on 'Measurement Sources' in the Toolbox.
- 3. Drag the 'Speed' computed source from the Toolbox and drop it on the project name in the VCU MS 50.4P Project Tree. Do not drop it on 'VCU MS 50.4P'!



#### A 'Calculated Speed Wizard' opens.

Calculated Speed Wizard	- Add New	
Calculated Speed Con Select speed inputs for	nfiguration Calculating a reference speed.	
Configure on device	■ DDU7	Choose device
Input source:	Wheel speeds	Choose input source (internal/external)
Drive shaft switch:	Rear wheel drive	Choose driven axle
Speed input front left:	v_wheel_fl	
Speed input front right:	v_wheel_fl	Choose individual wheel
Speed input rear left:	v_wheel_fi 👻	speed channels
Speed input rear right:	v_wheel_fi	
Speed difference:	5 <b>*</b> X	Set limit for speed
		difference for calculation
	< Back Next > Finish Cancel	

4. Click 'Finish' when done.

The speed calculation is inserted into the VCU MS 50.4P Project Tree.

		System	DDU7.rlp - RaceCon V2.5.0.2002			- * ×
	System Logger Deplay Callers	ton/Measuring Tools Windows				
	DDU7 Race Mode Visible Protection Sheet locked					
Croad calculation	Status Hode Project Security					
Speed calculation		_		_		
DDU Dustast	Project 0 X	dal New Project 🔲 DOU7 🖸 Speed		4.1-1	Coobox	8 X
in DDU Proje <u>ct</u>					Devices Display Elements	
_					Measurement Dements	
Tree	B- C Logger				Measurement Sources	
	B- Display B- CAN Bas 1			<b>(</b> )	<ul> <li>Sersors</li> </ul>	
	B- 🛅 C4N Bas 2	Speed configuration			Bosch Waard     Customized Sensor	
	<ul> <li>B Computed Channels</li> <li>B 40 Channels</li> </ul>	Canfigure an device	<b>D</b> 5017		- Analog sparces	
	- B Calibration Items	Cangue in device	<b>1</b> cou/		Characteristic Curve	
	- 🖷 Macros	Input source	lifeed speed		Multipoint Adjustment	
Measurement		Drive shaft suitch			Sensitivity/Offset	
	<ul> <li>Group adjustments</li> </ul>	Drive shart switch	Rear wheel drive	•	Characteristic Curve	
channels	CCP Master	Speed input front left	🕞 🔁 v_wheel_fl		Revolution	
chunnets	in- 👸 Measurement Container				Velocity     Computed sources	
coloulated enced	Cata - Speed P x	Speed input front right	District 🗑		Adjustment chemel	
calculated speed	Uata i opece y X	Speed input rear left.	🗃 🔁 v_wheel_ft		Characteristic Curve	
	la work 😰				Tool	
and calculated		Speed input rear right	t (and a constant)		Geor Lookup Table     Hysteresis	
	Speed_dat_ds	Speed difference		50 %	M Laphiger	
distance 🔶	Differed vfro de COU7 vehicle speed				PWM Out	
austance					Sensitivity/Offset	
					5 Speed	
		Т				
<b>a a b</b>						
Configuration	× •	Configuration			-	
		Info Status		3.3	c	
window	20 21 🐨 standard - 🔝 - 😥	Servers(1) A Warnings(74) D Messages(64)		135/135 >		
manaon	None Speed *	Type Time Sender Message				
	CanChangedProtectors True	10:33:45 DDU7 - Ne Last connection to	device(Dhemet/NCP).			
	CanChanger/sbility True		3ed ta device@thernet/NCP). (J. (BYK Device: DDU7_BASE_6727 )			
	*	Alarm - Ne No channel source	configured, skipping denent			
	CanChangedProtectionState	10:33:47 DDU7-Ne Logger data match	es the local data.			

# 13 Power Stages

#### Power stage details

The VCU MS 50.4P uses integrated power stages with built-in diagnosis. For the high side switches, overload-behaviour (mode "bulb" or "DC motor", restarts etc.) is determined inside the IC itself.

A measurement shunt is used for current measurement. The low side switches come with a switchable, discrete free wheeling diode. Current measurement is done inside the IC; one common value for two switching channels is available.

#### Diagnostics

Low side:

- shortcut to GND in switched off state
- overcurrent
- shortcut to U\_batt
- open load
- overtemperature (power stage)

#### High side:

- shortcut to GND
- overcurrent/ overtemperature
- shortcut to U\_batt in switched off state
- open load
- current measurement and plausibilisation in CCA

#### Suggestion for the implementation of a current control

There is no analogue circuitry for a current control. However, the current measurement values can be used for the calculation of an appropriate pwm dutycycle in the Customer Code Area (CCA).

Current measurement is executed at a 1 kHz frequency, the reconfiguration of the pwm dutycycle in the blue SIMULINK blocks can be done in different frequencies including a 1 ms raster.

For a current control using the low side switches, an additional external current sensor needs to be read. The current measurement is not sufficiently accurate and is only available for 4 of the 8 channels. (The free wheeling diode needs to be activated.)



#### 

#### Danger of Fire!

Due to the possible callable power at the outputs O\_HSOUT1-4 (pins B25, B26, B51, B58, A08, A09, A04, A05), an electrically caused fire at the load cannot be excluded.

The installed loads must therefore meet the common requirements such as class PS3 according to EN62368-1 chapter 6.

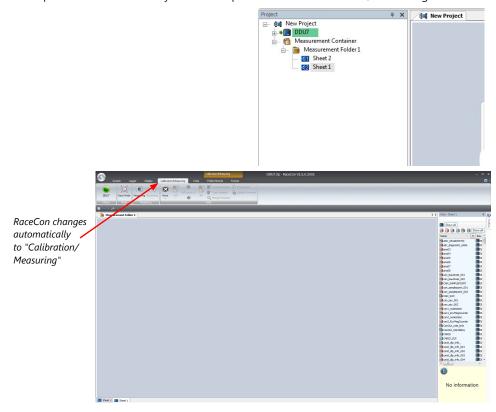
# 14 Online Measurement and Calibration

- 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

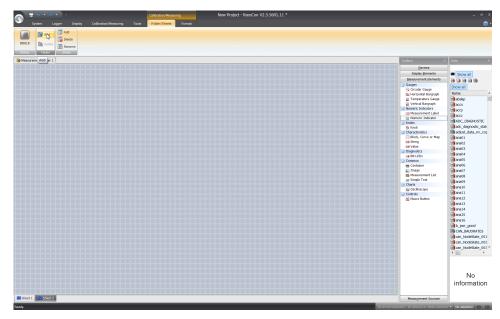
# 14.1 Setting up an online measurement

VCU MS 50.4P 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.

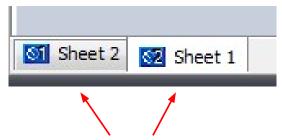


- 2. Click on the 'Folder/Sheets' tab, which appears when you are in the 'Calibration/ Measurement' window, to create a new measurement folder.
- 3. Click on the 'Add' button for folders in the upper left corner.



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

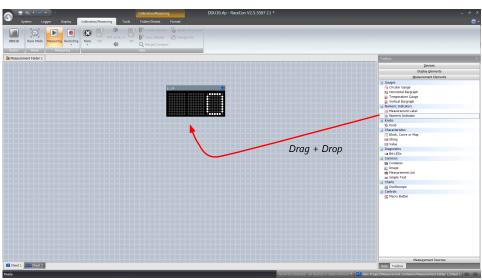
4. To change between different sheets, click on the tabs on the bottom of the 'Calibration/Measuring' window.



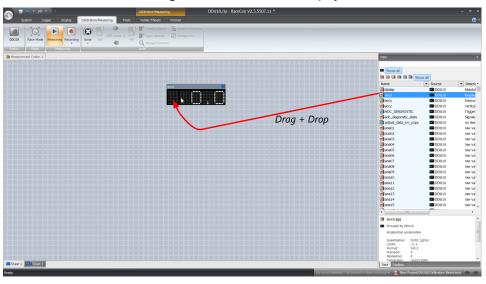
Tabs to switch between sheets

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 VCU MS 50.4P shows the green status, the value is displayed.

RaceCon offers different types of measurement elements:

60

50

40

30

20

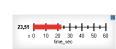
10

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23,51







Circular gauge

Temperature gauge

Vertical Bar graph style

60

50

40

30

20

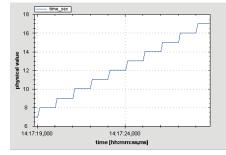
10

Horizontal Bar graph style





Numeric indicator

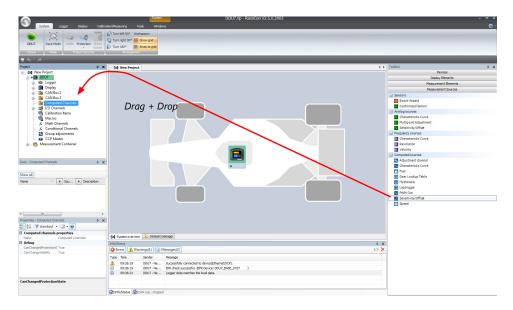


Oscilloscope (Chart)

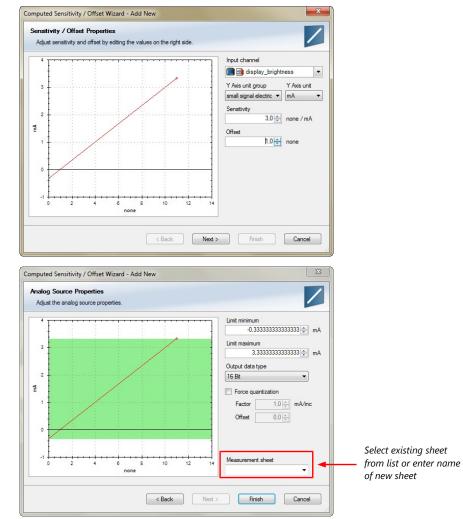
## 14.1.1 Automatic creation of measurement sheets

RaceCon can create measurement sheets automatically.

You can create and use measurement sheets with the VCU MS 50.4P as well as with all other devices connected to RaceCon.



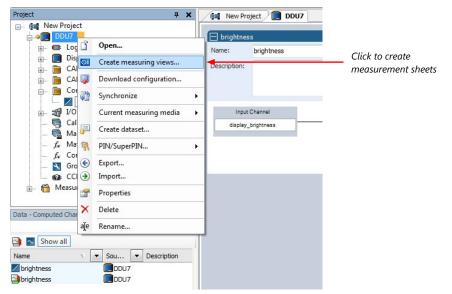
1. During the configuration of a measurement channel, select a measurement sheet from the list box or enter a name for a new measurement sheet.



Bosch Motorsport

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

2. To create the sheets, right-click on VCU MS 50.4P and select 'Create measurement views...' from the VCU MS 50.4P context menu.



The automatically created sheet is inserted in the Project Tree under 'Measurement Container' and 'Device Channels'. If the VCU MS 50.4P is connected to RaceCon and the status is green, live values of the channels are shown.

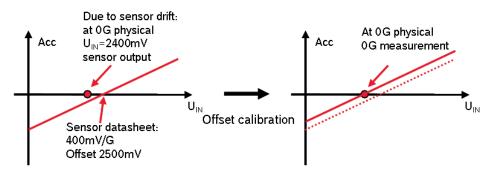
### 14.1.2 Using the measurement sheets

- 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'.

phys	<b>0,0000</b> G	SENSITI	400,000		Zuoponi callesius
raw	2490,0 mV	OFFSET	2500,000	mV	
		MIN	-5,000	G	-
		MAX	5,000	G	
		ADJ_VAL	0,000		

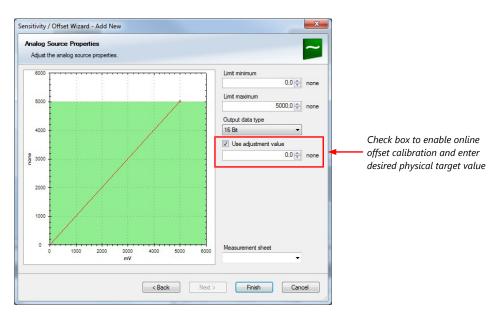
# 14.2 Online calibration of measurement channels

- Analog sensors drift with age, temperature, etc.
- Manual calibration is necessary
- Solution: online offset calibration
- Example: acceleration sensor

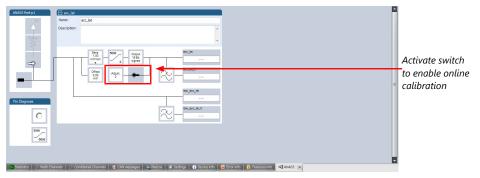


# 14.2.1 Enable online offset calibration for measurement channel

During creation of the measurement channel



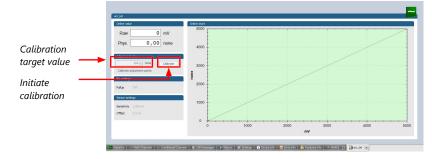




## 14.2.2 Performing the online offset calibration

VCU MS 50.4P has to be connected to RaceCon to calibrate the sensor's offset.

- 1. Apply the desired physical condition to the sensor (e.g. 1 G to an acceleration sensor).
- 2. Open the measurement channel's online page by double-clicking on the measurement channel name in the Data Area.
- 3. Enter the physical target value (e.g. 1 G) and press the 'Calibrate' button.

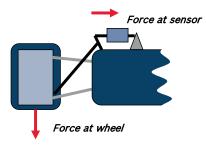


The sensor's offset is now calibrated.

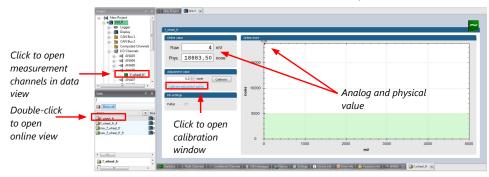
# 14.3 Online calibration of multipoint adjustment channels

#### Example: measurement of wheel force

- Physical property 'wheel force' not directly measureable
- Load transfer through suspension kinematics
- Physical value at sensor position defined by vehicle
- Curve definition by online adjustment at vehicle



- Create a multipoint adjustment measurement channel. To create a multipoint channel, see chapter 'Configuring a multipoint adjustment [> 68]'.
- Download the configuration on the VCU MS 50.4P. To connect the VCU MS 50.4P to RaceCon, see chapter 'Setting up a new RaceCon Project [▶ 21]'.
- 3. Click on the desired channel in the VCU MS 50.4P Project Tree.
- 4. Double-click on a measurement channel in the Data Area to open the online view.



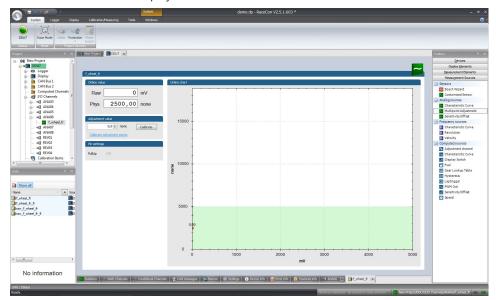
5. Click on 'Calibrate adjustment points' to open calibration window.

Point	Value	Unit	Calibration
1	1000,00	none	Calibrate
2	3000,00	none	Calibrate
3	4000,00	none	Calibrate
4	5000,00	none	Calibrate

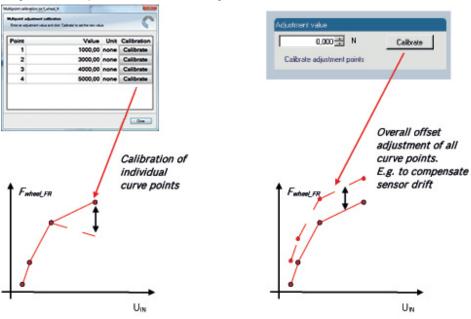
- 6. Apply the desired physical condition to the sensor (e.g. by applying a force on the wheel).
- 7. Enter the physical value in the value column of the desired calibration point (e.g. 745 N).

- 8. Press the 'Calibrate' button of the desired calibration point.
- 9. Repeat for all curve points.
- 10. Click 'Close' when done.

The calibration curve is displayed in the online view.



### Adjustment points vs. offset adjustment

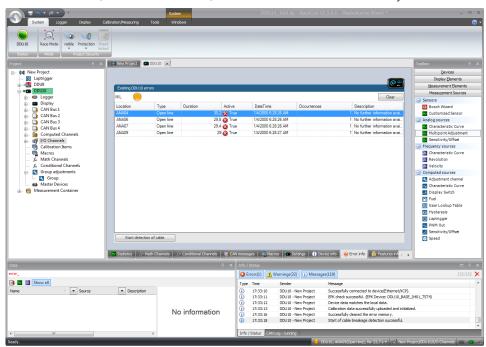


# 15 Error Memory

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.

# 15.1 Error memory representation in RaceCon

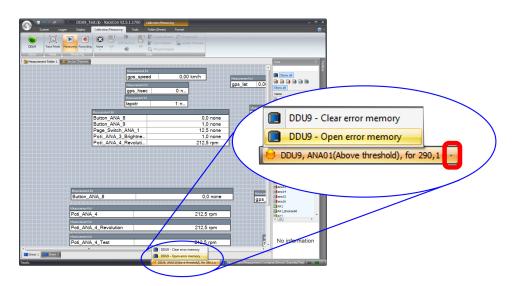
Bosch Motorsport devices feature an error memory. Information on errors can be visualized via RaceCon (online measurement) or can be transmitted via telemetry.



## 15.1.1 Accessing the memory

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

System Looper Depley O Double DDU30 Sonita Mede Node Next Factor Sha	ed		en dons		DDU10_	Test.rip - RaceCon	V2.5.5.0 - Masterlicense	Bosch *		- = ×
	In New Project	00U10 💌							Toobox	
for New Project     Solution     Solution     Solution	Existing DOU 30 e	rrora							Display (jements Measurement Bene Measurement Source	ents
ig- 🚥 Logger	ML 😑							Clear	Sensors	
- Display	Location	Type	Duration	Active	DateTime	Occurrence	as Descripti	on	Bosch Wizard	
CAN Bus 1     CAN Bus 2	ANA04	Open line		2 🙆 True	1/4/2000 6:28	IG AM	1 No farthe	r information avai	Customized Sensor	e
CAN Bus 3	ANA06	Open line		8 🙆 True	1/4/2000 6:28			r information avai.	<ul> <li>Analog sources</li> </ul>	
E CAN Bus 4	ANA07	Open line		4 🙆 True	1/4/2000 6:28			r information avai.	Characteristic Curv	/e
Computed Channels	ANA09	Open line	-	19 🙆 True	1/4/2000 6.28	7 AM	1 No furthe	r information avai	Multipoint Adjustm	rent
- 2 VO Channels									Sensitivity/Offset	
- 🧠 Calibration Items									<ul> <li>Frequency sources</li> </ul>	
- 🦏 Macros									Characteristic Curv	xe.
fr. Math Channels									Revolution	
f <sub>e</sub> Conditional Channels									Velocity	
<ul> <li>Group adjustments</li> <li>Group</li> </ul>									Computed sources	
Master Devices									Adjustment channe	
Measurement Container									Characteristic Curv	NO.
B- C Messelenen contante									Display Switch	
									Fuel	
									🔛 Gear Lookup Table	
									Hysteresis	
									C Laptrigger	
									PWM Out	
									Sensitivity/Offset	
	Start detecti	on of cable							Speed	
							$\frown$			
	Statistics (in )	feth Chernels	5 Conditional Channels	CAN	ressages 🛛 👼 Macro	Settings 🚺	Device int 🥢 😥 Error info	👸 Features infe 🧹		
Deta	, .			• ×	info / Status		$\sim$			= • ×
error_					C Errors(1)	mings(32) 🕕 Mess	ages(119)			52/152 🗙
🔁 🔤 🖪 Show all					Type Time	Sender	Message			
Name / - Source	· Description				(i) 17:33:10	DDU10 - New Project	Successfully connected to	device themet/VDP		
					(i) 17:33:11	DDU 10 - New Project	EPK check successful. (EF			
				- 1	(i) 17:33:12	DDU 10 - New Project	Device data matches the	local data.		
		N	o information		(i) 17:33:13	DDU 10 - New Project	Celbration data successf		ized.	
		IN	o mormation		17:33:16	DDU10 - New Project	Successfully cleared the			_
					(i) 17:33:18	DDU10 - New Project	Start of cable breakage of	letection successful.		
				- k	Info / Status GAN IG			_		
* III III					anto / Status CANLO	g-running				



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

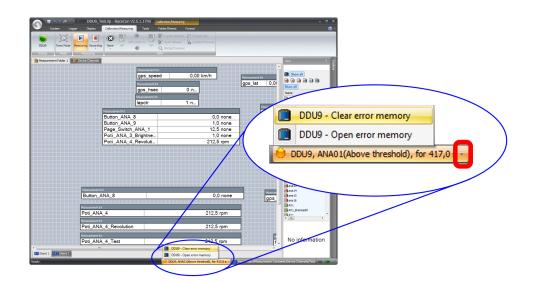
- the user actively clears the error memory
- the user updates the firmware

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

## 15.1.2 Clearing the error memory

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

DDU20 Race Mode visible Protection She visible Protection She visible Protection She								
ect 0 X	New Project	00010						Toobox 0
and New Project								Qevices
Laptrigger							-	Display Denents
	-						· · · · · · · · · · · · · · · · · · ·	Measurement Elements
. • m DDU10	Existing DDU10 er	rrora					$\sim$	Measurement Sources
🚋 📾 Logger	MIL 😑						Clear	- Sensors
😑 🧰 Display	Location	Type	Duration Act	i.e	DateTime	Occurrences	Description	Bosch Wgard
🔬 🛄 CAN Bus 1	ANACH	Open line	30.2		14/2000 6:28:26 AM		1 No futher information avai-	Customized Sensor
B- CAN Bus 2	ANAD6	Open line	29,8 🙀		1/4/2000 6 28 26 AM		1 No further information avai-	- Analog sources
CAN Bus 3     CAN Bus 4	ANA07	Open line	29.4 🙀		14/2000 6 28 26 AM		1 No further information avail.	Characteristic Curve
CAN Bus 4     Computed Channels	ANA09	Open line	29 🙀		1/4/2000 6/28/27 AM		1 No further information avai.	Multipoint Adjustment
E all I/O Channels			-					Sensitivity/Offset
Calibration Items								Frequency sources
- 🖏 Macros								Characteristic Curve
- fr Math Channels								Revolution
<ul> <li>f_c Conditional Channels</li> </ul>								Velocity
Group adjustments								<ul> <li>Computed sources</li> </ul>
Group								Adjustment channel
Master Devices     Measurement Container								Characteristic Curve
Measurement Container								Display Switch
E. C. manual designed								
g. G.								Fuel
								Gear Lookup Table
E. C. Harrison de la contra								Gear Lookup Table
								Gear Lookup Table Hysteresis Laptrigger
E. G. management								Gear Lookup Table Hysteresis Laptrigger PNM Out
2 - C								Gear Lookup Table     Hysteresis     Laptrigger     PWM Out     Sensitivity/Offset
in and a second second	Start detection	on of cable						Gear Lookup Table Hysteresis Laptrigger PNM Out
								Gear Lookup Table     Hysteresis     Laptrigger     PWH Que     Gessitivity/Offset     Speed
			(- Conditional Durmets 💈	CAN message	Macros 🚥 S	ettings 0 Device info	🥹 Emor Info 📻 Features of c	Gear Lookup Table     Hysteresis     Laptrigger     PWH Que     Gessitivity/Offset     Speed
			🔆 Conditional Ossanets 🔒			ettings 🚺 Device info	😢 Error Info 🛱 Features ref 🛛	Gear Lookup Table Hysteresis Lookup Table Hysteresis Couptinger PavM Out Sesitivity/Offset Speed
				× Info/Sti	tus -	ettings Device info	e Ensrindo 🛱 Restarces and -	Gear Lookup Table     Hystersis     Lookup Table     Hystersis     Cuprigner     PMM Out     Sessitivity/Offset     Speed
				× Info/Sti	her rs(1) 🚺 🔥 Warnings(3			Gear Lookup Table     Hystersis     Lookup Table     Hystersis     Cuprigner     PMM Out     Sessitivity/Offset     Speed
a Stor II		4ath Channels		X Info/Sta	tus rs(1) A Warnings(3 ime Sender 7:33:10 DDU 30 -	2) () Messages(119) Messa	on shilly connected to device(Ethernet/NCP)	Gertickup Table Hysterss Gupting Fund Out Speed
2 (Store B)	Statistics //- N	4ath Channels		X Info / Sta C Error Type 1 () 1 () 1	tus rs[1] Marnings[3 ine Sender 7:37:10 DDU10 7:37:11 DDU10	2) () Messages(119) Messa New Project Succes New Project DPK ch	pe ufully connected to device([themet/\CP] eck successful. (EPK Device: DOU 10_BAS	Gertickup Table Hysterss Gupting Fund Out Speed
Store H	Statistics //- N	4ath Channels		X Info/Str Type 1 () 1 () 1	tue rs(1) Warnings(3 ine Sender 7:33:10 DDU10 7:33:11 DDU10 7:33:12 DDU10	2) () Messages(119) Messa New Project BPK ch New Project BPK ch New Project Device	pr sfully connected to device("thermet/XCP" eck successful. (tPK Device: DDU10_INC data matches the local data.	Gericologi Table Gericologi Table Historica E part Carl Second Second 132/152 A A B Carl Composition Compositio
2 (Store B)	Statistics //- N	4ath Channels	¢ .	× tofo/St Contraction Type 1 () () ()	tre rs(1) Warnings(3 ime Sender 7:33:10 DDU10 7:33:11 DDU10 7:33:12 DDU10 7:33:13 DDU10	2) () Messages(119) Messa New Project Succer New Project DPK ch New Project Califor New Project Califor	pr mfully connected to device((thermet)/UDP) exit successful. (TPK Device: DDU 30_BAG data matches the local data. tion data successful, ycelanded and intta	Gari Lohuo Taba Hystores Hystores Park Gar Seed Seed 133/752 Seed
2 (Store B)	Statistics //- N	4ath Channels		× trés/Stu	hu: s(1) ▲ Warnings(3 ime Sender 7:33:10 DDU 30 7:33:11 DDU 30 7:33:12 DDU 30 7:33:13 DDU 30 7:33:10 DDU 30 7:33:10 DDU 30	2) () Messages(119) Messa New Project Succer New Project Divice New Project Calibra New Project Succer	pr ståly connected to device/[themet/http:/ eck.successful. (EPK Device: DCU 10, BAS data matches for local data. toto data successfully uploaded and inte ståly clavad for are ror nemory.	Gari Lohuo Taba Hystores Hystores Park Gar Seed Seed 133/752 Seed
2 (Store B)	Statistics //- N	4ath Channels	¢ .	× trés/Stu	hu: s(1) ▲ Warnings(3 ime Sender 7:33:10 DDU 30 7:33:11 DDU 30 7:33:12 DDU 30 7:33:13 DDU 30 7:33:10 DDU 30 7:33:10 DDU 30	2) () Messages(119) Messa New Project Succer New Project Divice New Project Calibra New Project Succer	pr mfully connected to device((thermet)/UDP) exit successful. (TPK Device: DDU 30_BAG data matches the local data. tion data successful, ycelanded and intta	Gari Lobup Table Grant Lobup Table Christeness Christe



# 15.2 Information on errors available from the error memory

In general, properties of the error memory and properties of an individual error need to be distinguished.

## 15.2.1 Error Memory Properties

The following property is available for the error memory itself:

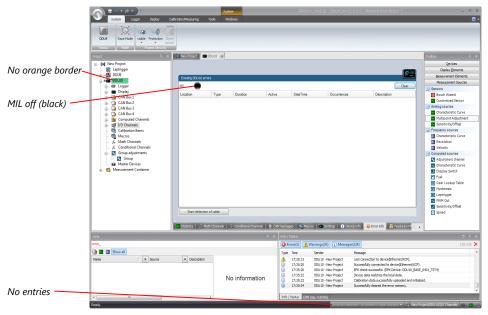
- Error Status (device measurement label "error\_state")0: no error present in memory
  - 1. at least a set is set.
  - 1: at least one inactive error present in memory, no active errors
  - 2: at least one active error present in memory

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



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):

		bration Measuring	System			DDU10_Test.ri	o - RaceCon V2.5.	5.0 - Masterlicense Bosch *	_ = X
	DU9 Satus Mode Woble Protection Short			-					
	Project 0 X	🕬 New Project 🛛 🖬	0U10 💌						Toobax 0 X
Constantly orange border		Existing DDU10 erro							Devices Display Elements Measurement Elements
	DDU10	Mi	3					Cear	Measurgement Sources
	🗊 🖬 Display	Location	Type	Duration	Active	DateTime	Occurrences	Description	<ul> <li>Sensors</li> <li>Bosch Wizard</li> </ul>
MIL constantly orange —	GAN Bus 1     GAN Bus 2	ANAD4	Open line	114,3	False	1/4/2000 6:28:26 AM		1 No further information avai	Customized Sensor
······································	👜 🛄 CAN Bus 3	ANAD6 ANAD7	Open line Open line	113,5	False False	1/4/2000 6:28:26 AM 1/4/2000 6:28:26 AM		<ol> <li>No further information avai.</li> <li>No further information avai.</li> </ol>	<ul> <li>Analog sources</li> </ul>
	CAN Bus 4     Computed Channels	ANACO	Open line	113,1		1/4/2000 6:28:27 AM		1 No further information avai.	Characteristic Curve
	B- 10 Channels								Sensitivity/Offset
	- 🦷 Calibration Items								Frequency sources
	- 🌄 Macros - 🔓 Math Channels								Characteristic Curve Revolution
	fx Conditional Channels								Velocity
	Group adjustments     Group								Computed sources
	Master Devices								Adjustment channel Characteristic Curve
	🔬 - 🎁 Measurement Container								Display Switch
									Tuel
									Gear Lookup Table
									C Laptrigger
									NVM Out
		Start detection	of cable						Sensitivity/Offset
		Statistics 🍐 Mat	h Channels   🍰	Conditional Channels	CAN mes	sages 👼 Macros 📾 S	iettings 🕕 Device I	nfo 🛛 🥹 Error Info 🛛 🔒 Features Inf	•
	Ceta				9 × Info	) / Status			
	error_				0	Errors(1) 🔥 Warnings(3	8) 🚺 Messages(12	23)	157/157 🗙
	🔁 🔤 Show all				Typ	oe Time Sender	я	lessage	*
	Name A 💌 Source	Description			()			tart of cable breakage detection successful.	
								ast connection to device(Ethernet/NCP). uccessfully connected to device(Ethernet/NCP)	
Info cycling through			No	information	()	17:35:20 DDU10	New Project B	PK check successful. (EPK Device: DDU 10_BAS	
								evice data matches the local data. albration data successfully uploaded and initia	leed.
errors, present in					Ľ				•
error memory	۲				Inf	o/Status CAN Log - runni		10	
circi memory	Ready.						00010	, ANA09(Open line), for 113,15 + 🖉 New I	mjett/00010/0/0 Channels 😑 😁 💒

2	(at	least	one	active	error	present	in	memory):
_	(							

	System Logoer Display Co	albration,Measuring	System Tools Windows	_	DDU10_Test.r	ip - RaceCon V2.5.5.0 -	Masterlicense Bosch *	- = ×
	DDU9 Status Mode Status Mode Froject Security							
	Project 0 X	Ren New Project 🔳	DOU10 💌					Toobox 0 X
Blinking orange border	Gal New Project Galager G→I						(C=)	Devices Display Elements Neasurement Elements
	COULO	Existing DDU 10 erro	rs					Measurement Sources
	⊕- 📾 Logger	MI 🦰					Clear	Sersors
MIL blinking orange	B Display	Location	Type Dura	ion Active	DateTime	Occurrences	Description	Bosch Wizard
MIL blinking orange	⊕- □ CAN Bus 1     ⊕- □ CAN Bus 2	A1404	Open line	83,3 👸 True	1/4/2000 6/28/26 AM		1 No further information avai	Customized Sensor
	CAN Bus 3	AN406	Open line	82,9 👸 True	1/4/2000 6:28:26 AM		1 No further information avai	<ul> <li>Analog sources</li> </ul>
	🔬 🛄 CAN Bus 4	ANA07	Open line	82,5 👸 True	1/4/2000 6:28:26 AM		1 No further information avai	Characteristic Curve
	B- 🗎 Computed Channels	ANA09	Open line	82,1 😵 True	1/4/2000 6:28:27 AM		1 No further information avai	Multipoint Adjustment
	🛞 🛷 I/O Channels							Sensitivity/Offset
	- 🧠 Calibration Items - 💀 Macros							Characteristic Curve
	fr Math Channels							Revolution
	f_c Conditional Channels							Velocity
	😑 🌂 Group adjustments							<ul> <li>Computed sources</li> </ul>
	Group							Adjustment channel
								Characteristic Curve
								Display Switch
								Gear Lookup Table
								Hysteresis
								<ul> <li>Laptrigger</li> </ul>
								PWM Out
								Sensitivity/Offset
		Start detection	of cable					Speed
		Statistics 🌾 Mai	th Channels 🍐 Cond	tonal Channels 🛛 🤮 CAN	nessages 🔄 Nacros 🛤	Settings () Device info	😢 Error info 🔒 Features inf 🧃	×
	Data			0 X	Info / Status			= + x
	error_				😮 Errors(1) 🔥 Warnings	32) (i) Messages(119)		152/152 🗙
	📬 🏧 🖾 Show all				Type Time Sender	Messag		*
	Name / Source	Description					∾ sfully connected to device(Ethernet/XCP	<b>N</b>
							eck successful. (BPK Device: DDU 10_BAS	
Info cycling through	1						data matches the local data.	
ingo cycung infough			No inf	ormation			ton data successfully uploaded and inits ifully cleared the error memory.	slaed.
errors present in							fully cleared the error memory. Fcable breakage detection successful.	
								•
error memory	<				Enfo / Status CAN Log - runn			
	Ready.					💛 DOU10, AN	404(Open line), for 78,0 s + 🗐 New	Project/20U11\7,0 Channels 💿 💼 📩

### 15.2.2 Error Properties

The following channels are recognized and memorized inside the devices:

Data		
err		
🖷 🖷 😋 😋 🖷 🔤 🔤	л 🏬 🚥	Show all
Name / 👻	Source 🔻	Description
error_active_rotate cerror_location_rotate cerror_location_rotate cerror_state cerror_state cerror_type_rotate	DDU9 DDU9 DDU9 DDU9	error active rotation. signals if error is present or not error location rotation signals global state of error manager error type rotation

Error type (device label "error\_type\_rotate"):
 e.g. "below\_threshold" for a violation of the minimum voltage range defined in the configuration, "shortcut\_Batt" for a shortcut to battery voltage etc.

- Error locations (device label "error\_location\_rotate"):
   e.g. "ANA01" for an error concerning the first ANA channel
- Error durations

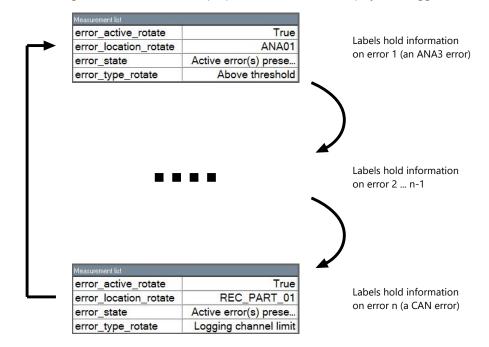
How long has the error been active? If an error encounters a non-active period before being cleared from the memory and is then detected again, the error duration keeps on accumulating. The number of active periods can be seen from the "number of oc-currences".

- Number of occurrences
   How many times has the error been detected since the last time the error memory was cleared.
- Error active state (device label "error\_active\_rotate")
   All failure modes are continuously diagnosed; any error detected will be written to the error memory. Once an error is detected, it is qualified as "active".
  - 1 (TRUE) Error was detected in most recent diagnose run (active)

 0 (FALSE) Error is inactive: error was not detected in most recent diagnostic run, however the error has not been cleared from the memory by the user and remains in the non-volatile memory

The aforementioned channels (error\_active\_rotate, error\_location\_rotate, error\_type\_rotate) are device specific properties (e.g., C 60) and are not related to the complete Race-Con project (e.g., "error no. 3 from the error memory"). Therefore, only one property label is available in each device. The errors from the error memory (possibly more than one error possible per device) share these three labels. The labels cycle through the errors currently present in the memory and represent the respective property of each error periodically.

The following screenshot shows error properties, which can be displayed or logged:



After the last error and its error properties have been displayed, the labels will start again with the first error in the error memory stack and its error properties will be displayed again. Therefore, monitoring these labels over a sufficiently long period provides the information on all individual errors in the error memory.

To understand this behavior, it is recommended to observe the three labels in a measurement sheet (while more than one error is active) and watch the values change periodically:

Measurement list		
error_active_rotate	True	
error_location_rotate	REC_PART_01	
error_state	Active error(s) prese	
error_type_rotate	Logging channel limit	

The verbal representation of the numerical codes of these labels can be visualized in the properties window of the measurement page:

👔 🧕 🝸 standard 🔹 🗔 🔹		
Channel Measurement		
Actual measurement rate	100 ms - time synchronous event channel	
Default measurement rate	100 ms - time synchronous event channel	
Channel properties		
Address	0x25040B95	
Annotations		
Description	signals global state of error manager	
Name	error_state	
Physical conversion	(Verbal)No error present[0]Passive error(s) present[1]Active error(s) present[2]	
Physical maximum	2	
Physical minimum	0	
Physical quantisation	none	
Physical unit		
Annotations		

# 15.3 Analog Input Diagnosis

# 15.3.1 Monitoring limits / Shortcut Detection / Cable Breakage

The pin diagnosis functionality (check whether measurement is within the desired range) can be activated in the ANA pin setup wizard; to allow for a diagnosis regarding shortcut to ground, shortcut to battery voltage and cable breakage, a minimum / maximum has to be defined.

Pin Properties Configure the analo	g pin properties.
Pullup value:	3.01 kOhm -
	Pin Diagnosis & montoring limits V Enabled Minimum: 1000 (2) Maximum: 4000 (2) mV
	< Back Next > Finith Cancel
NA01 Red-p28	
5V	
Pullup	Description:
3	5000 _ Output Page_Switch_ANA_1
	Cutopart 1 B B Annual Signed
in Diagnosis	

# 15.3.2 Open Line Detection

The implementation of open line detection consists of pull up resistors being activated and deactivated; evaluating the behavior of the measured value detects cable breakage, regardless of the pull up resistor being activated by the user.

- 1. Open the Error Memory of the Device.
- 2. Click "start detection of cable".
- 3. Check the Error Memory for new fault entries, regarding "Open line errors".



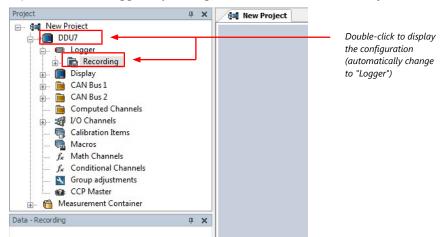
# 16 Recording

# 16.1 Features

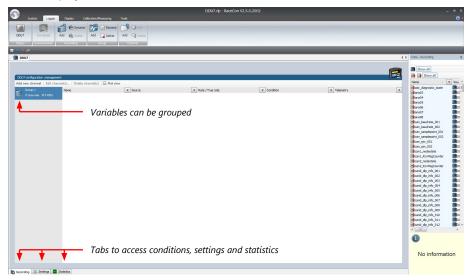
- Synchronized recording of VCU MS 50.4P analog and digital input channels, VCU MS 50.4P internal measurement channels, ECU data, Data from external sensor interfaces
- Up to two independent recordings
- Measurement rate 1 ms to 1 s
- Two global start conditions (thresholds)
- Up to 16 measurement conditions (fast-slow-switches)

# 16.2 Configuration of recordings

1. Expand the list of 'Loggers' by clicking on '+' in the VCU MS 50.4P Project Tree.



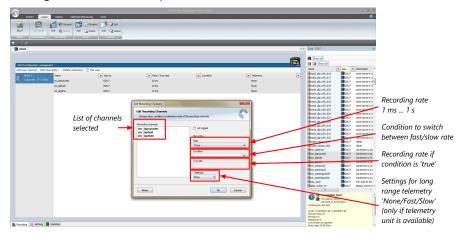
2. Double-click on 'Recording' in VCU MS 50.4P Project Tree. The recording configuration is displayed in the Main Area.



- 3. To add measurement channels to a recording, click 'VCU MS 50.4P' in the VCU MS 50.4P Project Tree. In the Data Area, the measurement channels are displayed.
- 4. Drag and drop desired measurement channels into recording group.

©			DDU7.rlp -	RaceCon V2.5.0.2002				- 0	9 X
System Logger									۰ 🌚
DOU7 Status	Image: Second system     Image: Second system       Image: Second system     Image: Second system       Record system     Second system								
🚍 🗞 T 🏕 T T									
0007						4 1	Dats - DDU7		
DDU7 configuration management Add new channel   Edit channel	t hel(s)   Delete channel(s)   🗄 Flat	. view					Show all Show all Name	• Sou • Description	
Group 1	Nane	Source	<ul> <li>Rate / True rate</li> </ul>	Condition	<ul> <li>Telemetry</li> </ul>		carid_dp_info_016	DDU7 carid stored	
8: Jaana 81380;	an Teleconte. Control de la control de la co	Drag measur channels into			Recording p	roperties	Control (1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	B007         and item           B077         Calman           B077         Calman           B077         Calman	dind dind dind dind dind dind dind dind
🖹 Recording 💷 Settings 🚾 Si	tetatos						Quantization: 1/n: Limits:0255 Pormat:%1.0 Precision:0 Resolution:0 Conversion:m: lancourb	e.	

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

VCU MS 50.4P 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).

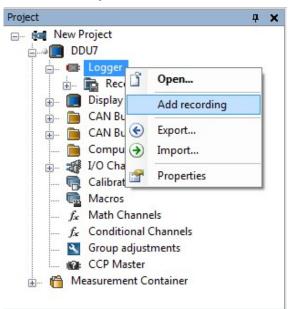


If the maximum bandwidth of a block is reached, a warning will be displayed. To fix this problem you can view the allocation of the channels and data rate in the 'Statistics' tab of the Main Area. See chapter 'Recording statistics [**▶** 101]' for more information.

## 16.2.1 Adding a recording

VCU MS 50.4P supports up to two independent recordings.

To add a recording, select 'Add Recording' from the context menu of the Logger in the VCU MS 50.4P Project Tree.



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

## 16.2.2 Adding a recording group

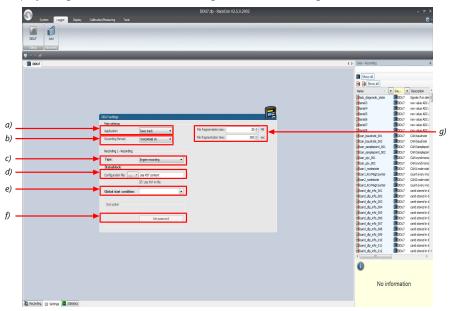
Recording channels can be grouped.

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.



## 16.2.3 Global settings

To display the global VCU MS 50.4P 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.

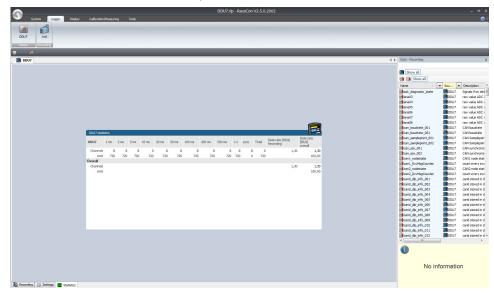
- f) If selecting WinDarab V7 in b), enter a password hint and a password (optional).
- g) Setting for automatic fragmentation. Do not change!

## 16.2.4 Recording statistics

The tab 'Statistics' shows the channels' allocation and their current data rate related to the transmission frequency of the VCU MS 50.4P 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 VCU MS 50.4P and limits the overall transmission speed.



## 16.2.5 Recording diagnosis

The channel 'statectrl\_ok' of the VCU MS 50.4P 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.

# 16.2.6 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.

	0007.10 - Racecon v2.3.0.2002	
System Logger Display Calibration/Measuring Tools Folder/She		🕡 -
	ataset P1 Change A2.	
Lun counte o la opinio	taset 🔛 Update Firmware	
0007 Race Mode Measuring Recording None We du Re Q Merph	ompare	
Status Mode Measuring Data		
/ 🛅 Measurement Folder 1		4 b Data - 00U7 🐺 😭
		, second s
		Show all
		Name Sou. *
		mess_mt_m03request
		meas_compression_m01
		meas_globcond_m03
		Biness_rate_n01
		Emeas_rate_m03
		CUTINGCTR MODE
		CUTTINGCTR_MODE_TESTEE
		EPCODE IN
		Bry_pvate Dia
		📴 rangemon_adc_high_error 🔳 Di
		Brangenon_adc_jow_error
		REV1_Tmax CX
	statecti_ok	REV2_Tmax OK
	8 7 6 5 4 3 2 1	REV3_Tmax
		REV4_Teax C
		estativan CX
		Statectri_err Ct
		Etecu_core
		TELE LOP PORT
		Batemetry_state
		Bitme_day Dt
		the_hour 🔲 🛙
		Entre_nin III -
		< II
		statochi_ok     Provied by DDU7
		V 👩 Provided by DDU7
		Summary of system and measurement
		Quantisation: 1/nc
		Limits 20255
		Format:%1.0 Predston:0
Sheet 2 Sheet 1		Resolution 0
		к <u>п</u> э

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, VCU MS 50.4P 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.

## 16.2.7 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.
meas_backend_buf_size_ecu / _fde meas_write_rate_intern_001 / _002	dias. 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. 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 da blocks. Data is removed from the buffer as soon as a medias have processed it. Effective data write rate to internal storage media, after compression, for first / second logging.

# 16.3 Event logging

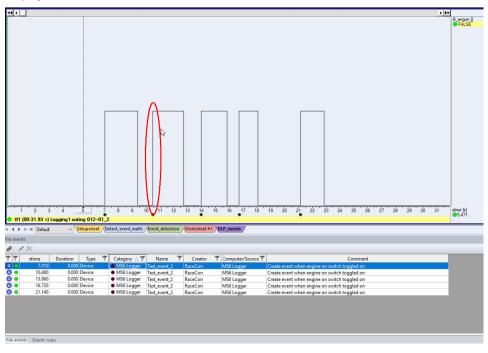
Event Logging implements the possibility to observe a channel if short spikes are expected. With Event Logging, every occurrence of a user defined threshold (more complex conditions are possible) leads to an event being raised. It is listed in a table along with its time stamp, its ID and even with a 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	gger 🗙	
🖃 📾 New Project 🔺	MS6 Logger Events		
Hand MS6 Logger	🖗 Add Event 🦻 Edit E	Event 🐔 Delete Events	
庄 📾 Logger	Active Name	V Description	<ul> <li>Trigger Channel</li> </ul>
庄 – 🛄 CAN Bus 1	TemperatureHig	h Chip temperature is critical high	B tempHigh
CAN Bus 3     Computed Channels		Edit Event	×
- Events		Edit Event	
Calibration Items		Fill out all required fields to edit the selected event.	
- 👼 Macros			1
f_x Math Channels v		Name	
Properties 🛛 🖓 🗙		TemperatureHigh	
		Description	
ੈ ↓ 🝸 standard 🔹 🖃 ▾ 🥑		Chip temperature is critical high	
<ul> <li>Event properties</li> </ul>		Category	
Description Chip temperature is critical hig Name TemperatureHigh		Warning	~
Temperaturenign		Trigger Channel	
		📾 🙆 B_tempHigh	<ul> <li>V</li> </ul>
Name		Edge	
Name		Rising	~
		Reset Delay	
		200	车 ms
Data			
Starts with $$			
🗲 🛄 Show all			OK Cancel
Name 🛆 🗸 Source	<ul> <li>Description</li> </ul>		.:

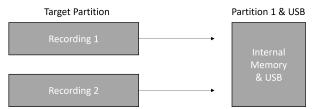
Display in WinDarab:



Events rules					# ×
💁 = 💁 🎯					
Name		•		Computer/Source	Desc
User defined events	۲	0			
▲ ♦ Chassis		0			
DamperFL_on_bump	۲	0	KAM7FH	ABTZOKEI	
▲ Gearbox		0			
Shift_2-3	۲	0	KAM7FH	ABTZOKEI	
A 🔸 SYNC		0			
@ sync_issue			KAM7FH	ABTZ0KL1	
MS6 Logger		5			
@ Test_event_2			RaceCon	MS6 Logger	
File events Events rules					

# 16.4 Data Logger and USB recording

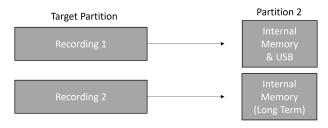
### Default settings:



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.

# 16.5 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.

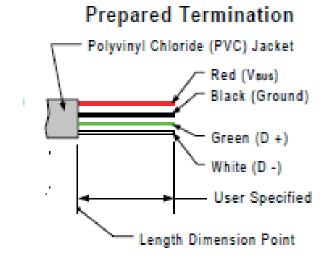
Software Upgrade DATA\_USB enables USB recording. To activate Software Upgrade DATA\_USB, enter the license key as described in the chapter 'Feature activation' [> 26].

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

#### Wiring harness

0		
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.

## 16.5.1 Recording data on USB device

- 1. Plug an USB device to VCU MS 50.4P.
- 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 VCU MS 50.4P.
- 5. Record measurement data. If an USB device is present, the VCU MS 50.4P 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.

A 18 -	WinDarab v7 Developer - Formula3		-	0 ×
Start Tools Windows				style 🖂 🥹 🗸
Channels Arektrack - Channels Arektrack - Colors Dockable windows Control Bars Worksl	I I I I I I I I I I I I I I I I I I I			
•				
File Explorer 0 ×		Channels		а × •
Out Lap Laptime		Name	Source	Descripti
	If ( ) HX Worksheet #			
Events	A P A A (WHARKACKE)	_	^	.0. ×
Time Car From To Duration Channel I	Min Max			

- 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.

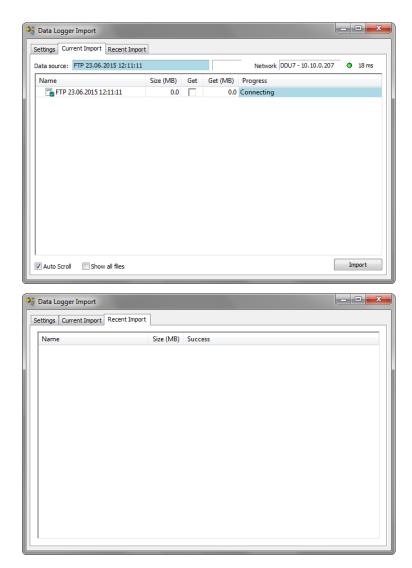


11. Click on 'Settings' tab and select the option 'Flash Card/USB Stick'.

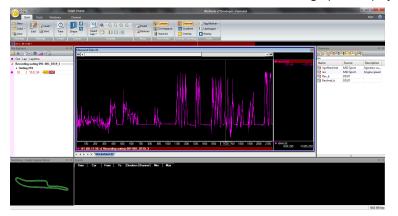
💐 Data l	Logger Import					-		>
Settings	Current Import	Recent Import						
Import	t sources			Common o	ptions			
🗹 Fla	ashCard / USB-S	itick		Delete	ARP cache entry aft	er ping to devi	ce failed.	
🗹 De	evice			Force	password, if not set l	by recording co	onfiguratio	n:
Bu	urst						New	/
	Device / IP: Export file:	C80 V	ap 🗸	~	🗹 Dele	ort all on conne te transferred ort latest files f	files	
			ap ~			ort latest files f	îrst	
	Save files in:	D:\daten						
Subfo	older template:						∼ [a]+	
Filen	ame template:	C65-USB-[CardIn	fo] outing [outing	03]-[lap03]-[n]			∼ [a]+	
Advan	ced Con	nment Fields			$\searrow$	Арр	bly change	s

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.



- 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.

### 16.5.2 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 VCU MS 50.4P 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!

### 16.5.3 Troubleshooting

When no data on the USB device is recorded:

Configure the measurement label **usb\_mediastate** on a RaceCon measurement view or on a VCU MS 50.4P display page.

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

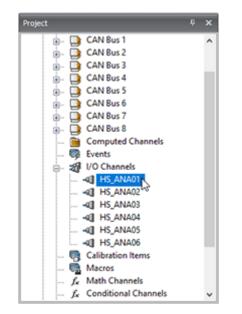
State	Description
0: Wait: Device not found	The USB device is not found (also: waiting for re-plug stick). No USB device inserted. USB device is defect. No electrical connection or wiring harness problem. USB software upgrade not activated (Purchase of unlock code needed).
1: Wait: Device detected	An 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 VCU MS 50.4P 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 VCU MS 50.4P.
6: Error: Media corrupt	The USB device is not in valid BFS format. (Hint: Re-format the USB device in RaceCon.)

# 16.6 High speed logging

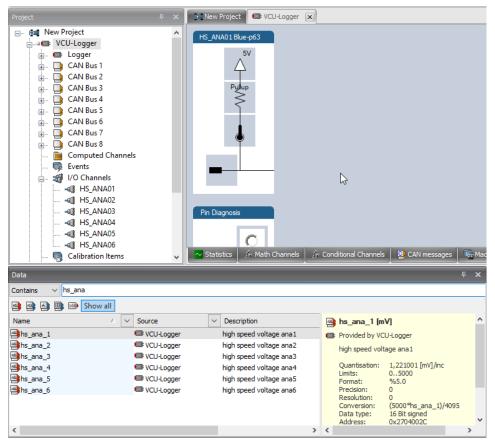
The VCU MS 50.4P can acquire analogue channels at a rate of up to 200 kHz, provided that the upgrade "High speed logging" has been activated on the device concerned.

Six analogue channels are available for high speed logging: HS\_ANA01 - HS\_ANA06. To set up the logging for high frequencies, please consider the following hints:

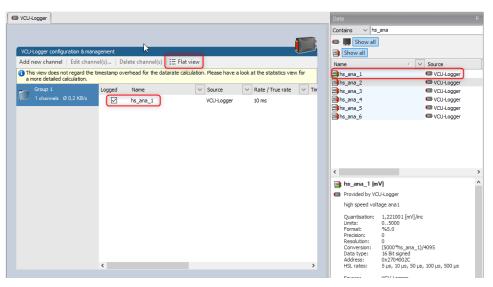
The pin configuration (pull up, pin diagnosis) is done like on any conventional pin: Under "I/O channels", the list of high speed channels appears and can be modified after a double click on the menu item in the tree view:



The logging setup is based on the channels named "hs\_ana\_1"... "hs\_ana\_6" which appear under the tree item "[Device]-Logger" (hint: use a text filter in the data field to exclude all other list items).



To include these channels into the logging, display the list of logged channels and drag and drop into the list the hs\_ana\_xx channel you want to be logged. Attention: This will only work if "flat view" is deactivated.



After double clicking the logging list entry you just created, set the desired logging rate. You will note that for hs\_ana\_xx channels, logging frequencies of more than 1 kHz are available.

Edit Recording Channel		×
Edit Recording Channel		
Change channel, rates, condition or telemetry mod	de of the recording channel.	
Channel:		
💷 🔤 hs_ana_1		$\sim$
not logged		
Recording		
Rate:		
10 ms 🗸		
off		
5 μs 10 μs	True rate:	
50 µs		~
100 μs 500 μs	Pretrigger (ms):	
1 ms K		* *
2 ms 5 ms	-	•
10 ms		
20 ms 50 ms		
100 ms		
200 ms 500 ms		
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. isott		

# 17 Lap Trigger

# 17.1 Lap trigger (timing beacon)

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

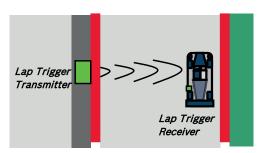
- Vehicle lap time measurement
- Calculation of lap-dependent functions (lap fuel consumption, min/max values)
- Calculation of lap distance dependent functions
- Control of data logging system

### 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)



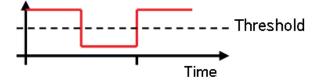
### 17.1.1 Electrical trigger signal

In VCU MS 50.4P all sources of measurement channels can be used as trigger signal.

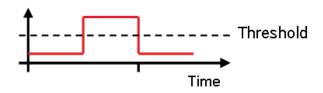
- Analog input
- Digital input
- CAN input

### 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)

### 17.1.2 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 [▶ 127]) 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.

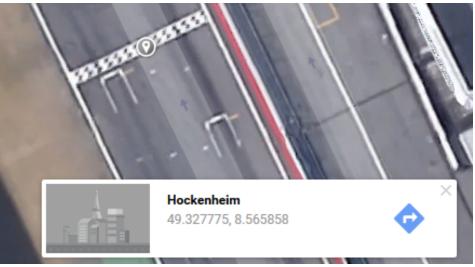


Photo: Google Maps

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.

			Ö
Define the latitude and longitude of the GPS		Laptigger configuration           General         Presettings         Conditions         Trigger         Countdown         Segment timing         GPS           Decimal labtude:	
detection point.		L 49,32777400 Decimal longitude: 8,55584700	
Define the detection	_	Laptrigger detection range:	m
range around the detection point.		CPS channel sources: Longitude source: ■ ■ ⊕ ops.long	
Define the channel		Latitude source:	•
sources for Longitude, Latitude, Direction and	$\sim$	GPS speed source:	•
Speed.		C C C C C C C C C C C C C C C C C C C	•
	Configuration		

#### 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.

### 17.1.3 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.

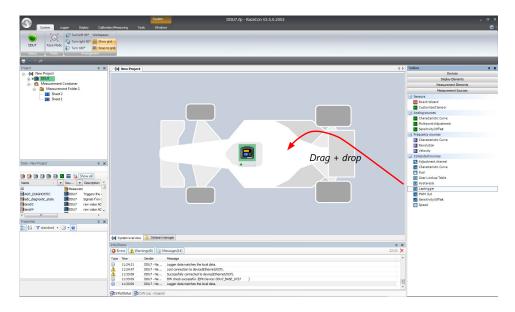
### 17.1.4 Forced triggers

Lap distance based insertion of 'forced trigger'.

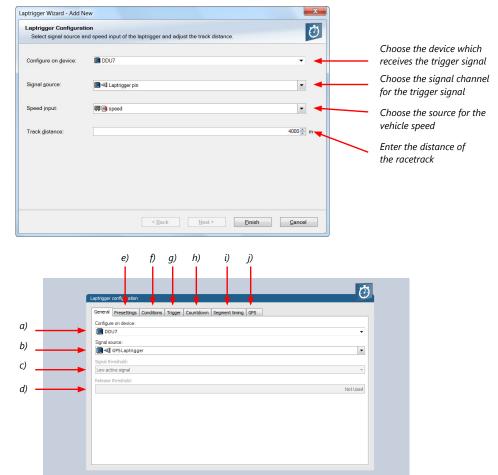
Under race conditions, trigger signals are sometimes missed. Software functionality introduces 'forced trigger'.

### 17.1.5 Setting up a lap trigger

- 1. Click 'Measurement Sources' in Toolbox.
- 2. Drag 'Laptrigger' into 'System Overview'. Do not drop it on 'VCU MS 50.4P'!



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



a) Change signal device, if desired.

Onfiguration

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.

	Station froject 🔟 Laptrigger (x)
	Laptrigger configuration
Preset values for lap counter	General Presetting: Conditions Trigger Countdown Segment timing
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linimum laptime that a new	Outing counter start value:
	Lap time threshold:
est laptime' is accepted	10 👘 s
reset value for 'best laptime'	Lap time best preset:
·····	
	Configuration
Change signal for vehicle speed,	Speed source:
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igger release.	Track distance:
	4000 👘 m
efine settings for distance	Min. distance: 20 (m) %
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	800 m
ised reingger protection.	Enforce laptrigger
used reingger protection.	V Enforce hiptrager
useu reingger protection.	Enforce laptrigger
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Define settings for distance	Zi Enforce laptrager         Max. distance:       120(2)       4400 m
efine settings for distance	Configuration Configuration
befine settings for distance ased forced trigger.	Ø Enforce laptriger         Max. distance:         120 (§)         4400 m
Define settings for distance vased forced trigger.	Enforce highlight     Max. distince:     120      480

	Laptrigger configuration	U
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nain trigger).	Detection time:	
	Retrigger lock time:	
efine settings for sub trigger.	5000 🖗 m	
ot applicable with a GPS lap trigger.	Detection time: 30 (5) ms	
	Retrigger lock time:	
	5000 🐑 ms	

Configuration

Define settings for countdown time:			Lastroner configuration
Define settings for segment timing.			Laptrigger configuration
Define settings for segment timing.			
timer.			General Presettings Conditions Trigger Countidown Segment timing
timer.	Define settings for countdown		Mode:
Define settings for segment timing.			None
Define settings for segment timing.	umer.		Start lima:
Define settings for segment timing.			Start diffe.
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Define settings for segment timing.		Comgeration	A1
	Define settings for segment timing.	•	General Readings Conditions Traper Countions Segment timing      Hode:     Image:     Les segment distance from naih traper:
Configuration			

#### Only applicable for a GPS Laptrigger

Define the latitude and longitude of the GPS detection point.	Laproger conflucation General Presettings   Conditions   Trigger   Countidown   Segment timing   GPS Decimal lastude: 49,32777400  ←  Decimal longitude:	
Define the detection range around the detection point.	8,5594700 € DC Laptigger detection range: 20 € m Longitude sources:	
Define the channel sources for Longitude, Latitude, Direction and	GPS direction source:	
Speed.	Configuration	

### 17.1.6 Lap trigger channel diagnosis/counter reset

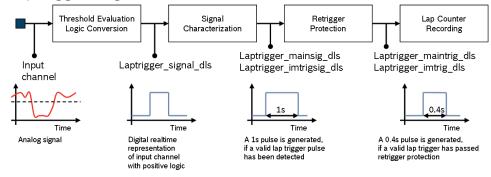
To display a quick lap trigger channel diagnosis and to reset counters use the diagnosis page in RaceCon. Any 'Laptrigger\_xxx' channel can be displayed.

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

A diagnosis window opens in Main Area.

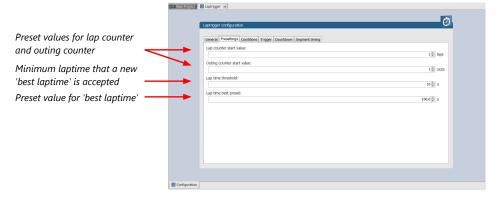


#### Lap trigger diagnosis scheme

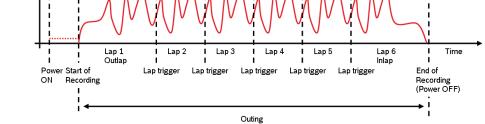


### 17.1.7 Lap trigger presettings

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



# 17.2 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 [▶ 121])

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'.

# 17.3 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:

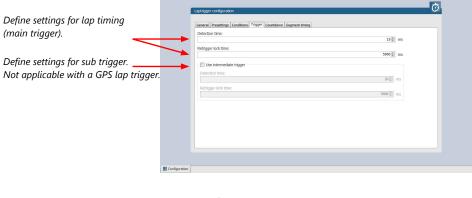
Channel	Function
Laptrigger_lapctr_dls	Number of completed laps

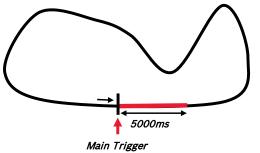
Channel	Function
Laptrigger_laptime_dls	Running laptime
Laptrigger_laptime_best_dls	Laptime of best lap
Laptrigger_laptimeold_dls	Laptime of last lap completed
Laptrigger_laptimeseg_dls	Segment time of last segment
Laptrigger_lapctr_dls	Number of completed laps

# 17.3.1 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.

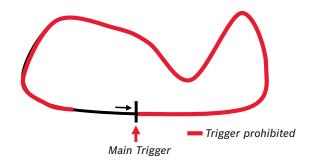




### 17.3.2 Distance based retrigger protection

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 %.

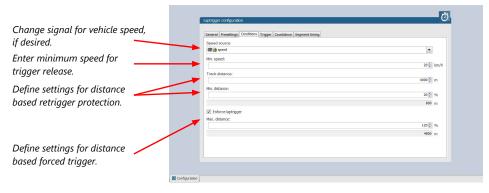
	(Traditional and the second seco
Change signal for vehicle speed,	Capturge Complexition
if desired.	Speed source:
Enter minimum speed for	Min speed: Track diatance: 20 State
Define settings for distance	4000 0 m Mn. dstance: 200 m 300 m
55 F	✓ Enforce aptrigger
	Max. distance:
	120 (2) 96
Define settings for distance based forced trigger.	480 m
	Configuration

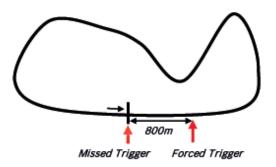


### 17.3.3 Distance based forced trigger

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.





# 17.4 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

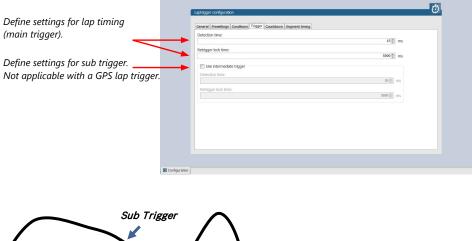
To display segment times use the following channels:

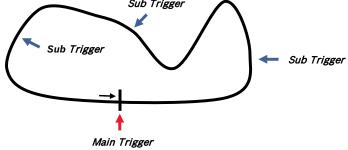
Channel	Function
Laptrigger_lapdiff	Time difference between finished lap and last lap
Laptrigger_lapdiffb	Time difference between finished lap and best lap
Laptrigger_lapseg_dlast	Difference of lap segment time compared to last lap
Laptrigger_lapseg_dbest	Difference of lap segment time compared to best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

### 17.4.1 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.





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

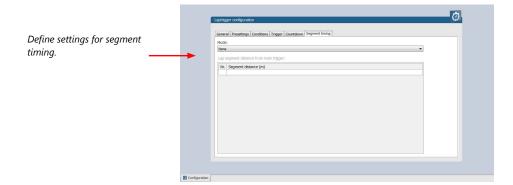
## 17.4.2 Distance mode

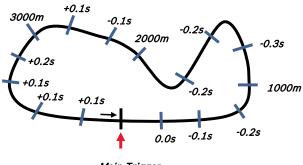
Using main trigger (20 ms pulse) at Start-Finish-Line.

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'.



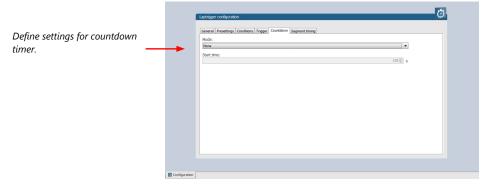


### Main Trigger

# 17.5 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.



## 17.6 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.

neral	Presettings	Conditions	Trigger	Countdown	Segment timing	GPS	Known Racetracks			
	al latitude:									GPS Track detection
								49,32777400 🜲	DD	Override Track distance & position
Decim	al longitude:									
								8,56584700 🜲	DD	
Laptr	gger detectio	on range:								
								30 🌲	m	
	e source:									
	gps_lat									~
ongitu	gps_lat de source: gps_long									~ ~
ongitu engitu	de source: gps_long ection source									
ongitu engitu	de source: gps_long									
ongitu PS dir PS dir	de source: gps_long ection source	ion								~

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.

neral	Presettings Conditions Trigger Countdow	n Segment timi	ng GPS Kno	wn Racetracks	
Builtin R	acetracks			User defined Racetracks	
Active	Track	^		Active Track	Add Track
$\checkmark$	Lime Rock Park			Nürburgring Nordschleife	Edit Track
$\checkmark$	Magny cours				Edit Irack
$\checkmark$	Misano				Remove Track(s)
$\checkmark$	Monza				
$\checkmark$	Ningbo Speedpark			Edit RaceTrack 'Nürburgring Nordschleife'	
$\checkmark$	Nogaro				
	Nürburgring			Specify Racetrack properties	
$\checkmark$	Oschersleben		Copy	The GPS position indicates the position of the start-finish line.	
$\checkmark$	Oulton Park		Track >		
$\square$	Paul Ricard			Track Name: Nürburgring Nordschleife	
	Pau-Ville				Get values from Laptrigg GPS definition
$\square$	Portimao circuit			Track length: 25378 🜩 m	Gr 5 dennition
$\leq$	Portland Int Raceway			GPS Latitude: 50,33401400  DD	
$\leq$	Redbullring Road America			GPS Longitude: 6,94527800  DD	
$\leq$	Road America Rockingham			GPS Longitude: 6,9452/800 UD	Set values to Laptrigger
	Sepang				GPS definition
	Shanghai				
	Silverstone				
	Slovakiaring				OK Cano
	Snetterton 300				

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

# 17.7 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.

### 17.7.1 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 [▶ 112]. Under the ribbon "Segment timing", you need to choose your segmentation mode which can either be distance or intermediate trigger based.

stance or	Gener	al Presettings Conditions Trigger Countdow	n Segment timing GPS	
ermediate	Mode			
	Dista	nce		
gger	UV U	se predated laptime		
ter your	Lap s	egment lengths and times		
ment time	Nr.	Segment length (m)	Segment time (s)	
d distance 🔶	1	500	44,800	
	2	1.000	93,200	
	3	1.500	135,600	
ter your				
	Entir	e lap time:		

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.

### 17.7.2 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.

# 18 GPS Sensor

# 18.1 GPS (Global Positioning System)

Space-based global navigation satellite system.

GPS provides positioning, navigation, and timing services to worldwide users.

GPS receiver (sensor) gives digital information about position (longitude, latitude, height), ground speed, course, and status.

#### Two types of GPS receivers:

CAN output -> Read in messages via CAN Input of VCU MS 50.4P (not covered here)

Serial output -> Read in messages via RS232 Interface of VCU MS 50.4P

Serial Interface is characterized by:

Voltage levels: RS232 is standard (+/-12 V), UART (0 V/ 5 V) needs level shifter

Baud rate: 9,600 is standard for GPS, VCU MS 50.4P supports 1,200 to 115,200 baud. GPS Rx interface baud rate must match VCU MS 50.4P interface baud rate. VCU MS 50.4P Baud rate can be set with the 'GPS\_BAUDRATE' characteristic Data format: VCU MS 50.4P expects 8 data bits, no parity bit, 1 stop bit (8N1)

### 18.1.1 Serial interface characterization

Serial Interface is characterized by:

Voltage levels: RS232 is standard (+/-12 V), UART (0 V/ 5 V) needs level shifter

Baud rate: 9,600 is standard for GPS, VCU MS 50.4P supports 1,200 to 115,200 baud. GPS Rx interface baud rate must match VCU MS 50.4P interface baud rate. VCU MS 50.4P Baud rate can be set with the 'GPS\_BAUDRATE' characteristic Data format: VCU MS 50.4P expects 8 data bits, no parity bit, 1 stop bit (8N1)

### 18.2 Protocol

VCU MS 50.4P expects NMEA Protocol (ASCII).

The following messages are decoded:

Message	Function
GGA	GPS fix information
GSA	Overall satellite data
GSV	Detailed satellite data
RMC	Recommended minimum data for GPS
VTG	Vector track and speed over the ground

On most GPS sensors, these messages are activated in the default configuration.

## 18.3 Sensor recommendation

The system has been tested with the Navilock NL-8004P MD6 Serial PPS Multi GNSS Receiver. This sensor is based on a U-Blox 8 chipset and is fully configurable with the Navilock "U-Center" software. To use this sensor with Bosch Motorsport components the transfer rate, the satellite system and the update rate need to be reconfigured. More information about the configuration can be found in the Appendix.

### 18.3.1 Configuration of the recommended Navilock NL-8004P MD6 Serial PPS Multi GNSS Receiver

For the sensor configuration, the sensor needs to be connected to the Navilock software "U-Center" which is available from Navilock free of charge. Navilock offers a USB connection cable for the sensor.

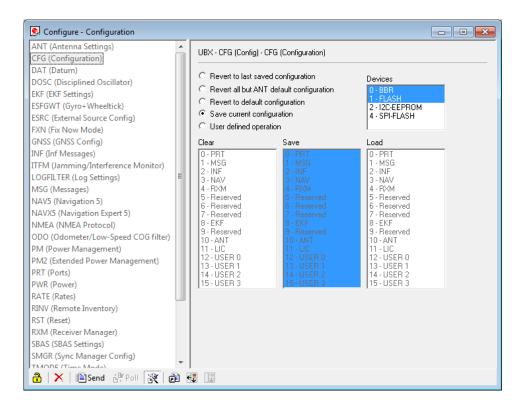
In "U-Center" click **"View"** – **"Configuration View"** to start the configuration. The following 3 points have to be changed:

### Transfer Rate

- Click on "PRT (Ports)".
- Change the baud rate to a fixed value, this value needs to meet the setting of Race-Con. For a good signal quality we recommend 115,200 baud.
- Click on **"Send"** to store the new setting in "U-Center".

💽 Configure - Ports				
ANT (Antenna Settings)	~		nfig) - PRT (Ports)	3 s
CFG (Configuration)				
DAT (Datum)	ш	T	1-USABT1 ▼	
DOSC (Disciplined Oscillator)	ш	Target	I - USARTI	
EKF (EKF Settings)	ш	Protocol in	0+1+2 - UBX+NMEA+R1 -	
ESFGWT (Gyro+Wheeltick)	ш	Protocol out	0+1 · UBX+NMEA	
ESRC (External Source Config)	ш	1 lotocor out		
FXN (Fix Now Mode)	ш	Baudrate	115200 🔻	
GNSS (GNSS Config)	ш		Auto bauding	
INF (Inf Messages)	ш			
ITFM (Jamming/Interference Monitor)	ш			
LOGFILTER (Log Settings)	=			
MSG (Messages)	ш			
NAV5 (Navigation 5)	ш			E
NAVX5 (Navigation Expert 5)	ш			
NMEA (NMEA Protocol)	ш	Oversampling		
ODO (Odometer/Low-Speed COG filter)	ш	. 2		
PM (Power Management)	ш			
PM2 (Extended Power Management)	ш			
PRT (Ports)	ш		V.C	
PWR (Power)	ш		X timeout (>=FW7.00)	
RATE (Rates)	- 1	Enable	ature (>=FW7.00)	
RINV (Remote Inventory)				
RST (Reset)		Inverse H	Polarity (low-active)	
RXM (Receiver Manager)		Threshold	0	
SBAS (SBAS Settings)		DIO.		
SMGR (Sync Manager Config)	- I	PIO		-
TMODE (Time Mode)		-		
🔒 🗙 🗐 Send 🦉 Poll 🚉 💼	1			

- Click on "CFG (Configuration)".
- Click on "Send" to save the new setting on the sensor.



#### Satellite System

- Click on "GNSS (GNSS Config)".
- Set the ticks as shown in the following picture.
- Click on "Send" to store the new setting in "U-Center".
- As during configuration step 1, click on "CFG (Configuration)".
- Click on"**Send**" to save the new setting on the sensor.

😥 Configure - GNSS Configuration		
ANT (Antenna Settings)	UBX - CFG (Config) - GNSS (GNSS Config)	
CFG (Configuration)		
DAT (Datum)	Channels	
DOSC (Disciplined Oscillator)	Channels GNSS ID configure GNSS name enable min max Signals	
EKF (EKF Settings)		
ESFGWT (Gyro+Wheeltick)	0 🔽 GPS 🔽 8 16	
ESRC (External Source Config)	1 🔽 SBAS 🔽 1 3	
FXN (Fix Now Mode)	2 Galileo 🗆 0 0	
GNSS (GNSS Config)		
INF (Inf Messages)	3 🔽 BeiDou 🗌 8 16	
ITFM (Jamming/Interference Monitor)	4 🗆 IMES 🗖 🛛 🔿	
LOGFILTER (Log Settings)	5 🔽 OZSS 🗆 🛛 🕄	L LI SATE
MSG (Messages)		L CLOTH
NAV5 (Navigation 5)	6 🔽 GLONASS 🗆 8 14	
NAVX5 (Navigation Expert 5)		
NMEA (NMEA Protocol)	Number of channels available 32	
ODO (Odometer/Low-Speed COG filter)		
PM (Power Management)	Number of channels to use 32 Auto set	
PM2 (Extended Power Management)	For specific SBAS configuration use CFG-SBAS	
PRT (Ports)		
PWR (Power)		
RATE (Rates)		
RINV (Remote Inventory)		
RST (Reset)		
RXM (Receiver Manager)	For specific GLONASS configuration use CFG-GLO	
SBAS (SBAS Settings)		
SMGR (Sync Manager Config)	۰ III III III III III III III III III I	•
TMODE (Time Mode)		
🔒 🗙 🖹 Send 🤔 Poll 💥 💼		

### Update Rate

- Click on "RATE (Rates)".
- Change the "Measurement Period" to 55 ms.
- Change the "Navigation Rate" to 1 cyc.
- Values which lead to a lower frequency will lower the precision of the sensor, we recommend the mentioned values.
- Click on "Send" to store the new setting in "U-Center".
- As during configuration step 1, click on "CFG (Configuration)".
- Click on"**Send**" to save the new setting on the sensor.

🧕 Configure - Rates	_		- • •
ANT (Antenna Settings)		UBX - CFG (Config) - RATE (Rates)	9 s
CFG (Configuration)		OBA - Crid (Conlig) - RATE (nales)	
DAT (Datum)		Ti o	
DOSC (Disciplined Oscillator)		Time Source 1 - GPS time	
EKF (EKF Settings)		Measurement Period 55 [ms]	
ESFGWT (Gyro+Wheeltick)		Measurement Frequency 18.18 [Hz]	
ESRC (External Source Config)		Measurement Frequency 18.18 [Hz]	
FXN (Fix Now Mode)		Navigation Rate [Cyc]	
GNSS (GNSS Config)		Navigation Frequency 18.18 [Hz]	
INF (Inf Messages)		Navigation requeitcy 10.10 [12]	
ITFM (Jamming/Interference Monitor)			
LOGFILTER (Log Settings)	Ξ		
MSG (Messages)			
NAV5 (Navigation 5)			
NAVX5 (Navigation Expert 5)			
NMEA (NMEA Protocol)			
ODO (Odometer/Low-Speed COG filter)			
PM (Power Management)			
PM2 (Extended Power Management)			
PRT (Ports)			
PWR (Power)			
RATE (Rates)			
RINV (Remote Inventory)			
RST (Reset)			
RXM (Receiver Manager)			
SBAS (SBAS Settings)			
SMGR (Sync Manager Config)			
TMODE (Time Mode)	- I		
🔒 🗙 🖹 🖹 Send 🖓 Poll 🖹	1		

#### Note

Sensor needs reception for visible signal. It takes time to start the sensor.

### 18.4 Measurement labels

The decoded NMEA messages are copied to these VCU MS 50.4P measurement labels.

Measurement label	Function
gps_PDOP	Position Dilution Of Precision
gps_HDOP	Horizontal Dilution Of Precision
gps_VDOP	Vertical Dilution Of Precision
gps_lat	Latitude +/- [degree]
gps_long	Longitude +/- [degree]
gps_elv	Antenna altitude above/below mean sea level (geoid) in meters
gps_speed	Speed over the ground in kilometers/hour
gps_direction	Track angle in degrees

Measurement label	Function
gps_declination	Magnetic variation degrees (Easterly var. subtracts from true course)
gps_year	Years since 1900
gps_mon	Months since January - [0,11]
gps_day	Day of the month - [1,31]
gps_hour	Hours since midnight - [0,23]
gps_min	Minutes after the hour - [0,59]
gps_sec	Seconds after the minute - [0,59]
gps_hsec	Hundredth part of second - [0,99]
gps_smask	Bit mask over received NMEA sentences (Bit 0 = GGA, Bit 1 = GSA, Bit 2 = GSV, Bit 3 = RMC, Bit 4 =VTG) within last second.
gps_sig	GPS quality indicator (0 = Invalid; 1 = Fix; 2 = Differential, 3 = Sensitive)
gps_fix	Operating mode, used for navigation (1 = Fix not available; 2 = 2D; 3 = 3D)

These measurement labels are arrays, where the indexed element points to the same satellite.

(E.g. gps\_info\_satsigstrength[3] tells the receiving signal strength of satellite 3. Satellite 3 has the SAT-ID given in gps\_info\_satid[3])

Measurement label	Function
gps_info_satid[ ]	Satellite PRN number
gps_info_satinuse[ ]	Used in position fix
gps_info_satelevation[ ]	Elevation in degrees, 90 maximum
gps_info_satazimuth[ ]	Azimuth, degrees from true north, 000 to 359
gps_info_satsigstrength[]	Signal, 00-99 dB

# 18.5 GPS troubleshooting

#### Electrical

Is the transmitter signal of the GPS sensor connected to the receiver pin of serial interface of the VCU MS 50.4P?

Is the GPS sensor powered up?

Does the GPS sensor deliver RS232 signal levels?

Is the sensor connected to the "sensor ground" of the device?

#### Interface

Do the baud rates of the GPS sensor and the VCU MS 50.4P match?

Is the GPS sensor set up for 8N1 transmission parameters?

Is the GPS sensor set up for NMEA messages?

Are the GGA, VTG, RMC messages activated?

### GPS sensor start-up

Does the GPS sensor 'view' the sky?

Did the GPS sensor complete its initial start-up procedure? This may take up to 20 min.

A correct reception is indicated when 'gps\_fix' is showing '3D Fix'.

#### GPS sensor values are frozen

Does the sensor has lost its reception? The old values will be kept if the reception is lost. The gps\_smask channel shows which NMEA sentence is received.

# 19 Telemetry System LTE 65

- Support for long-range online telemetry
- Individual programmable team code
- Fast block slow block mechanism
- Programmable data rate
- Ethernet or RS232 interface
- Full online track coverage on almost all tracks

## 19.1 Software setup

Drop Telemetry from Toolbox into system overview.

	System	Systemtest C80_BASE_0516.rlp - RaceCon V2.9.0.10 - Mastericense Bosch *	_ = ×
System Logger Display Ca	ibration/Measuring Tools Windows		
MSR.og Convection Project P	Workspace: Show grid Show to grid Arranyonent Arranyonent Arranyonent Markanyone		Toobox 6 ×
B- 64 RaceCar≢23 ∧			Devices
Total     Total     Total     Construction     Const			Lorden     Lorden
Name The project's name.	1		
the proposed failure.	See System Overview		Measurement Elements Measurement Sources
Data			÷ ×
Contains ~ statec			No function filter>
Name 🗠 🗠 Source		Lived A	
Om_stateCard     MS6Log       Statectrl_err     MS6Log       Statectrl_err     MS6Log       Statectrl_err     MS6Log       Statectrl_err     MS6Log       Statectrl_err     MS6Log	Cardmemory protocol state recording o	Revenue and the second se	
Ready.		No errors detected - all cleared or state ar	intern 🔹 📴 RaceCar#23 🚥 🗰 🔬

Adding channels to telemetry

- 1. Expand the list of 'Loggers' by clicking on '+' in the VCU MS 50.4P Project Tree.
- 2. Double-click on 'Recording' in VCU MS 50.4P Project Tree.

The recording configuration is displayed in the Main Area.

3. Click 'Edit channel(s)'.

The 'Edit Recording Channels' window appears.

4. Choose between 'Fast/Slow block' transmission.

#### Using fast block/slow block transmission

VCU MS 50.4P telemetry has a bandwidth 200 kBit/s, the used bandwith can be adjusted to cope with the transmitting system. 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).

#### **Transmission Scheme**

	e recording channels. You may also change the telemetry mode.
ecording channels:	Rate:
_wheel_rr _wheel_rl _wheel_fr	10 ms
_wheel_fl	Condition:
	Ē
	True rate:
	Telemetru:
	Fast 💌
	None Slow
	Fast

None – channel(s) are not transferred Slow – channel(s) are transferred in the slow telemetry block Fast – channel(s) are transferred in the fast telemetry block

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.



## 19.2 Telemetry channels with special functionality

The Telemetry system allows the transmission of special information such as running distance of current lap, lap number of current lap and lap time, fuel consumption of last lap completed. You have to assign the channel type to the telemetry channel so that it is recognized accurately by RaceCon.

Channel's names are e.g.: Laptrigger\_lapdist\_dls, fuelcons, lapctr, Laptrigger\_lapdist\_dls. Different channel names are possible between different devices (e.g. ECU MS6, laptrigger module used in RaceCon).

For displaying the position of the car in the cloud, additionally GPS-position and lapdist can be send to the cloud, this is activated with the checkbox "cloud statistics".

Telemetry settings				
General Settings				1
WD Server INI Folder	Use RaceCon project folder		•	
Project key:	04d2			hex
Configure on Device:	E80 Logger		~	1
Device Settings			Channel settings	_
Type:		N	Distance channel:	
LTE65	~	ß	🛺 🏊 Laptrigger_lapdist_dls	$\sim$
Mode:			Lap number channel:	
Ethernet	~		👭 👜 lapctr	$\sim$
Destination IP: 10	0.10.0.235		Lap fuel channel:	
Destination Port: 10	000		🐺 🔄 Fuel_fuelcons_dls	$\sim$
Data Rate:		it/s	Previous lap time channel:	
		140	🕌 🔄 Laptrigger_laptimeold_dls	$\sim$
Cloud statistics en			GPS Latitude channel:	
channel data will	d statistics, I understand device distance or GPS be decoded and available to Bosch in the Bosch		🕌 😁 gps_lat	$\sim$
LTE Cloud.			GPS Longitude channel:	
To enable the Bo channels must be	sch LTE cloud, at least the Distance or both GPS configured.		💭 🔤 gps_long	$\sim$

- 1. Assign the desired channels to the channel types. The table below shows the function of the available channel types.
- 2. Click 'Ok' when done.

Measurement channel	Function
Distance	Running distance of current lap
Lap number	Lap number of current lap
Lap fuel	Fuel consumption of last lap completed
Lap time	Exact lap time of lap completed

The telemetry channels and their assigned channel types are displayed in the overview list.

	Welcome to RaceCon	Rail	New Project FM40					4 Þ 🗙
1	FM40 configuration & mai	nagerr	nent					
	Add a new channel	) <u>E</u> di	it channel(s)   📑 Delete cl	nannel(s)				
	Name 👻	•	Source	✓ Width [Byte]	*	Telemetry mode	<ul> <li>Channel type</li> </ul>	~
	acc_lat		DDU8	2		Slow		
	distlap		MS5.1	2		Fast	Lap distance	
	fuelcons		MS5.1	2		Fast	Lap fuel	
	lapetr		DDU8	1		Fast	Lap number	
	laptime		MS5.1	2		Fast	Lap time	
	xtime		FM40	4		Fast	Time	
	FM40							

# 19.3 Setting up car in WDServer

WDServer is a program used to capture data streaming from a transmitter and convert to WinDarab; WDServer also creates a log of the data received over telemetry.

C70. Test.bmscfg - WinDarab Server		
Workdesk CF-Cards Telemetry Protocol Options ?		
Bits         Stop         Stop         Byte/Sec:         0           lock/Sec:         10         Dist.         - <t< td=""><td>Computer</td><td>Car Application</td></t<>	Computer	Car Application
21 12 (017) 77:752 Using Iop C. C. Usern Wildbird AgeData/Loca/Temp/WDServer Protocollog 21 12 (017) 77:552 Usinering on polycoll (TPUDP) 21 12 (017) 77:555 Usinering on polycoll (TPUDP) 21 12 (017) 77:1557 Usinedauling disablet Data will be send to each client using UDP. 21 12 (017) 77:1557 Difficult on the "If" viol found: "L'Usern Villbirdh/Document/RaceCon Projects/Dop_1234_00 in" WDServer Settings		
Add Car		
Car Settings		
Press F1 to obtain help.		NUM

- 1. To set up a new car, select 'Add Car'.
- 2. In the Car settings tab, enter a name for the new vehicle.

This name will be used as a part of the file name for WDServer's log of received telemetry data and will show up in WinDarab, when searching for the telemetry stream in the Network folder.

Car settings		×
Car settings UDP:10000 New: COM		
Car name	Data output to back	up system
Name: Car #1	Port:	<b>_</b>
Comment:	Baudrate:	9600 👻
Folder with the DCP-Configuration files Use global settings (Workdesk/Setting) This folder:	ngs/Telemetry)	
Print to:	No of lines per p	age: 64
Save to file:	No of lines per p	age. 04
ОК Са	ncel Apply	Help

- 3. You are now at the final step of configuring the telemetry stream. In order for the data to be decrypted by WDServer, two \*.ini files must be referenced by WDServer. After the configuration is sent to the logger, these two different \*.ini files will be created in the base folder. You can find the base WDServer folder, if you right-click the Telemetry and select 'Properties'. You can change this folder location for easier access if desired.
- 4. Define the link to the folder of the \*.ini files for each car or define it in the general WDServer settings, under the 'Telemetry' tab.

Settings	
Common Network adapters Telemetry	
Folder with the DCP-Configuration files C:\Users\kfl2abt\Documents\RaceCon Projects Change	
Template for the darab file name	
[year]-[mon]-[day] [hour].[min] Car [camame] File #[n]	
Folder to save the darab files in Change	
OK Cancel Apply Help	

- 5. Under the 'UDP' tab, select the drop-down menu and type in "UDP".
- For the UDP Port, type in the port number assigned to the device in RaceCon.
   Each vehicle being read by a single receiver device must have a unique port number.
   This information will be provided by Bosch upon delivery of the devices.

Car settings	×
Car settings UDP:10000 New: COM	
Settings	
Port: UDP -	
Udp Port: 10000	
OK Cancel	Apply Help

7. Click 'OK', to close the window.

- 8. Select the button 'WDServer Settings'.
- 9. Under the 'Common' tab, choose directories where WDServer can store its temporary files and log files. These are created during telemetry reception and can be used to help diagnose issues.

Settings	×	
Common	Network adapters Telemetry	
	r for temporary files ers\kfl2abt\Documents\WD_Server Change	
	r for log file 'wdserver.log'' sers \kfl2abt \AppData \Local \Temp Change	
	OK Cancel Apply Help	

Under the 'Telemetry' tab, the first section requests a folder path for the DCP- Configuration files. This is the folder path where RaceCon stored the \*.ini files required by WD-Server.

 Click on the "Change" button next to this section and navigate to this folder. A template can also be specified for the file nomenclature for logged telemetry as well as a save location.

Settings
Common Network adapters Telemetry
Folder with the DCP-Configuration files C:\Users\kfl2abt\Documents\RaceCon Projects Change
Template for the darab file name
[year]-[mon]-[day] [hour].[min] Car [camame] File #[n]
Folder to save the darab files in
Change
OK Cancel Apply Help

- To ensure proper communication between WDServer and the receiver, do not delete any old \*.ini files from this folder path. As mentioned in section 5, RaceCon will generate a new \*.ini file each time a project is synchronized; each new \*.ini file instance has an incremented file name. Retaining all of these \*.ini file iterations will ensure that WDServer always has a reference to whichever configuration is programmed into your vehicle's logger system.
- If the RaceCon project for the vehicle resides on a different computer, than that which is used for telemetry, then all \*.ini files for a given project should be transferred to the telemetry computer after every data synchronization in RaceCon. WDServer may have trouble recognizing \*.ini files stored on removable media, so best practice is to copy these files to the telemetry computer's hard drive.

# 19.4 Loading the telemetry data

The following is an example of a file name and data format for Car #91. File is typically located in WinDarab/Config/WDServer:

- + Computer + 1	· (3) 20, favotein	Basch + Wirdland + Confr	p + W05enet			+ 4	H Server HELENS		-
Organics + New fulder			Television in the				Characteristics and an	- 0	
MinDanab v7	A Nete		Date resulting	Type	Sex				
Data file locations	#1 MSD-Tred	iLaptop - Car #Ellimonds	12/09/2003 12-02	WinDucek Talamatry		1.88			
Favorites     Doubtrp     Doubtrp     Doubtrp     Doubtrp     Doubtrp     Doubtrp     Second Paces     South Data (DAP)     Speed Source     Speed Source     Speed Source									
Decuments Music Pictures Bituleon									
25 Villeos									
al Humaphup									
🕷 Camputer	+								
File name:							All supported him	("lender"	÷4.
Show before Right +						Add failer to locations	Open	Cance	

In the File Explorer, click 'Open' and navigate to the data set. Under 'Network', search for the car or cars that are required for viewing.

# 20 Firmware

# 20.1 Firmware and configuration

VCU MS 50.4P holds 2 types of data:

Firmware: The software (PST program file) of the VCU MS 50.4P.

Configuration: The default parameters for controlling the output of the VCU MS 50.4P.

# 20.2 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.

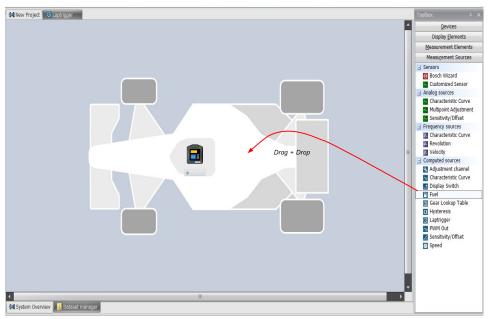
# 21 Cloning the Unit

Chapter left intentionally blank

# 22 Fuel Consumption Calculation

# 22.1 Setting up fuel consumption calculation and tank management

- 1. Select 'Measurement Sources' in Toolbox.
- Drag 'Fuel' element and drop it on the vehicle in System Overview. Do not drop it on the VCU MS 50.4P!



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

General							
Configure on device	DDU7	•					
Tank capacity		80.0 🚔	1 🔶				
Fuel consumption calculation							
Mode	Using fuel consumed	•					_
Fuel input	🚛 🖴 fuelcons	-	X 0.001	Adaptic	on factor to [ml]	-	
Consumption correction factor	1,000						
Mode Target lap consumption	Last lap's consumption	▼	.] ←				
rarger lap consumption		0,0 ¥	1				
Reset fuel consumption							
Mode	By RaceCon	•					
Reset signal source		*					_
Reset signal threshold	Low active signal	•					
		lot Used					

- 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.

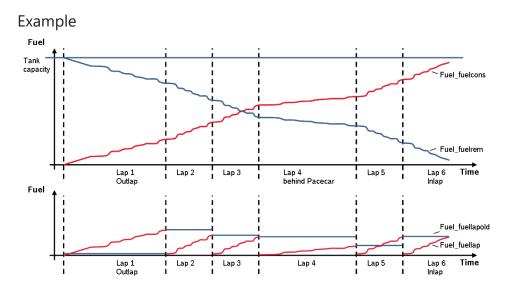
### 22.2 Fuel consumption diagnosis/counter reset

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.		
	Settings	Measurements	Button to reset total
	Tank capacity 80,0 1 Consumption correction factor 1,000	Total consumption	fuel consumption (Reset with RaceCon
	Target lap consumption 3,00	Fuel consumption - I	only)
	Remaining laps calculation Lest lep's consumption	Fuel remaining – I	D. H ( . )
	Reset fuel consumption By RaceCon	Last lap's consumption - I Reset	Button to reset fuel consumption manually
		Current lap's consumption - I	(Can also be triggered )
	1	Laps remaining	
Settings overview			
	Configuration Diffuel_laprem_dis X		



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			

## 23 RaceCon Shortcuts

The table shows important shortcuts simplify controlling the VCU MS 50.4P 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

# 24 Legal

## 24.1 Legal Restrictions of Sale

The sale of this product in Mexico is prohibited.

Due to embargo restrictions, sale of this product in Russia, Belarus, Iran, Syria, and North Korea is prohibited.

## 24.2 REACH Statement

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

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

## 24.3 Open Source Software (OSS) Declaration

### 24.3.1 antlr-2.7.7.jar License

ANTLR-2.7.7

SOFTWARE RIGHTS

ANTLR 1989-2006 Developed by Terence Parr

Partially supported by University of San Francisco & jGuru.com

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The primary ANTLR guy:

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

## 24.3.2 antlr311runtime.jar License

ANTLR-3.1.1

ANTLR 3 License

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CoSeMa - Common Sercos Master API

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xml\_io\_tools

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### 24.3.12 Avalonia

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# 25 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.



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