Bosch Motorsport **Display DDU 8** Manual

F 02U 002 643-02







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1 Preparation

Important Notes:

Use the DDU 8 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 DDU 8 is only certified with the combinations and accessories that are specified in this manual. The use of variant combinations, accessories, and other devices outside the scope of this manual 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. Don't hesitate to contact us, contact data can be found on the last page of this document.

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.

Edition: März 21, 2012



2 Power supply

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!

3 Onboard network concept





4 Technical data

The display DDU 8 integrates a programmable full color dash board display with a data logging system for motorsports applications. This allows for synchronized acquisition and visualization of engine data from the ECU and chassis data from up to 24 analog and 4 digital input channels. Additional input devices can be connected via the Ethernet and CAN buses. Recorded data from the internal 2 GB flash memory can be downloaded via high-speed Ethernet or via wireless connection with the BT 60 burst telemetry system.

As a base system the DDU 8 is sold as display only. Software upgrades for the DDU 8 (field upgradable by entering a key) activate data logger functionality, additional recording on USB Flash drive, CCP-Master and additional input channels.



Application

800 x 480 pixel high resolution 5" full graphics color display

Multiple user configurable display pages

Multicolor (RGB) gearshift lights

8 kHz AD converters with digital low pass filter

Configurable Math channels

User configurable CAN in/out messages

Up to 1,000 Hz acquisition rate for all channels

Online data compression

Up to 200 kB/s data acquisition rate

Up to 720 recording channels

1,000 kB/s upload rate

3-port network switch

Additional recording on USB Flash drive

CCP-Master, data acquisition from ECU that support CAN calibration protocol

Mechanical Data				
Size	161 x 111 x 31 (49) mm			
Weight	675 g			
Dust and splash water proof aluminum housing				
Operating temperature (internal) -20 +60 °C				
Max. vibration Vibration profile (see www.bosch-motorsport.com				
Connectors				

Autosport connectors double o	density	2 x 41 pin
Mating connector (Red) AS DD 6-12-41SN	F 02U (002 216-01
Mating connector (Yellow) AS DD 6-12-41SA	F 02U (004 180-01

Software

Configuration via RaceCon over Ethernet or MSA-Box II



Electrical Data		
Supply voltage	8 to 18 V	
Max. power consumption (w/o loads)	14 W at 14 V	
Inputs		
Page/brightness selection	2	
Analog channels	4	
Input range	0 to 5 V	
Resolution	12 bit	
Switchable pull up resistor	3 kOhm	
Outputs		
PWM outputs (Low side switch, 2 A ea	ach) 4	
Sensor supply 5 V/350 mA	1	
Communication Interfaces		
CAN	2	
Ethernet 100BaseT	3	
Laptrigger input (on yellow connector, active)	, always 1	
Application Hints		
Internal battery for data preservation i	ncluded	
Required service interval 12 months (internal battery is replaced)		
Accessories		
External switch for page selection (12 B	step switch) 3 261 209 658	
External switch for brightness adjustm selection (6 step switch)	ient or page 3 261 209 659	

Rugged USB Flash drive and connector are available on request.

Software Upgrades

Software Upgrade 1	F 02U V00 701-01	
Activation of internal data logger	2 GB	
Telemetry support	BT 60	
Long range telemetry support	FM 40	
Interface for telemetry (on yellow	connector) RS232	
Software Upgrade 2	F 02U V00 702-01	
Yellow connector unlocked		
GPS input		
20 additional analog channels		
Additional rotational channels (In	put Hall/inductive) 4	
Additional sensor supplies 5 V/35	i0 mA 3	
Additional sensor supply 10 V/35	0 mA 1	
Additional sensor supply 10 V/1 A	non regulated 1	
Interface for GPS	RS232	
Software Upgrade 3	F 02U V00 796-01	
CCP-Master (ASAP2 file from ECU required)	J manufacturer	
Software Upgrade 4	F 02U V00 871-01	
Requires Software Update 1		
USB-Port unlocked (USB Flash drive 2 GB Bosch File System (BFS) format included, works with Bosch File System (BFS) preformatted USB Flash drive only)		
Part Number		

Display DDU 8

F 02U V00 320-03



5 Inputs and outputs

5.1 Input channels

5.1.1 Analog inputs

The DDU 8 analog inputs accept an input signal of 0 to 5 V. A 3.01 kOhm pull-up resistor can be activated by software.

5.1.2 Digital inputs

The digital inputs of the DDU 8 accept 0 V to 5 V signals of Hall-effect sensors by default. Connect the output of the Hall-effect sensor to the REVn_P pin and leave the REVn_M pin open. Support of inductive speed sensors is available as a hardware option. Inductive sensors are connected to the REVn_P and REVn_M pins.

5.1.3 Page selection switch

Pin 36 of the **DDU 8 life connector** is used as a page selection switch for the display. The internal pull-up resistor is automatically activated. Display pages are selected by connecting the pin to SENSGND with different resistor values over a 12 position switch:

Page	Resistor Value
Page 1	43,9 Ohm
Page 2	142 Ohm
Page 3	264 Ohm
Page 4	409 Ohm
Page 5	609 Ohm
Page 6	846 Ohm
Page 7	1180 Ohm
Page 8	1650 Ohm
Page 9	2430 Ohm
Page 10	3830 Ohm
Page 11	6980 Ohm
Page 12	23200 Ohm





5.1.4 Display brightness switch

Pin 37 of the life connector is used as a dimmer switch for the display. The internal pull-up resistor is automatically activated. Different dim settings are selected by a connecting the pin to SENSGND with different resistor values over a 6 position switch. The individual brightness settings for LEDs and the display are defined by RaceCon.

Dim Level	Resistor Value
Level 1	43,9 Ohm
Level 2	142 Ohm
Level 3	264 Ohm
Level 4	409 Ohm
Level 5	609 Ohm
Level 6	846 Ohm

5.2 Output channels

5.2.1 PWM output

The DDU 8 has 4 low side switch outputs controlled by pulse width modulation (PWM). Each switch is rated 2 A max current. Maximum PWM switch frequency is 8 kHz with a 0 % ... 100 % duty cycle. Each output is short circuit protected to GND and battery voltage. It is mandatory to connect the LS_PWM pins to vehicle GND as indicated in the circuit diagram when using the PWM outputs.

5.2.2 Sensor power supply

The DDU 8 has three types of sensor power supply: 12 V unregulated battery voltage, 5 V and 10 V regulated voltage. The 12 V unregulated output is fused and rated 1 A max. The regulated 5 V and 10 V outputs can deliver 350 mA each. They are short circuit protected to battery voltage and GND.



5.3 Communication channels

5.3.1 CAN bus

The DDU 8 has 2 CAN buses configurable as input and output. Different baud rates are selectable. Please note that the DDU 8 does not contain any CAN termination resistors. Thus the CAN termination resistors need to be integrated into the wiring loom.

5.3.2 Ethernet channels

The DDU 8 has three 100 MBit full duplex Ethernet communication ports. The ports are internally connected with an Ethernet switch. The Ethernet ports have 'cable auto crossover' functionality.

5.3.3 RS232 ports

The DDU 8 has two RS232 serial ports. Baudrate for both ports is programmable. RS232 port 1 is reserved for online telemetry, port 2 can be used for reception of data from a serial GPS receiver.

5.3.4 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: AS 0-12-35SN

Pin	Name	Description	Used for DDU 8
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	+



5.4 Pin layout life connector

Life Connector ASDD-2-12-41PN (Red)

Pin	Name	Description	Direction	Remark
1	UBATT (Kl. 30)	power supply Ubat	input	
2	switched positive KI.15	switched power supply Ubat	input	
3	switched positive Kl.15	switched power supply Ubat	input	
4	unit ground (Kl. 31)	ground power supply	input	
5	unit ground	ground power supply	input	
6 7 8 9	ETH1_TX+ ETH1_TX- ETH1_RX+ ETH1_RX-	Ethernet interface 1 (10/100BaseT)	bidirectional dataline	
10	ETH_SCR	screen for Ethernet	screen	
11 12 13 14	ETH2_TX+ ETH2_TX- ETH2_RX+ ETH2_RX-	Ethernet interface 2 (10/100BaseT)	bidirectional dataline	
15 16 17 18	ETH3_TX+ ETH3_TX- ETH3_RX+ ETH3_RX-	Ethernet interface 3 (10/100BaseT)	bidirectional dataline	
19 20	CAN1_H CAN1_L	CAN interface 1 (up to 1 MBit/s)	bidirectional dataline	MS 3/MS 4 CardMemory
21 22	CAN2_H CAN2_L	CAN interface 2 (up to 1 MBit/s)	bidirectional dataline	
23 24 25 26	USB_Power USB_DP USB_DM USB_GND	USB power USB data + USB data - USB ground	input input input input	
27	SENSPWR5_1	5 V power supply for analog sensors	output	
28	SENSGND_1	sensor ground 1	output	
29	TimeSync	signal of synchronisation	inout	used for timing of system components
30	LS_GND_1	PWM ground	output	
31	LS_SWITCH_1	PWM lowside switch 1	input	
32	LS_SWITCH_2	PWM lowside switch 2	input	
33	LS_SWITCH_3	PWM lowside switch 3	input	
34	LS_SWITCH_4	PWM lowside switch 4	input	
35	LS_GND_2	PWM ground	output	
36	ANA01: Page select	analog signal 1	input	
37	ANA02: Brightness select	analog signal 2	input	
38	ANA03: Alarm reset	analog signal 3	input	
39	ANA04	analog signal 4	input	
40	ANA05	analog signal 5	input	
41	ANA06	analog signal 6	input	



5.5 Pin layout sensor connector

Sensor Connector ASDD-2-12-41PA (Yellow)

Pin	Name	Description	Direction	Remark
1	UBATT_FUSE1	battery voltage supply	output	
2	SENSPWR10_1	10 V power supply for analog sensors	output	
3	SENSPWR5_2	5 V power supply for analog sensors	output	
4	SENSPWR5_3	5 V power supply for analog sensors	output	
5	SENSPWR5_4	5 V power supply for analog sensors	output	
6	SENSGND_2	sensor ground 2	output	
7	SENSGND_3	sensor ground 3	output	
8 9	RS232_1_TX RS232_1_RX	RS232_1 transmit data RS232_1 receive data	bidirectional dataline	used for telemetry link
10 11	RS232_2_TX RS232_2_RX	RS232_2 transmit data RS232_2 receive data	bidirectional dataline	used for GPS- sensor
12	RS232_GND	RS232 ground		
13 14	REV1_P REV1_M	speed signal 1 positive (ind. and hall) speed signal 1 negative (ind.)	input	
15 16	REV2_P REV2_M	speed signal 2 positive (ind. and hall) speed signal 2 negative (ind.)	input	
17 18	REV3_P REV3_M	speed signal 3 positive (ind. and hall) speed signal 3 negative (ind.)	input	
19 20	REV4_P REV4_M	speed signal 4 positive (ind. and hall) speed signal 4 negative (ind.)	input	
21	ANA07	analog signal 7	input	
22	ANA08	analog signal 8	input	
23	ANA09	analog signal 9	input	
24	ANA10	analog signal 10	input	
25	ANA11	analog signal 11	input	
26	ANA12	analog signal 12	input	
27	ANA13	analog signal 13	input	
28	ANA14	analog signal 14	input	
29	ANA15	analog signal 15	input	
30	ANA16	analog signal 16	input	
31	ANA17	analog signal 17	input	
32	ANA18	analog signal 18	input	
33	ANA19	analog signal 19	input	
34	ANA20	analog signal 20	input	
35	ANA21	analog signal 21	input	
36	ANA22	analog signal 22	input	
37	ANA23	analog signal 23	input	
38	ANA24	analog signal 24	input	
39	ANA25	analog signal 25	input	
40	ANA26	analog signal 26	input	
41	LAP_TRIG	laptrigger input	input	





7 Starting up the DDU 8

7.1 Before starting

Install the software required for DDU 8 operation. It is developed for Windows 2000/XP/Vista/7. Following software versions are used in this manual:

- DDU 8 setup, configuration and calibration: RaceCon 2.1.0
- Measurement data analysis: WinDarab V7

Set up the 100 Mbit Ethernet connection to the DDU 8.

- All three Ethernet ports of DDU 8 are internally connected by a network switch
- All Ethernet ports have 'cable auto crossover' functionality

Pin	Description
Pin 1+2+3	12 V supply voltage
Pin 4+5	GND supply voltage
Pin 6	Ethernet Tx+
Pin 7	Ethernet Tx-
Pin 8	Ethernet Rx+
Pin 9	Ethernet Rx-
Pin 10	Ethernet Screen

Minimum wiring loom of the Life connector (red):

7.1.1 Setting up the network interface

The DDU 8 contains a DHCP server, network addresses can be assigned automatically to the configuration PC. The DDU 8's IP address is 10.10.0.207.

- 1. Switch off the PC's firewall.
- 2. Set up the PC's network interface as shown in the screenshots.



7.1.2 Starting the DDU 8

The DDU 8 powers up by turning on the ignition of the car. At startup the DDU 8 will display a Bosch logo.



After a moment the DDU 8 shows a display element screen.

The 'Link LED' at the PC's network adapter will illuminate.

If the LED is off, check the wiring harness.

7.1.3 About RaceCon

RaceCon is an all integrated software tool for configuration and calibration of Bosch Motorsport hardware products. It is used to set up, configure and calibrate the DDU 8.

For better understanding, Bosch Motorsport offers a video tutorial that explains many functions of RaceCon.

The video tutorial is available in the 'Software Download' section of www.bosch-motorsport.com.



7.1.4 Connecting the DDU 8 to RaceCon

The following screenshot shows an overview of the RaceCon Main Screen with its areas. All (sub-) windows are resizable and dockable.

New Project - RaceCon		_ _ _ _ ×
Elle Edit View Extras Help		
	• • • Design mode > = 102 1 MBt/s • • Online • (0, • • 0, Race Mode) + 1 00 .	
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		DDU5
Project		n DDU6
		DDU8
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		I I OOIDOX
		MS15 Sport
ļ		II MS3.1
Data - New Project 🛛 📮 🗙		MS4.0
Search:		M54.2
Used Name		MS4.3
1 dile		MS5.0
		MS5.1
Data Area		MS5.2
Dala Alea		MS5.5
		MS15.1
		MS15.2
		PDB
		Custom ECU
		Data logging systems
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riopettes - New Floject 4 X		📾 BT60
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Security	Type Time Sender Message	TABLE M-A6
Protection False		EM-D1
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image.	Info/Statue Dt CâN Los, storned	Measurement sources
	The second Physics and a second s	Macro actions
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1. Start the RaceCon software.

RaceCon	
File Edit View Extras Help	
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RaceCon	
Last Projects	
	Theory of Villeville Tradecistics Tradecistics
	No tudorals available
.0.6	
Ouick Start	
Open an example Configuration	
Bash	





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



3. In the Toolbox select the DDU 8 and drag it into the Main Area. A pop up window to specify the DDU 8 program archive appears.

We tota Web Web cone to Reaction Web years Used New Project Web years Web years Web years			_1#1×
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Used T. Name Loger program active: Used T. Name Loger program active:	Gall New Project		Devices Displays DDU4
Lind T. Name Logar program archive Logar pro		Drag + Drop	DDU6 DDU6 DDU6 DDU7 DDU8 DDU8
Used T. Name Name NS51 Used T. Name NS524			MS3 Sport MS4 Sport MS4 4 Sport MS4 4 Sport MS15 Sport
Utad T. Name Logar program active: Logar pro	· · · · · · · · · · · · · · · · · · ·	Create a new DOUR XI Specify datalogger program archive Select a program archive to the datalogger.	MS3.1 MS4.0 MS4.2 MS4.3 MS4.4
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Custom ECU			M MS152 MS24.3 MS24.4 PDB Bypers ECU
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3 Security GAN modules	Security	Tore Carden Marcone	CAN modules
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The current system overview Measurement occurrent	e current system overview		Measurement sources
Deckgrown mage	Aground mage.	•f (•f)	Macro actions





An information shows that the archive is valid or not.

- 4. Select the program archive delivered with the DDU 8 (.PST file).
- 5. Click 'Next'.

Create a new DDU8	×
Configure settings	
Configure settings of the datalogger.	
Application:	
Race track	•
Display switch:	
Rotary switch	•
< <u>B</u> ack <u>N</u> ext > <u>F</u> inish	<u>C</u> ancel
	11.

6. Select 'Race track'.

7. Choose the way to switch display pages that fits to your hardware configuration. For more information see chapter '8.4 Page select.

8. Click 'Finish'.

The DDU 8 is inserted into the project and RaceCon tries to connect to the device.





RaceCon detects configuration differences between the DDU 8 and the RaceCon project and asks for permission for data download.

9. Click 'OK' to proceed.



The download starts and the DDU 8 carries out a reset.





After the reset RaceCon reconnects to the DDU 8. Local configuration on both the PC and DDU 8 match (Indicated by green background and dot). The DDU 8 is now connected to RaceCon.







7.2 Feature activation

- Optional software feature packages are available for the DDU 8.
- 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 DDU 8 does not work on any other DDU 8
- If you have not purchased an option package, the next steps can be skipped.

1. To activate a feature, double-click on 'DDU 8' in the Project Tree and click on the 'Features info' tab in the Main Area.



The 'DDU 8 features info' window appears.





2. Double-click on the feature you want to activate.

A feature unlock window appears.



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

CU ID [7000000.9e2cef2d Copy to clipboard] Status/Unlock Order informations Name Description UPGRADE1 F02U.V00.701-01 - DDU8 UPGRADE 1, DATA LOGGER UPGRADE2 F02U.V00.701-01 - DDU8 UPGRADE 2, 20 ANA CHAN, 2ND CONN UPGRADE3 F02U.V00.871-01 - DDU8 UPGRADE 3, CCP MASTER, MEASURE 3, RD PARTY ECU UPGRADE4 F02U.V00.871-01 - DDU8 UPGRADE 4: USB-PORT UNLOCKED	DU8 fea	atures info	
Status/Unlock Order informations Name Description UPGRADE1 F02U.V00.701-01 - DDU8 UPGRADE 1, DATA LOGGER UPGRADE2 F02U.V00.701-01 - DDU8 UPGRADE 2, 20 ANA CHAN, 2ND CONN UPGRADE3 F02U.V00.796-01 - DDU8 UPGRADE 3, CCP MASTER, MEASURE 3, RD PARTY ECU UPGRADE4 F02U.V00.871-01 - DDU8 UPGRADE 4: USB-PORT UNLOCKED	ECU ID	f7000000:	9e2cef2d Copy to clipboard
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Name Description PUPGRADE1 F02U V00.701-01 - DDU8 UPGRADE 1, DATA LOGGER UPGRADE2 F02U V00.702-01 - DDU8 UPGRADE 2, 20 ANA CHAN, 2ND CONN UPGRADE3 F02U V00.796-01 - DDU8 UPGRADE 3, CCP MASTER, MEASURE 3.RD PARTY ECU UPGRADE4 F02U V00.871-01 - DDU8 UPGRADE 4, US8-PORT UNLOCKED	Statu	is/Unlock 0rd	Jer informations
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UPGRADE3 F02U.V00.796-01 · DDU8 UPGRADE 3, CCP MASTER, MEASURE 3.RD PARTY ECU UPGRADE4 F02U.V00.871-01 · DDU8 UPGRADE 4: USB-PORT UNLOCKED		UPGRADE2	F02U.V00.702-01 - DDU8 UPGRADE 2, 20 ANA CHAN, 2ND CONN
UPGRADE4 F02U.V00.871-01 - DDU8 UPGRADE 4: USB-PORT UNLOCKED		UPGRADE3	F02U.V00.796-01 - DDU8 UPGRADE 3, CCP MASTER, MEASURE 3.RD PARTY ECU
		UPGRADE4	F02U.V00.871-01 - DDU8 UPGRADE 4: USB-PORT UNLOCKED
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- 4. Perform these steps to activate other features you purchased.
- 5. Switch the car's ignition off and on again to cycle the power of the DDU 8.



7.3 1st display configuration (Quick Start)

This chapter explains the configuration of a display element showing the battery voltage. See chapter '8.2 Display element configuration' for a detailed instruction to configure display elements.

- 1. Expand the DDU 8 Project Tree by clicking '+'.
- 2. Double-click on 'New Page'.

The DDU 8 display configuration area opens.





3. Drag a 'Large Element' from the Toolbox and drop it on the display page.

A message in the 'Large Element' box shows that it is not linked to a measurement channel.



- 4. In the DDU 8 Project Tree, click on 'DDU 8' to display the available measurement channels.
- 5. In the data window, scroll down to 'ub' (measurement channel for battery voltage).





6. Drag the 'ub' measurement channel from the Data Area and drop it on the 'Large Element'.



7. Right-click on 'DDU 8' in the DDU 8 Project Tree and choose 'Download Configuration'.





BOSCH

The configuration download starts and the DDU 8 carries out a reset.



The value of the battery voltage is displayed on the DDU 8.





7.4 1st recording (Quick Start)

This chapter explains the configuration of the recording of the battery voltage channel. See chapter '12 Recording and telemetry'for a detailed instruction to configure recordings.

This function requires the installation of Software Upgrade 1.

For data recording on the DDU 8, the software upgrade 'DDU 8 Datalogger' must be activated. See chapter '7.2 Feature activation' for an instruction to activate software upgrades on DDU 8.

- 1. Expand the DDU 8 Project Tree by clicking '+'
- 2. Expand the Logger Tree by clicking '+'.
- 3. Double-click on 'Recording'.

The DDU 8 recording configuration area opens.





- 4. In the DDU 8 Project Tree, click on 'DDU 8' to display the available measurement channels.
- 5. In the data window, scroll down to 'ub' (measurement channel for battery voltage).



6. Drag + drop the 'ub' measurement channel into the recording area.

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7. Right-click on 'DDU 8' in the DDU 8 Project Tree and choose 'Download configuration'.



The configuration download starts and the DDU 8 carries out a reset.

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Source DDU0	U 07:55:00 DDUB Successfully connected to device(Ethernet/VCP)	-
Condition	U 07:55:00 DDU8 EPK check successful (EPK Device: DDU8_RASE_0507)	-
Relevenced condition of the channel	07.25:00 DDU0 Local reference page data differs with ecu reference page data.	
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As we did not define global start conditions, recording starts immediately.



- 8. Start the WinDarab software.
- 9. Disconnect the DDU 8 network cable.
- 10. Click on the 'Import/Export' icon.
- 11. Select 'Data logger C50/C55/C60/DDU7/DDU8' and click 'OK' when done.

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The 'Read measurement Data' dialog opens.

- 12. Click on 'Modify' button and select the base folder.
- 13. Choose 'FTP' as data transmission method.
- 14. Choose 'DDU8 10.10.0.207' in the Vehicle dropdown list.
- 15. Activate 'Auto save'.
- 16. Click 'Save' when done.

	Data logger C55/C60/DDU8: Read measurement data	
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	Basefolder: C:/Bosch/WinDarab 7/DATA/DataFiles Subfolder:	
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	Free disk space drive C: 196 GB Image: Auto Save Image: Auto Replace	<u>C</u> lose



17. Connect the DDU 8 network cable.

Data transmission from the DDU 8 starts automatically.

Measurement files are stored automatically in the base folder.

Templates for fo	lder- and filenam	ies			<u>M</u> odify
Basefolder:	C:/Bosch/Winl	Darab 7/DATA/DataF	iles		
Subfolder:					
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Linked files:					*
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- 18. Click on 'Close' when transmission has finished.
- 19. Click on the Start button and choose 'Open measurement file'.
- 20. Select the measurement files from the storage folder.
- 21. Click on 'Open'.
- 22. Click in 'New Desktop' to open a new measurement data window.

23. Drag the 'ub' measurement channel from the Channel list and drop it into the measurement data window. 'ub' measurement channel's graph is displayed.

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



8 Display configuration

- DDU 8 features 800 x 480 full color TFT display + 10 color LEDs
- Display and LEDs are fully configurable
- ECU channels, analog channels, and CAN channels can be displayed
- Display elements: large numeric, medium numeric, bar graph style, alarm messages, static elements, image element
- DDU 8 supports up to 12 display pages, 6 brightness settings for display and LEDs

8.1 Display page setup

8.1.1 Organizing display pages



- All Pages: Display elements placed on this page are displayed on all pages. Recommended for "Alarm" display elements.
- Single Page: Display elements placed on this page are displayed only on this page.

The priority of display elements placed on "All Pages" is higher than the priority of display elements placed on single pages.

Example: An Alarm placed on "All Pages" is displayed on all display pages and is always in front of other display elements.





8.1.2 Adding a new display page

Right-click on 'Display' and click 'Add Page' in the menu.

	Open	
8	Add page	
۲	Export	
۲	Import	
P	Properties	

A new empty page opens.

8.1.3 Selecting display pages

In the DDU 8 Project Tree, click on 'DDU 8', then on 'Display' and double-click on the page you want to select (example: 'New Page').



In the Main Area, a representation of the DDU 8 opens.





8.2 Display element configuration

8.2.1 Numeric display element

Adding a numeric display element to display page

The 'Large Element' and the 'Medium Element' numeric display elements differ in element and font size. The element and font size can be changed using the Numeric Wizard.

1. Drag a numeric display element from the Toolbox and drop it on the display page. A message in the numeric element box shows that it is not linked to a measurement channel.



2. Drag a measurement channel from the Data Area and drop it on the numeric display element.



The measurement channel is linked to the numeric display element.



Note: In this view the displayed values are random values and do not show the real values of the measurement channels.

Configuring a numeric display element

1. Double-click on the numeric display element. The Numeric Wizard window opens.

	Numeric Wizard	X		
	Configure the numeric element See configuration changes live on the display behind			
	General Conditional Formatting			
a) — b) — c) — d) —	Iitle: ub Value Text: <channel value=""> Channel: Image: walk Display type: Value</channel>	Format Eont size: Normal Alignment: MiddleRight Borderstyle: Single line Background: 0; 0; 0 Foreground: 255; 255; 255	— <i>f</i>)	
e) —	Decimal places:	Extended	— g)	
		<u>Q</u> k <u>C</u> ancel		

a) Enter the title displayed on top of the numeric display element.

b) Enter the text displayed in the middle of the numeric display element.

The variable <channel value> displays the value of the measurement channel.

c) Choose the measurement channel.

d) Choose the type of input data:

- Value
- Gear
- Time (in different formats)

e) Enter the number of decimal places of the measurement channel.

f) Choose the font size, alignment, borderstyle, background and foreground color of the numeric display element.

g) Click the Extended button to show further options to change the color of the title, border and text individually.

2. Click 'OK' when done.


8.2.2 'Bargraph' display element

Adding a 'Bargraph' display element to display page

Drag the 'Bargraph' display element from the Toolbox and drop it on the display page.

Configuring a 'Bargraph' display element

1. Double-click on the 'Bargraph' display element. The Bargraph Wizard window opens.

	Bargraph W	/izard				×	
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						111	

- a) Enter the title displayed on top of the 'Bargraph' display element.
- **b)** Choose the measurement channel.

c) Define the tick text corresponding with the physical value. You can add more tic labels by entering values in the row labeled with *.

- d) Choose the orientation of the Bargraph (horizontal or vertical).
- e) Chose the color mode of the Bargraph:
 - Solid: The whole Bargraph and tics are colored in one color
 - Stacked: The Bargraph is subdivided in segments with different colors. The colors are set in the tab 'Conditional Formatting'. For details, see chapter '8.2.5 Conditional formatting'.
- f) Define if ticks and numbers are shown.
- g) Choose the style of the border lines.
- h) Enter the physical value where the Bargraph begins.
- i) Enter the physical value where the Bargraph ends.
- **j)** Choose the background color of the Bargraph.
- **k)** Choose the foreground color of the Bargraph.

I) Click the Extended button to show further options to change the color of the title, border and text individually.



2. Click 'OK' when done.

Note: The tab 'Conditional Formatting' is explained in chapter '8.2.5 Conditional formatting'.

8.2.3 'Alarm' display element

The 'Alarm' display element displays a warning message in case of a defined condition becoming 'true'. In case of a condition becoming 'false', the 'Alarm' display element is not shown.

Two types of 'Alarm' display elements are available:

- Alarm: An alarm displaying a defined text
- Alarm Icon: An alarm displaying a defined image (e.g. a warning triangle)

Adding an 'Alarm' display element to display page

Drag an 'Alarm' element from the Toolbox and drop it on the display page.

Configuring an 'Alarm' (text) display element

1. Double-click on the 'Alarm' display element.

The Alarm Wizard window opens.

	Alarm Wizard	×	
	Configure the alarm element See configuration changes live on the display behind	TXT WARNING	
a) b) c) d) e)	General Alarm representation Conditional Formatting Itle: battery_voltage Eont size: Normal Cgndition: Image: Distance of the size of the siz	Y Y Y Y	— в)
f)	Decimal places:	<u>Cancel</u>	

a) Enter the title displayed on top of the 'Alarm' display element.

b) Choose the condition when the alarm will be activated:

- Create a condition using the Condition Creator. For more information see chapter '8.7.1 Creating a new condition channel'.
- Choose an existing condition

The Alarm is displayed if function is 'TRUE', i.e. result of the calculation is >0.

c) Enter the alarm message displayed in the middle of the 'Alarm' display element. Enter the variable <channel value> to display the value of the measurement channel.

d) Choose the measurement channel.



e) Choose the type of input data:

- Value
- Gear
- Time (in different formats)

f) Enter the number of decimal places of the measurement channel.

g) Choose the font size, alignment, borderstyle, background and foreground color of the 'Alarm' display element.

2. Switch to the tab 'Alarm representation'.

	Alarm Wizard	×
	Configure the alarm element See configuration changes live on the display behind	WARNING
a) b) c) d) e)	 General Alarm representation Conditional Formatting Beset mode: resettable Image: Conditional Formatting Bink mode: off Image: Conditional Formatting Image: Conditional Formatting Image: Conditional Formatting Image: Conditititititititititititititi	<u>C</u> ancel

- a) Choose if the alarm can be reset or not.
- **b)** Choose if the alarm blinks slowly, fast or does not blink.
- c) Enter the minimum time the Alarm display element is displayed if an alarm is triggered.

d) Enter the time until the Alarm resets automatically after the minimum display time entered in c). Only possible if Alarm is resettable.

e) Enter the time until the Alarm can appear again after a reset.

- 3. Click 'OK' when done.
- 4. Copy alarm to all display pages by clicking 'Move to' -> 'All Pages'.





Configuring an 'Alarm Icon' (image) display element

1. Double-click on the 'Alarm Icon' display element. The Alarm Icon Wizard window opens.

Alarmicon Wizard	×
Configure the alarm icon element Enable 'Use transparency' to define parts of the image as tranparent.	TXT WARNING
General Alarm representation	
Select picture:	
Condition:	1
Use image transparency	
▶ <u>C</u> olor key:	[
Iolerance:	
<u>k</u>	<u>C</u> ancel

a) Select the image from the hard drive that is shown in case of an alarm.

b) Choose the condition when the alarm will be activated:

- Create a condition using the Condition Creator. For more information see chapter '8.7.1 Creating a new condition channel'.
- Choose an existing condition

The 'Alarm Icon' is displayed if function is 'TRUE', i.e. result of the calculation is >0.

c) Enable the checkbox if you want to define parts of the image as transparent.

d) Select the basic transparent color key. This means that any pixel of the image near (depending of the tolerance value) to this color gets transparent.

e) Select a tolerance in percent to define parts of the image as transparent.

2. Switch to the tab 'Alarm representation'. It is configured in the same way as the 'Alarm' text display element.

3. Click 'OK' when done.

Note: If several active alarms in the display overlap, each alarm is in the foreground for 2 seconds.



8.2.4 Other display elements

Two types of other display elements are available:

- Label: A label displaying a specified text
- Picture element: An element displaying a static picture (e.g. temperature warning)

Adding a Label or picture display element to display page

Drag the Label or picture display element from the Toolbox and drop it on the display page.

Configuring a Label display element

1. Double-click on the Label display element.

The Label Wizard window opens.

	Label Wizard		×	
	Configure the label display element See configuration changes live on the displa	ay behind	TXT	
	General			
a) b)	 Ţitle: Te <u>x</u> t: Label	Format Eont size: Normal Alignment: MiddleCenter Borderstyle: Single line Background: 0; 0; 0 Foreground: 255; 255; 255		— c)
		Sextended		— d)
			ancel	

a) Enter the title displayed on top of the Label display element.

b) Enter the text displayed in the middle of the Label display element.

c) Choose the font size, alignment, borderstyle, background and foreground color of the Label display element.

d) Click the Extended button to show further options to change the color of the title, border and text individually.





Configuring a Picture display element

Supported image file formats are: bmp, jpg, gif, png, tif

1. Double-click on the Picture display element. The Picture Wizard window opens.

	Р	icture Wizard
		Configure the image element Enable 'Use transparency' to define parts of the image as transparent.
		General
a) -	-	Select picture:
b) -	-	Use image transparency
c) -	-	> Color key: 0; 0; 0
d) -		▶ <u>I</u> olerance:
		<u>k</u> ancel

a) Select the image from the hard drive.

b) Enable the checkbox if you want to define parts of the image as transparent.

c) Select the basic transparent color key. This means that any pixel of the image near (depending of the Tolerance value) to this color gets transparent.

d) Select a tolerance in percent to define parts of the image as transparent.



8.2.5 Conditional formatting

This function pigments the displayed values in dependence of a specified measurement channel value.

Example: The text color changes from white to red when the battery voltage is fewer than 12 V.

Conditional Formatting is available at numeric, 'Bargraph' and 'Alarm' display element.

1. Double-click on the display element. The Numeric Wizard window opens.

2. Switch to the tab 'Conditional Formatting'.

	Num	neric Wizard						J	×
	Ca	onfigure the nume See configuration cl	NUM 88888	8					
	0	General Conditiona	Formatting						
a)	 • •	 Use jower limit 			ľ	✓ Use <u>upper limit</u>			
	ſ	Lower limit			1 [Upper limit			
b)	 	Limit value:		12 ≑		Limit value:		14 🛨	
c)	 	Reset hysteresis:		0 ÷		Reset hysteresis:		 0÷	
d)	 _	Borderstyle:	Double line	-		Borderstyle:	Double line	 •	
		Background:	0; 0; 0	•		Background:	0; 0; 0	 •	
		Foreground:	255; 0; 0	-		Foreground:	0; 255; 0	 •	
e)	 -	Extended				Section Extended			
							<u></u> k	<u>C</u> ancel	

The lower and the upper limits are configured in the same way.

a) Check the box to activate the formatting at a lower limit.

b) Enter the limit value when the formatting is active.

c) Enter the limit value when the reset hysteresis function is active. The reset hysteresis function avoids the high-frequent switchover of the measurement channel value.

d) Choose the borderstyle, background and foreground color of the numeric display element.

e) Click the Extended button to show further options to change the color of the title, border and text individually. If a 'Bargraph' display element is used, its colors can also be changed.



8.2.6 Context menu

The context menu appears by right-clicking on a display element.

	Copy to	•	├ →	Copy element to different page or all pages
	Move to	•		Move element to different page
	Change to	•	├ →	Change type of display element
	Remove channel		├ →	Remove assigned measurement channel
\times	Delete			Delete element
۹.	Bring to front			Manage overlapping elements
5	Send to back			
	Add to library			Insert element into library in toolbox
P	Properties		├ →	Show and edit properties

8.3 LEDs

The LEDs are fully configurable to show the optimal shifting point. They can also be configured to flash in case of a customized condition becoming 'true'.

8.3.1 Configuring shift LEDs

To use shift LEDs, RPM and gear measurement channels an ECU has to be loaded in RaceCon.

- 1. In the display view, click on the tab 'LEDs'.
- 2. Click on the button 'Add shift lights'





The shift light configuration window appears.

	S	nift light co	nfiguration								<u>×</u>	l	
		Edit the sh Shift lights	i ft light cor are available	nfiguratior e only once	n perDDU8!S	elect at lea:	st a revolutio	n channel to	enable the :	shift lights o	n the device.		
	ſ	Input config	guration										
a) —	-	• <u>R</u> evolution	channel	🛄 📑 nm	not		-	<u>G</u> ear	channel 📕	📕 📑 gear		t	- <i>f</i>)
b) —	-	Use RF	PM hysteresis		0 🗧 rpm			i	Needs an inj	put in ASCII	format (e.g. gear_ddu). Gear Lookup		
		- Deltere abd							can be asea				
,		rattern styl	e selection a	na revolutio	in to gear ma	pping							
c) —		Select Patt	ern <u>s</u> tyle						-				
d) —	-	Default	1	2	3	4	5	6	7	8	Selected LED pattern		
		6800	6800	6800	6800	6800	6800	6800	6800	6800			
		6700	6700	6700	6700	6700	6700	6700	6700	6700			
		6600	6600	6600	6600	6600	6600	6600	6600	6600			
e) —	-	6500	6500	6500	6500	6500	6500	6500	6500	6500	$\bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \oslash \oslash \oslash$		
		6400	6400	6400	6400	6400	6400	6400	6400	6400			' B)
		6300	6300	6300	6300	6300	6300	6300	6300	6300			
		6200	6200	6200	6200	6200	6200	6200	6200	6200			
		6100	6100	6100	6100	6100	6100	6100	6100	6100	$\bullet \bullet \bullet \circ \circ$		
		6050	6050	6050	6050	6050	6050	6050	6050	6050	$\bullet \bullet \circ \circ$		
		6000	6000	6000	6000	6000	6000	6000	6000	6000	\bullet 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
											<u> </u>		

3. Set up the shifting lights using the following configuration possibilities:

a) Choose the measurement channel for 'Revolution'. Revolution must have 1/min quantization.

b) Enter the limit value when the RPM hysteresis function is active. The RPM hysteresis function avoids the high-frequent switchover of the measurement channel value.

c) Choose a predefined Pattern style.

d) Define the gear (must be ASCII quantization). Only if gear channel is used.

e) Define the RPM-limits individually for each LED and each gear.

f) Choose the measurement channel for 'Gear'. Gear must have an ASCII quantization (1st gear='1' = 49, 2nd gear='2'= 50, ...). (ASCII quantization is standard for the 'gear' channel of Bosch ECUs. If you get the gear information of a different control unit as the Bosch ECU (e.g. a gearbox control unit), use the Gear Lookup Table to translate numeric values to ASCII format. For more information see chapter ''8.3.2 Converting a gear channel to ASCII representation.)

g) Choose the number and color of the LEDs corresponding to the RPM-limits shown in the table. You can choose the number and color of each LED individually by right-clicking.

4. Click 'OK' when done.

The configuration is displayed in the DDU 8 LED Configuration window.





8.3.2 Converting a gear channel to ASCII representation

If you get the gear information of a different control unit as the Bosch ECU (e.g. a gearbox control unit), use the Gear Lookup Table to translate numeric values to ASCII format.

- 1. Click on the Measurement Sources button in the Toolbox.
- 2. Drag the 'Gear Lookup Table' symbol and drop it in the 'Computed Channels' folder.



The Gear Lookup Table Wizard appears.

3. Set up the settings as shown in the screenshot.

	Gear Look Gear loo Specify	up Table Wizard - Add New kup table properties a mapping between input value	es and corresponding output (AS	SCII) values.	× <i>f</i> x	
This column shows the numeric value of the input channel	Mappir	g: Input Value 2 3 4 5 5 6 7 0	Curput (ASCII) Curput (ASCII)	Input channet		Choose the input channel of the gear information Enter the default ASCII value that is set if no output value is entered in
This column shows the ASCII value of the output channel			<back 1<="" td=""><td>lext > Enish</td><td><u>Cancel</u></td><td>the table</td></back>	lext > Enish	<u>Cancel</u>	the table



4. Click 'OK' when done.

The 'Create channel on DDU 8' window appears.

5. Enter the name and an optional description of the translated ASCII measurement channel.

Create Channel				
Set the unique name for th	e channel and	l add an opti	onal descr	iption. 🦳
Name:				
gear_ASCII				
Description:				

6. Click 'Ok' when done.

A graphic shows the connection between the input and output channels. The measurement channel can now be used in the shift LED configuration.



8.3.3 Creating customized LED pattern

You can create your own LED pattern with an individually created condition. The LEDs flash if the condition becomes true.

1. Click on the button 'Add pattern' in the display view.

The LED pattern configuration window appears.

	LED pattern configuration	
	Edit LED pattern 2 Select possible LED colors directly on the pattern by contextmenu!	
a)	Pattern	
b)	Mode Pattern selection C Solid © Blink slow C Blink fast Run demo C Display 'on' pattern C Display 'off' pattern	d)
c) —	Condition	
	L	

a) Choose the number and color of the LEDs by right-clicking.

b) Select if the LEDs blink or do not blink.

c) Choose the condition when the LEDs will flash.

- Create a condition using the Condition Creator. For more information see chapter '8.7.1 Creating a new condition channel'.
- Choose an existing condition

d) Check the box to show a demo of the LEDs. (Important to check blinking)

To create a LED that alternately blinks in two different colors, choose 'Display "on" pattern' and define the LEDs in the one color. Then choose 'Display "off" pattern' and define the LEDs in the other color.

2. Click 'OK' when done.

The configuration is displayed in the DDU 8 LED Configuration window.





8.3.4 Assigning display pattern priority

You can assign the priority of the created display pattern and shift lights.

The 1st display pattern is activated before all following pattern if its condition is 'true'. The 2nd display pattern is only activated if the condition of the 1st display pattern is 'false' or the LEDs of the 1st display pattern are transparent.

Change the priority by clicking the 'Move up' or 'Move down' button.





8.4 Page select

8.4.1 Option 1 – 12 position switch

- 12 position switch connected to analog input ANA01
- 3 kOhm pull-up resistor in DDU 8 automatically activated
- 12 position switch connects resistor to GND (43,9 / 142 / 264 / 409 / 609 / 846 / 1180 / 1650 / 2430 / 3830 / 6980 / 23200 Ohm)

Welcome to RaceCon Red New	Project 📄 Display		X 4 Þ
		• • • •	
	0 1 2 2 ⁿⁿ		
		ar twater	
	105	9	
	oil pressu	re to high	
	throttle lapti	mespeed	
		101.0	
	DDU 8 Motorsport	BOSCH	
		0	
551 page 1 552 page 2 555 brake 5	measurement 1 KS measurement 2 K	🛙 measurement 3 🕅 info page 🕅 Áll	Pages 🔜 LEDs 🖼 Alarms 🖬 👍
Call balls 1 The balls a			
	$\overline{)}$		

Display pages selectable by page select switch

Connection diagram of 12 position switch



Note: If pin ANA01 is open or directly connected to GND, the DDU 8 displays Page 1 by default.



8.4.2 Option 2 - up/down switches

- 'Up switch' connects ANA01 to GND
- Optional 'Down switch' connects ANA01 to GND over a 3 kOhm resistor
- 3 kOhm pull-up resistor in DDU 8 automatically activated
- Application: page control from steering wheel or motorcycle

Display page selected at power-down will show up at next power up automatically.

The software calibration variable DISPLAY_SWITCH needs to be set:

- 0 Rotary switch
- 1 Up/Down switch
- 2 Up/Down switch with wrap around



By default, the DDU 8 is configured for a 12 position rotary switch.

Connection diagram of up/down switches



Note: De-bounce time of switches is 30 ms.





8.5 Display + LED brightness

- 6 position switch connected to analog input ANA02
- 3 kOhm pull-up resistor in DDU 8 automatically activated
- 6 position switch connects resistor to GND (43,9 / 142 / 264 / 409 / 609 / 846 Ohm)



Connection diagram of brightness switch



Write configuration to DDU 8 to activate changed brightness settings!



8.6 Math + condition channels

8.6.1 Math channels

Math channel

- 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

Conditional function

- 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 channels can be used globally in the whole DDU 8 project.

8.6.2 Creating a new math channel

1. Follow the steps shown in the screenshot.





The 'create/edit math channel' window appears.



- 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.
- 3. Click 'Finish' when done.

The math channel is displayed in the DDU 8 math channel window.



8.6.3 Creating a new conditional function

1. Follow the steps shown in the screenshot.





The 'create/edit conditional function' window appears.



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 If-condition becomes TRUE for the first time after power-up
- when 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.

2. Define the conditional function using the following configuration possibilities:

- a) Enter the name of the conditional function.
- **b)** Enter the If-condition. Click on the pencil symbol to open an editor to enter expressions.
- c) Enter the Then-condition. Click on the pencil symbol to open an editor to enter expressions.
- d) Enter the Otherwise-condition. Click on the pencil symbol to open an editor to enter expressions.
- e) Enter the reset value (must be a number).
- 3. Click 'Finish' when done.

The conditional function is displayed in the DDU 8 math channel window.



Example: Setting up a condition for maximum front brake pressure



- 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).
- As '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 that is already set to 40 before, nothing changes.
- When 'p_br_front' rises to 40, the If-condition changes to TRUE again and triggers the THENcondition. Now the reset value (10) is used for 'p_br_front_mx' in the THEN-condition.
- Because 40 is bigger than 10 the new value of 'p_br_front_mx' is 40.



8.7 Condition channels

Condition channel

- 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

Condition combination

- Combination of several (up to 16) condition channels for more complex calculations
- Logical result

All condition channels can be used globally in the whole DDU 8 project.

8.7.1 Creating a new condition channel

1. Follow the steps shown in the screenshot.





The 'create/edit condition' window appears.



- 2. Define the condition channel using the following configuration possibilities:
- **a)** Enter the name of the condition 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 constant.
- 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 minimum 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 high-frequent switchovers.

e) Enter the time the signal of the measurement channel is delayed after its ending.

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.



3. Click 'Ok' when done.

The conditional channel is displayed in the DDU 8 condition channel window.

8.7.2 Creating a new condition combination

1. Follow the steps shown in the screenshot.





The 'create/edit condition combination' window appears.

	Create/edit condition combination	×
	Combine multiple conditions.	fx.
a) ——	Name:	
<i>b)</i> ——	Add AND Add OR Remove Edit	
~)		
	<u> ≪ B</u> ack <u>N</u> ext > <u>Einish</u> <u>C</u> ano	el

2. Define the condition combination using the following configuration possibilities:

a) Enter the name of the condition combination.

b) Create the condition combination in the window.

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

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.

4. Click 'Finish' when done.

The conditional combination is displayed in the DDU 8 condition channel window.



9 CAN bus

DDU 8 has 2 CAN buses. Both buses are fully configurable.

- Baudrate (125 kBit ... 1 MBit)
- 11 Bit or 29 Bit identifiers
- Input configuration: Read messages from CAN bus and convert to DDU 8 measurement / display variables. CAN bus supports row counter configuration.
- Output configuration: Write DDU 8 measurement variables to CAN messages, output frequency and row counter are configurable, CAN gateway functionality (transfer from one bus to the other)

9.1 CAN bus trivia

CAN message

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

CAN bus

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

Configuration of DDU 8 bus data rate in 'Properties' menu

Image: Second secon	Project			
Image: Computed-channels Image: CAN Bus 1 Image: CAN Bus 1 Image: CAN Bus 2 Image: CAN Bus 1 Image: CAN Bus properties Image: CAN Bus properties Image: CAN Bus 1 Image: CAN Bus 1 <td< td=""><td>🖃 🛯 🚛 New Project</td><td></td><td></td><td></td></td<>	🖃 🛯 🚛 New Project			
Properties - CAN Bus 1	Laptrigger			
Calibration Items CAN Bus 1 CAN Input CAN Dutputs CAN Bus 2 Computed-channels Input-channels Macros Macros Macros Measurement Folder 1 Properties - CAN Bus 1 Properties - CAN Bus 1 Macros Measurement Folder 1 Measurement Folder 1 Measurement Folder 1 Macros Measurement Folder 1	🗄 🖕 DDU8			
Properties - CAN Bus 1 Imput Imput-channels Imput-	🔤 🖳 Calibration Items			
Properties - CAN Bus 1	🖃 👘 CAN Bus 1			
Image: CAN Dutputs Image: CAN Bus 2 Image: CAN Bus 1 Image: CAN Bus properties Baud rate Image: Protection 125 kBaud 200 kBaud 500 kBaud 1MBaud	🗌 🔚 🧰 CAN Input			
Image: CAN Bus 2 Computed-channels Input-channels Macros Imput-channels Macros Imput-channels Macros Imput-channels Macros Imput-channels Macros Macros Measurement Folder 1	CAN Outputs			
Properties - CAN Bus 1 ↓ ★	🗊 📄 CAN Bus 2			
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Image: Standard of the second sec	Input-channels			
Properties - CAN Bus 1	Macros			
Properties - CAN Bus 1	Display			
Properties - CAN Bus 1 ✓ ✓				
Properties - CAN Bus 1 ♀ ×	🖃 🛄 Measurement Folder 1			
Properties - CAN Bus 1				
Properties - CAN Bus 1				
Properties - CAN Bus 1				
Image: Second state Image: Second state Image: Second state Image: Second state <th>Properties - CAN Bus 1</th> <th></th> <th>д</th> <th>×</th>	Properties - CAN Bus 1		д	×
CAN Bus properties Baud rate Protection 125 kBaud 250 kBaud 500 kBaud 1MBaud 1MBaud	📰 🧕 🛛 🍞 all 🕞 🤯 standard	• 🗉 • 🕑		
Baud rate 1 MBaud Protection 125 kBaud 250 kBaud 250 kBaud 500 kBaud 1 MBaud	CAN Bus properties			
Protection 125 kBaud 250 kBaud 500 kBaud 1 MBaud	Baud rate	1 MBaud		-
250 kBaud 500 kBaud 1 MBaud	Protection	125 kBaud		1
500 kBaud 1 MBaud		250 kBaud		
1 MBaud		500 kBaud		
		1 MBaud		
Raud rate	Raud rate	L		_
Baud rate of the CAN bus	Baud rate of the CAN bus			
	Dava rate of the entit bus			



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
0x100	0	💁 p_oil		💁 t_oil				
0x100	1	💁 s_dam_fl		💁 s_dam_fr				
0x100	2	💁 s_dam_rl		🤮 s_dam_rr				
Message Id	Row Counter	Payload	Area					

9.2 CAN input

9.2.1 Input configuration

Project	Р Х	
🖃 🚛 New Project		
i		
		Create new channel to read from CAN bus
🖻 📄 CAN Bus 1		
CAN Input New CAN Channel		Import Vector CAN database (DBC) channel configuration
😥 📄 CAN Bus 2 Import from DBC file		
🛅 Computed Cha		
f _x Conditional Ch. 😒 E×port		Export RaceCon CAN input configuration to file
📺 🛫 I/O Channels 🕥 Import		
Macros		
f _{ac} Math Channels T Properties		Import RaceCon CAN input configuration from file
E Logger		
CLP Master		Display CAN bus properties (Baudrate)
🛨 ··· 🛅 Measurement Lontainer		

9.2.2 Create new CAN channel

- 1. Right-click on CAN Input of desired bus (CAN1 or CAN2).
- 2. Select 'New CAN Channel' from menu.
- 3. Insert name and description of channel.





The channel is listed in the Data window and a CAN channel configuration window opens.

Data - C	AN Input								ф,	×
		📑 Show all								
Used	Туре	Name	*	Function	∇	~	Source	*		
	ш)	p_oil					📰 DDU8			

9.2.3 CAN channel configuration





9.2.4 Extracting data from CAN bus

Representation: Byte

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

	C	AN channel p_oil	configuration						
		General							
a)	 •	Label	p_oil						
b)	 •	CAN Id	0÷	hex	🔲 Extende	ed .			
c)	 •	Timeout	0 🛨	ms	Default valu	e 🗌	0 🗧	raw	
d)	 •	🔽 Use multiple	xer 🔕 Hide		Value		0 🗧		
		– Multiplexer –							
		Representation	Bute C B	it					
		Start	0	1	Len	ath		1	
		Тире		1	Enc	lian	• Little	O Big	
				1					
e)		- Data							
-,		Representation	• Byte O B	it					
		Start	0]	Len	ngth		1 ≑	
		Туре	Unsigned 💌]	End	lian	Eittle	e O Big	
f)	 •	0 1	2	3	4	5	6	7	

- **a)** Enter name of the CAN-channel.
- **b)** Enter CAN message ID. Check the box, if extended IDs (29 bit) are used.
- c) If replacement values are used, specify time-out period and raw value.
- d) Check the box, if a multiplexer (row counter) is used.
- e) Enter data position, length and format.
- f) 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.

	AN channel p_oil configura	tion		
	General			
a) ——	Label p_oil			
b) ——•	CAN Id	0 🗧 hex	Extended	
c) —	<u>T</u> imeout	0 🗧 ms	Default value	0 🗧 raw
d) —	🗹 Use multiplexer 🛛 🙆	Hide	Value	0
	Multiplexer			
	<u>R</u> epresentation C Byte	💿 Bjt		
	Start	0 🗧	Length	1 🗮
	Type Unsigne	ed 🔽	Endian	⊙ Little ⊖ Big
	- Data			
	L Dala			
e) ——•	Bepresentation C Bute	(⊂ B)		
e) ——•	Bepresentation C Byte	⊙ Bjt	Longth	7
e)	Bepresentation C Byte	• Bjt	Length	7
e)	Bepresentation C Byte Start Type Unsigne	● Bjt 25 ÷	Length Endian	7.≢ ⊙Little OBig
e)	Bepresentation C Byte Start Type Unsigne	● Bjt 25÷	Length Endian	7 .€ Little C Big
e)	Bepresentation C Byte Start	Bit 25 4 3 2	Length Endian	7≝ € Little C Big
e)	Bepresentation C Byte Start	Bit 25 4 3 2	Length Endian	7 <mark>:</mark> € Little O Big
e)	Bepresentation C Byte Start	 ● Bit 25 → ad ▼ 4 3 2 	Length Endian	7 <u>≓</u> €Little O <u>B</u> ig
e)	Bepresentation C Byte Start	● Bit 25 ed ▼ 4 3 2 	Length Endian	7 <u>≢</u> €Little O <u>B</u> ig
e)	Bepresentation C Byte Start	Bit 25 4 3 2 4 -	Length Endian	7≝ €Little O Big
e)	Bepresentation C Byte Start	Bit 25 25	Length Endian	7≝ €Little C Big

- **a)** Enter name of the CAN-channel.
- **b)** Enter CAN message ID. Check the box, if extended IDs (29 bit) are used.
- c) If replacement values are used, specify time-out period and raw value.
- d) Check the box, if a multiplexer (row counter) is used.
- e) Enter data position, length and format.
- f) The matrix table shows the assignment of the bits.
 - Red colored fields show the assignment of the data bits.
 - Orange colored fields show the assignment of the multiplexer bits.



9.2.5 Conversion to physical values

	[Conversion —				
a) —	-	Factor	1,00 🛨 bar/Bit	Minimum	0,00 🛨 bar 🔶	— e)
b) ——	-	Offset	0,00 🛨 bar	Maximum	255,00 🛨 bar 🔸	f)
c) —	-	Unitgroup:	pressure		🗖 Adjust automatically 🔸	— g)
d) —	-	Unit:	bar 💌			
	L					

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.

9.2.6 Special features

CAN analyzer functionality

This functionality is only available, if a MSA-Box (I & II) is used to connect the DDU 8 to the PC. Choose the CAN bus that is connected to the MSA-Box to display the raw value and the converted physical value here.

Measurement V	alue on CAN	
Value	8, 8, 8, 8, 8, 8, 8, 8, 9, n	one
Raw Value	8, 8, 8, 8, 8,	

Automatic creation of online measurement sheets

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

For an online view of the value measured by the DDU 8, insert the channel in an online measurement sheet which is described in the next chapter.

Measurement Sheet	
Pressures	•





9.2.7 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.



The measurement element displays the values of the assigned channel.

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



9.2.8 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.

Channel Import × Channel creation from measurements Choose the desired measurements to import as a channel and click 'OK' 194 channels and 60 messages available channels to import Name Unit Id Size RowCtr RowVal Descrip aps ath 🕒 accx g 777 Vector_ accy accz activate_blip g 777 Vector 777 g Vector g flag flag 100 Vector A<u>d</u>d all activate_cut 100 Vector Vector, Vector, aps 779 773 ŏ ax1_Bremse60... ay1_Bremse60... g 500 16 Vector 5C0 779 16 Vector g V Remove all 8 Vector battlow_b 77A 0 Vector -ÞÍ 270 measurements in 16 CAN messages recognized, 130 measurements skipped, for details check the Infolog. Cancel <u>0</u>k

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

The channels are inserted in the Data window.

9.2.9 Export RaceCon CAN configuration

- 1. Right-click on CAN Input of desired bus (CAN1 or CAN2).
- 2. Select 'Export...' from menu.
- An 'Export Selection' window opens.

Export displayed content to	×
Export Selection All items shown below will be exported. Please click "Export' to select a destination to store to.	€
- 💼 CAN Input	
Export	ancel



- 3. Specify the filename.
- 4. Click 'OK' when done.

9.2.10 Import RaceCon CAN configuration

- 1. Right-click on CAN Input of desired bus (CAN1 or CAN2).
- 2. Select 'Import...' from menu.

A file browser opens.

3. Select the input file and click 'OK'.

An 'Import Selection' window opens.

Importing from file 4.rex(2.1.0.20) Drag&Drop elements from the import cont Summary: 0 imported elements	tent to the current project	×
Import content (source)	Current Project (target) aps aps aps CAN Bus 1 CAN Bus 2 CAN Bus 2 CAN Bus 2	
	< <u>Back</u> <u>N</u> ext > <u>Finish</u> <u>Cancel</u>	

- 4. Select channels to import.
- 5. Drag and drop the channel to 'CAN Input' of desired CAN bus on right hand side.
- 6. Click 'Next'.

If a measurement channel belongs to more than one source (e.g. DDU 8 and ECU MS 5.1), the 'Solve Label Ambiguity' window opens.

In	Importing from file output.rex(2.1.0.20)								
	Select for all ambigous objects the appropriate one Summary: 7 imported element, 3 ambigous label								
	Labels								
	Status	Source	Import	Source	Project Label	Description			
	(DDU8	time_sec/CAN row 1/CANMessage_123/C	DDU8	time_sec	Linkable with 'time_sec' label			
	Ø	DDU8	time_min/CAN row 1/CANMessage_123/CA	DDU8	time_min	Linkable with 'time_min' label			
	Ø	DDU8	time_hour/CAN row 1/CANMessage_123/C	DDU8	time_hour	Linkable with 'time_hour' label			
				< <u>B</u> ack	Next >	Finish Cancel			



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

9.3 CAN output

9.3.1 Output configuration

E stal New Project E→S DUB	Project		X
 Calibration items CAN Bus 1 CAN Input CAN Bus 2 Computed Channels Conditional Channels Macros Matrix Import Import Import RaceCon CAN output configuration from fil Matrix Display Display CAN bus properties (Baudrate) 	Kew Project DDU8 Calibration Items CAN Bus 1 CAN Input CAN Bus 2 CAN B	W CAN message port port perties	reate new CAN output message xport RaceCon CAN output configuration to file nport RaceCon CAN output configuration from file visplay CAN bus properties (Baudrate)

9.3.2 Create new CAN output message channel

- 1. Right-click on CAN Output of desired bus (CAN1 or CAN2).
- 2. Select 'New CAN Message' from menu.

The 'Create new CAN message' window opens.

Create new CAN message	×
Create a new CAN message Enter the CAN-Id and an optional row-counter position	on.
<u>N</u> ame: [CANMessage_123	
CAN-Id:	ided CAN-Id
Grid: 100 ms	
Se row counter	
Row counter position	
Eirst row counter value	(0254)
Number of rows 1 🗧	(160)
	<u>D</u> k <u>C</u> ancel

- 3. Enter name of message, CAN-Id and Grid (output interval).
- 4. Optionally, specify a row counter (multiplexer).
- 5. Click 'OK' when done.


A CAN message configuration window opens in the Main Area.

💊 volles_display.rlp - RaceCon				
: File Edit View Extras Help				
: 🎦 😂 🛃 🎒 🐰 🗈 🛍 🚿 🔊 • (* •) 🐉	rnchronize 🔹 🐌 🛛 Design mode 📄 🕨 🧕 🎯 👷 🔤 🚽 🔍 🚽 🖓 层			
Project 🛛 🗘 🗙	Welcome to RaceCon Key New Project C DDU8	4 Þ 🗙	Toolbox	- 4 X
E Mew Project	Definition of CAN	▲	Devices	
			🖃 Displays	^
E- CAN Bus 1	message		DDU4	
- 📄 CAN Input	CAN Message Properties			
CAN Outputs				
E Computed Phannels				
- f Conditional Channels	Grid 100 ms 💌 Position Byte 0 💌			
📕 🗟 1/0 Chanala 🗾	Data Order - C. Little Conference - C. Die Conference - Contemporate - Little - C.		MS3 Sport	
Data - CAN Outputs 📮 🗙	Byte of dei 🤝 Eittle Endlah 💭 Big Endlah Eitst tow counter value 📊 🔤		MS4 Sport	
Show all			MS4.4 Sport	
Used Type Name v 🍸 Function	CAN Message Configuration - Drag channels into the window		MS15 Sport	
CANMessage_123	Add new row Delete selected row		MS3.1	
CANMessage_234	Byte 0 Byte 1 Byte 2 Byte 3 Byte 4 Byte 5 Byte 6	Byte 7	📺 MS4.0	
Output messages	0x1		🛗 MS4.2	
on CAN bus 1			📕 MS4.3	
ON CAN DUS I			/ 💭 MS4.4	
	📑 Statistics 🖉 Math Channels 🖉 Conditions Channels 📑 Device into 📑 Fault into 📑 Features into 🔤 CANMessa	ge_123	/ MS5.0	
Properties - CANMessage 123 🛛 🗸 🗙	Info/Status	4 х	MS5.1	
📰 👌 🛛 👽 standard 👻 💷 🗸 🕢	C Errors 🔥 Warnings 👔 Messages	0/0 ×.	MS5.2	
	Type Time Sender Message		MS5.5	
CAN id 0x1			MS15.1	
Extended CAN id False	Content of		MS15.2	
CAN id			Display elements Measurement elements	
The CAN id of the channel.	message		Measurement sources	
			Macro actions	
Ready.	No errors detected - all cleared or state unknown 🔤 Ne	aw Project/DDU8/CAN B	us 1/CAN Outputs/CANMess	age_123 .::

- 6. Click on 'DDU 8' in the DDU 8 Project Tree to display all labels.
- 7. Select the desired measurement channel and drop it on message's bytes.

💊 volles_display.rlp - RaceCon	
: File Edit View Extras Help	
🗄 🎦 🊰 🛃 🎒 🗼 🛍 🖏 🍼 🔎 🕶 🤇 💭 Synchronize 🔹 🧶 Design model) 🕨 💿 🎯 🔍 💽 💌 🔍 Race mode 🗈 🏭 🎯 🖕	
Project # X Welcome to RaceCon 🙀 New Project 👘 DDU8 4 b >	🕻 Toolbox 🕹 🗘
Guil New Project	Devices
	🖃 Displays 🔺
	DDU4
CAN Input DEC CAN Message Properties	PDU5
CAN Outputs	PDU6
B Construction of Characteristic Caracteristic Caracterist	DDU7
Computed channels	DDU8
	ECUs
Data - DDU8	MS3 Sport
	MS4 Sport
Used Type Name / V Function Drop Configuration - Drag channels into the window	MS15 Sport
time msec REAL TIME Belete selected row	MS13 Sport
time_mon REALTIME Bute 0 Bute 1 Bute 2 Bute 3 Bute 4 Bute 5 Bute 6 Bute 7	MS4.0
time_min FEAL_TIME	- MS42
	MS4.3
	MS4.4
📮 Test 🚬 🔀 Statistics 🏂 Math Channels 📌 Conditional Channels 😭 Device info 💽 Fault info 💽 Features info	MS5.0
	MS5.1
Properties - time_day 4 × researce 000	MS5.2
2 4 9 all + 9 standard + 1 + 9 Control + 1 + 9 Control + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 +	🖵 📖 MS5.5
Channel Measurement	- MS15.1
Actual measurement rate	- MS15.2 -
	Display elements
	Measurement elements
Actual measurement rate of the channel Only valid if t	Measurement sources
	Macro actions
Ready. No errors detected - all cleared or state unknown 😬 New Pro	pject/DDU8/Calibration Items/time_day

The measurement channel is assigned to the CAN message.



9.3.3 Set up of word length, byte order and quantization

🔇 volles_display.dp - RaceCon	_ _ X
File Edit View Extras Help	
🗄 🎦 😂 🛃 🎒 💃 💷 🖄 🛷 🔎 🔹 🖓 🖓 🕫 👻 🕼 Synchronize 🔹 🧜 [Design mode]] 🕨 💿 🞯 🧐 🕲 💽	
Project	↓ Description Toolbox · · · · · · · · · · · · · · · · · · ·
E 🕼 New Project	Devices
	Displays
	DDU4
CAN Input	🚺 🔮 🗬 DDU5
CAN Dutputs	DDU6
B- CAN Bus 2 CAN Identifier (hex) 1 Extended Use row counter	DDU7
	CDU8
The fact conditional channels and rooms in the conditional channels in the conditing in the conditional channels in the conditional channels i	ECUs
Byte Order C Little Endian C Big Endian Eirst row counter value	MS3 Sport
	MS4 Sport
🕒 🖳 🖼 🖾 🖉 🦉 🖉 🖉 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 🖓 👘 👘 👘 👘 👘 👘 👘 👘 👘 👘 👘 👘 👘	MS4.4 Sport
Used Type Name / V Function	MS15 Sport
	MS3.1
usb_mediastate USB Byte 0 Byte 1 Byte 2 Byte 3 Byte 4 Byte 5 Byte 6 Byte 7	🔄 MS4.0
usb_erront USB 0x1 Caj usb_erront	🛗 MS4.2 🛁
33 unlinked	- MS4.3
e unimeu	I MS4.4
	MS5.0
Properties use areast	MS5.2
Chainer on CAN Dus	4 × MS5.5
	3/0 × MS15.1
CAN out channel properties Type Time Sender Message	MS15.2
Linked to channel usb_erront	MS24.3
	MS24.4
	Display elements
Linked to channel	Measurement sources
The linked channel.	Macro actions
Ready. No errors detected - all cleared or state unknown New Project/DDU8/CAN Bus 1/CAN Outp	outs/CANMessage_123/CAN row 1/usb_errcnt

Word length and quantization of channel are fixed.

Byte Order can only be changed if a channel allocates more than one byte.

9.3.4 Export RaceCon CAN configuration

- 1. Right-click on CAN Output of desired bus (CAN1 or CAN2).
- 2. Select 'Export...' from menu.

The 'Export Selection' window opens.

3. Specify the filename.

Export displayed content to	X
Export Selection All items shown below will be exported. Please click 'Export' to select a destination to store to.	€
CAN Outputs	
Export	ancel

4. Click 'OK' when done.



9.3.5 Import RaceCon CAN configuration

- 1. Right-click on CAN Output of desired bus (CAN1 or CAN2).
- 2. Select 'Import...' from menu.

A file browser opens.

3. Select the input file and click 'OK'.

An 'Import Selection' window opens.

Importing from file output.rex(2.1.0.20) Drag&Drop elements from the import con Summary: O imported elements	tent to the current project		×
Import content (source)	CANMessage_123	Current Project (target)	
	< <u>B</u> ack	<u>N</u> ext > Enish	2ancel

- 4. Select channels to import.
- 5. Drag and drop the channel to 'CAN Output' of desired CAN bus on right hand side.
- 6. Click 'Next'.

If a measurement channel belongs to more than one source (e.g. DDU 8 and ECU MS 5.1), the 'Solve Label Ambiguity' window opens.

Impo	orting f	rom file ou	tput.rex(2.1.0.20)			×
Se 9	lect for Summary	rallambigo v:7imported	ous objects the appropriate one element, 3 ambigous label			•
La	bels					
St	atus	Source	Import	Source	Project Label	Description
	0	DDU8	time_sec/CAN row 1/CANMessage_123/C	DDU8	time_sec	Linkable with 'time_sec' label
	Ø	DDU8	time_min/CAN row 1/CANMessage_123/CA	DDU8	time_min	Linkable with 'time_min' label
	Ø	DDU8	time_hour/CAN row 1/CANMessage_123/C	DDU8	time_hour	Linkable with 'time_hour' label
				< <u>B</u> ack	<u>N</u> ext >	Finish Cancel

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





10 Analog and frequency inputs

10.1 DDU 8 features

24 analog inputs (with Software Upgrade 2; 4 analog inputs available without upgrade)

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

4 frequency inputs (with Software Upgrade 2; no frequency inputs available without upgrade)

- 5 V Hall-effect type, 2.5 V trigger level
- 20 kHz max. frequency
- 10 ms measurement window

4 PWM outputs

- Low-side switch
- Up to 2 A each
- Output frequency selectable





10.2 Analog inputs

10.2.1 Measurement channels

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

Data - New Project - DDU8 - Input-channels - ANA06 - f_wheel_fl					д	×
<u>S</u> earch:						
Used	Name 🔺 💌	Source	▼ Description	-		
	<pre> f_wheel_fl f_wheel_fl_fi f_wheel_fl_fi f_wheel_fl fi faw_f_wheel_fl fi faw_f_wheel_fl_fi fi f</pre>	DDU8 DDU8 DDU8 DDU8 DDU8	Wheel force front left Wheel force front left Wheel force front left 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:

- DDU 8 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



10.3 Configuring inputs

10.3.1 Configuring a predefined Bosch sensor with the 'Bosch Sensor Wizard'

- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. Expand the list of 'I/O Channels' by clicking on '+' in the DDU 8 Project Tree.



3. Drag the 'Bosch Sensor Wizard' from the Toolbox and drop it on the desired analog input channel in the DDU 8 Project Tree. The 'Bosch Sensor Wizard' opens.

1 st : Choose the sensor's category	Bosch Sensor Wizard Select Sensor Select a sensor, based Sensor gategory Sensor group	on the order number.	Calibrati	on data		×	
2 nd : Narrow your choice by choosing a type	<u>Ω</u> rder number 0 280 130 026 B 261 209 160 ▼ 02U V00 123-01		•	Ohm 89 113 144 186	*C 130 120 110 100		These calibration values will be used
3 rd : Select the exact type		Sensor category TEMPERATURE SENSORS Sensor group NTC M12 Den <u>d</u> atasheet		322 435 834 1175 1707	80 70 50 40 30	_	
Opens sensor's – datasheet		< <u>B</u> ack		ext >	<u>F</u> inish	<u>C</u> ancel	

4. Click 'Finish' when done.



- 5. The 'Create channel on DDU 8' window opens.
- 6. Enter channel name and description.

eate channel on DDU8	<u>1</u>
Create Channel	
Set the unique name for the c	shannel and add an optional description. 🥄
<u>N</u> ame:	
t_rad_out	
Description:	
Outlet temperature of radiator	
	Ok Cancel

7. Click 'Ok' when done.

The channel is inserted into the DDU 8 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 _fi	filtered physical value



10.3.2 Configuring a generic linear sensor

Example: Acceleration sensor 5g

• From sensor data sheet - operating characteristics:

Output Signal					
Zero g (T _A = 25°C, V _{DD} = 5.0 V) ⁽⁴⁾	VOFF	2.25	2.5	2.75	V
Zero g (V_{DD} = 5.0 V)	VOFF	2.0	2.5	3.0	V
Sensitivity ($T_A = 25^{\circ}C$, $V_{DD} = 5.0 \text{ V}$) ⁽⁵⁾	S	380	400	420	mV/g
Sensitivity (V _{DD} = 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 2500 mV
- The sensor has a linear output signal with sensitivity and offset
- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. Expand the list of 'I/O Channels' by clicking on '+' in the DDU 8 Project Tree.

3. Drag the 'Sensitivity/Offset' analog signal source from the Toolbox and drop it on the desired analog input channel in the DDU 8 Project Tree.

A 'Sensitivity/Offset Wizard' opens.

4. To activate the internal DDU 8 pullup-resistor, check the box.

The internal DDU 8 pullup-resistor is used to get a 5 V signal at the analog channel of the DDU 8. It allows you to use a push-button.

The fixed value of the internal DDU 8 pullup-resistor is 3010 Ohm. If using an additional external pullup-resistor, set up the overall resistance.

Sensitivity / Offset	: Wizard - Add New				×
Pin Properties					~
Configure the ana	alog pin properties.				
<u>U</u> se pullup:					
Pullup <u>v</u> alue	3010				🕂 Ohm
		< <u>B</u> ack	<u>N</u> ext >	Einish	<u>C</u> ancel

5. Click 'Next' when done.





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



6. Click 'Next' when done.

The third part of the 'Sensitivity/Offset Wizard' opens.



Note: Working with automatically created measurement sheets is explained in chapter '11.2 Setting up an online measurement'.

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



The channel is inserted into the DDU 8 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 _fi	filtered physical value



10.3.3 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 on 'Measurement Sources' in the Toolbox.
- 2. Expand the list of 'I/O Channels' by clicking on '+' in the DDU 8 Project Tree.

3. Drag the 'Characteristic Curve' analog signal source from the Toolbox and drop it on the desired analog input channel in the DDU 8 Project Tree.

A 'Characteristic Curve Wizard' opens.

4. To activate the internal DDU 8 pullup-resistor, check the box.

The internal DDU 8 pullup-resistor is used to get a 5V signal at the analog channel of the DDU 8. It allows you to use a push-button.

The fixed value of the internal DDU 8 pullup-resistor is 3010 Ohm. If using an additional external pullup-resistor, set up the overall resistance.

Sensitivity / Offset	Wizard - Add New				×
Pin Properties					~
Configure the ana	log pin properties.				
<u>U</u> se pullup:	V				
Pullup <u>v</u> alue	3010				🕂 Ohm
		< <u>B</u> ack	<u>N</u> ext >	<u>F</u> inish	<u>C</u> ancel

5. Click 'Next' when done.

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





6. Click 'Next' when done.

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



Note: Working with automatically created measurement sheets is explained in chapter '11.2 Setting up an online measurement'.

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

The channel is inserted into the DDU 8 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 _fi	filtered physical value



10.3.4 Configuring a multipoint adjustment

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



- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. Expand the list of 'I/O Channels' by clicking on '+' in the DDU 8 Project Tree.

3. Drag the 'Multipoint Adjustment' analog signal source from the Toolbox and drop it on the desired analog input channel in the DDU 8 Project Tree.

A 'Multipoint Adjustment Wizard' opens.

4. To activate the internal DDU 8 pullup-resistor, check the box.

The internal DDU 8 pullup-resistor is used to get a 5 V signal at the analog channel of the DDU 8. It allows you to use a push-button.

The fixed value of the internal DDU 8 pullup-resistor is 3010 ohm. If using an additional external pullup-resistor, set up the overall resistance.

Sensitivity / Offset	izard - Add New
Pin Properties	~
Configure the ana	g pin properties.
<u>U</u> se pullup:	V
Pullup <u>v</u> alue	3010 💼 Ohm
	<u>≺Back</u> <u>N</u> ext> <u>Einish</u> <u>C</u> ancel



5. Click 'Next' when done.

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



6. Click 'Next' when done.

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



Note: Working with automatically created measurement sheets is explained in chapter '11.2 Setting up an online measurement'.

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



The channel is inserted into the DDU 8 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 _fi	filtered physical value

Online definition of the curve is covered in the chapter '11.3 Online calibration of measurement channels' of this manual.



10.3.5 Digital filter details

DDU 8 uses A/D converter oversampling and digital filtering to recording rate.







Cut-off frequency automatically adjusted to recording rate



Example:

- 100 Hz recording rate (10 ms)
- < 40 Hz passband (> 99%)
- > 50 Hz stopband (< 1%)



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
- DDU 8 filters have constant, frequency independent delay
- Delay (e.g. 22 samples at 10ms) 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 realtime

10.3.6 Configuring a frequency input

This function requires the installation of Software Upgrade 2.

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. Expand the list of 'I/O Channels' by clicking on '+' in the DDU 8 Project Tree.

3. Drag the 'Velocity' digital signal source from the Toolbox and drop it on the desired 'REV' input channel in the DDU 8 Project Tree. The 'Velocity Wizard' opens.



Velocity Wizard - Add N	ew 🔀	
Velocity Properties Configure a frequency	input to measure a linear velocity.	Special functionality for sensors with frequency offset (e.g. Correvit)
Frequency offset:	0 Hz	 measurement
Number of increments:	44	 Number of teeth on the pulse wheel
Wheel circumference:	2000 📑 mm	 Circumference of wheel for speed
Output data type:	16 Bit	Calculation
		Choose data type of the measurement variable
Measurement sheet:		Enter nome to externation!!!
	< <u>Back</u> <u>N</u> ext> <u>Einish</u> <u>Cancel</u>	create a new measurement sheet

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

The channel is inserted into the DDU 8 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 _fi	filtered physical value

Note: Measurement of 'Revolution' is similar.



10.4 Computed sources

10.4.1 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
- PWM output control (covered in a special section)
- Lap trigger (covered in a special 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 DDU 8 Project Tree.

A 'Computed Sensitivity / Offset Wizard' opens.



3. Click 'Next' when done.





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



Note: Working with automatically created measurement sheets is explained in chapter '11.2 Setting up an online measurement'.

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

The channel is inserted into the DDU 8 Project Tree.



10.5 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 DDU 8 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.
- 6. Click 'OK' when done.

The channel is inserted into the DDU 8 Project Tree.





10.5.1 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. 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.

10.5.2 Setting up calculated speed for DDU 8

- 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 'Computed Channels' in the DDU 8 Project Tree. Do not drop it on 'DDU 8'!





A 'Calculated Speed Wizard' opens.

BOSCH

Calculated Speed Wizar	d - Add New	
Calculated Speed Co Select speed inputs for	nfiguration calculating a reference speed.	
<u>C</u> onfigure on device	DDU8	Choose device
Input <u>s</u> ource:	Wheel speeds	Choose input source (internal / external)
Drive shaft s <u>w</u> itch:	Rear wheel drive	Choose driven axle
Speed input front left: Speed input front right:	wheel_fi	Choose individual wheel speed
Speed input rear left:	🗰 🔤 vwheel_rl	channels
Speed input rear right:	🗰 🖶 vwheel_rr 💌	
Speed <u>d</u> ifference:	5 * * *	Set limit for speed difference for calculation
	<back next=""> Finish Cancel</back>	

4. Click 'Finish' when done.

The speed calculation is inserted into the DDU 8 Project Tree.

	Audio during Descrat			
	Volles_display.rip - RaceCon			
		r (* • (2) Synchronize • (), Design mode > • • • • • • (2), Race mode 11 👬 🔮 🕑	Taslan a M	
	E Set New Project	Velcome to RaceCon 1 🚛 New Project 1 💼 DDU8 2 💽 Speed		
,	I Speed		Displays	
			😂 🗖 DDU4	
Speed	Calibration Items	Speed configuration	• DDU5	
	CAN Bus 1	Configure on device		
calculation	Computed Channels			
in DDLL8	- fx Conditional Channels	Input gource Wheel speed	ECUs	
11 000 0	Macros		MS3 Sport	
Proiect		Drive shaft switch Rear wheel drive	MS4 Sport	
Tura	i 🕀 📾 Logger 💽	Speed input front left	MS4.4 Sport	
<i>i ree</i>	Data - Speed		MS15 Sport	
		Speed input front right I Seed_fr	MS4.0	
	Seed une Name	Constitution and the second seco	di MS4.2	
-	Speed_usc_usc_usc_usc_usc_usc_usc_usc_usc_usc	Speeu input teai ieit	MS4.3	
		Speed input rear right 🗰 📑 vwheel rr	MS4.4	
Magayramant			MS5.0	
weasurement	1 P	Speed difference	5 式 %	
channels	Properties - Speed			
	🔢 👌 🛛 🍞 all 🔹 🍞 standard 🔹 📃 🔹		MS15.1	<i>C</i>
calculated	Channel properties			יזדוgu-
	Computing device E DDU8	Configuration	MS24.3 roti	ion
speea ana	Name Speed		PDB / ALI	011
calculated	E Security	Crors A warnings D messages	Bypass ECU WIN	dow
calculated	Protection False	Type Time Sender Message	💶 🔤 Custom ECU 👱	
distance	Name		Display elements	
	The name of the measurement source.		Measurement sources	
			Macro actions	
	Ready.	No errors detec	cted - all cleared or state unknown 🔯 New Project/Speed 🚲	



10.6 Configuring PWM outputs

PWM

- Pulse Width Modulation
- Output frequency is constant
- 'On time' (duty cycle) controlled by input channel



DDU 8 has 4 PWM outputs

- Low-side switch
- Up to 2 A each
- Selectable output frequency
- Duty cycle controlled by characteristic curve







10.6.1 Configuring a PWM output

1. Click on 'Measurement Sources' in the Toolbox.

2. Drag the 'PWM Out' computed source from the Toolbox and drop it on the desired 'PWM_OUT' channel in the DDU 8 Project Tree.

A 'PWM Out Wizard' opens.



Note: Working with automatically created measurement sheets is explained in chapter '11.2 Setting up an online measurement'.

Note: Choosing a filtered channel as an input for 'PWM_OUT' will cause delayed reaction due to the delay introduced by the digital filter. Use unfiltered values for this purpose.

Note: The 'power-on' state of the PWM output is 'switch open' (0% duty cycle).

- 3. Click 'Finish' when done.
- 4. Enter channel name and description.
- 5. Click 'OK' when done.



The channel is inserted into the DDU 8 Project Tree.



Diagnostic channels

Measurement label	Function
pwm err is out 01 OI	PWM output 1 error open load
pwm err is out 01 OT	PWM output 1 error over temperature
pwm err is out 01 SCB	PWM output 1 error short circuit to battery
pwm err ls out 01 SCG	PWM output 1 error short circuit to GND

Note: The diagnosis of PWM output 2-4 is similar.



11 Online measurement

DDU 8 configuration

- System configuration (channel + display configuration, CAN I/O, PWM Out, etc.) is stored in the DDU 8
- Use RaceCon to create and download configuration from the PC to DDU 8
- Communication interface: Ethernet
- Communication protocol: XCP

Online measurement + calibration

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

11.1 Achieving an online connection

11.1.1 Set up the PC for access to the DDU 8

- 1. Switch off local firewall on the PC.
- 2. Set IP Configuration for the Ethernet interface to 'automatic configuration' (DHCP). See chapter '7.1.1 Setting up the network interface' for details.
- 3. Start RaceCon.
- 4. Establish the Ethernet connection to the vehicle.
- 5. Power on the vehicle.

Yellow dot indicates live connection to the device, but local RaceCon configuration does not match the DDU 8's configuration		
Click 'OK' to download RaceCon configuration to device		
	@ System overview Dataset manager	Statuc
		Status
		message
	Upp I Ime Server Metroge Metroge	
	10:59:03 DDU8 Successfully connected to device[Ethemet/ACP].	winaow
	10:59:03 DDU8 EPK check successful (EPK Device: DDU8_BASE_0507)	
	U 10:503 DDUB ELU dete matches the local deta.	
	() 10 59:04 DDUB Calibration data successfully uploaded and initialized.	
	No errors detected - all cleared or	



11.1.2 Going online

Click 'OK to download RaceCon configuration to DDU 8. The download starts.



A green dot and background at the device in the project view and the DDU 8 Project Tree indicate a successful download and system consistency.



Info/SI				
C Errors(1) (1) Messages(28)				
Туре	Time	Sender	Message	
	11:29:58	DDU8	Lost connection to device(Ethernet/XCP).	
(i)	11:30:01	DDU8	Successfully downloaded configuration.	
()	11:30:01	DDU8	Successfully connected to device(Ethernet/XCP).	
(i)	11:30:01	DDU8	EPK check successful. (EPK Device: DDU8_BASE_0110)	
()	11:30:01	DDU8	The ECU data matches the current project data.	

If the system's configuration in RaceCon has been changed, the dot and background becomes yellow and a configuration download is necessary.



11.1.3 Configuration download

- 1. Right-click on DDU 8 in the DDU 8 Project Tree.
- 2. Select 'Download configuration'.



The configuration download starts.



A Green dot and background indicate a successful download.



11.2 Setting up an online measurement

DDU 8 supports online measurement of sensor values and diagnostic variables.

Expand 'Measurement Container' and 'Measurement Folder 1' in the Project Tree and double-click on 'Sheet1'. 'Sheet 1' is opened in the Main Area.



From the context menu of the project, new measurement pages can be created.



From the context menu of a measurement page, the folder can be renamed and deleted. It also allows the creation of measurement pages.





From the context menu of a measurement page, the page can be renamed and deleted.



To change between different pages, click on the tabs on the bottom of the Main Project Area.



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

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





2. Click on 'DDU 8' in the Project Tree to display all measurement channels.

3. Select the desired measurement channel and drop it on the measurement element. If the DDU 8 is online, the value is displayed.



The measurement element's appearance can be changed using the Properties Menu.



⊟	Appearance	
	Color scheme	Default
	Segment shape	Round
	Value alignment	Center
🗆 Data		
	Decimal places	0
	Description	system time: second
	Digits	3
Ð	Linked to	📰 time_sec



RaceCon offers different types of measurement elements:









Circular gauge

Temperature gauge

Vertical Bar graph style

Horizontal Bar graph style



Numeric indicator





Oscilloscope (Chart)



11.2.1 Automatic creation of measurement sheets

RaceCon can create measurement sheets automatically.

You can create and use measurement sheets with the DDU 8 as well as with all other devices connected to RaceCon.

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



2. To create the sheets, right-click on DDU 8 and select 'Create measurement views...' from the DDU 8 context menu.





The automatically created sheet is inserted in the Project Tree under 'Measurement Container' and 'Device Channels'. If the DDU 8 is connected to RaceCon, live values of the channels are shown.



11.2.2 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 page or the keyboard shortcuts associated with the sheets.

3. Press the 'Esc' key to return to 'Design Mode'.






11.3 Online calibration of measurement channels

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



11.3.1 Enable online offset calibration for measurement channel





In the channel view





11.3.2 Performing the online offset calibration

DDU 8 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.

11.4 Group adjustment

Group adjustment is the simultaneous online calibration of several channels. This is useful e.g. to set all wheel forces and damper positions to '0' when the vehicle is positioned on a flat patch.

11.4.1 Configuration of group adjustment

Group adjustment consists of two components:

- An input channel which triggers the adjustment event
- A group of input channels linked to the group adjustment event



11.4.2 Setting up the group adjustment trigger channel

- 1. Click on 'Measurement Sources' in the Toolbox.
- 2. Drag the 'Group Adjustment Channel' element from the Toolbox and drop it on the DDU 8.



A 'Group Adjustment Channel Wizard' opens.

Group Adjustment (Pin Properties Configure the anal	Channel Wizard - Add New log pin properties.	×	
<u>P</u> in:	ANA26 / Yel-p40		Select the pin to which the sensor shall be connected
<u>U</u> se pullup:	Г		- Check the box to activate the
Pullup <u>v</u> alue	3010	Chm	internal DDU 8 pullup-resistor and set the resistor value
	<u>≺Back</u> <u>N</u> ext >	Einish <u>C</u> ancel	

Note: If a low-active signal is selected as an input channel, do not forget to enable the pull-up resistor for the pin. Otherwise the group adjustment will be triggered periodically. See chapter '10.3.2 Configuring a generic linear sensor'for further information concerning the pullup-resistor.



3. Click 'Next' when done.

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

Group Adjustment Cha Group Adjustment Cl Configure the group a	nnel Wizard - Add New hannel Properties ofjustment source properties.	×	Signal is active high
<u>I</u> hreshold level:	Low active signal		or active low
Detection time:	1000	ms	Define minimum active time
<u>R</u> etrigger lock time:	100	ms ns	
			Define minimum time between two activations
<u>M</u> easurement sheet:			Enter name to automatically
			create a new measurement
	<u>≺Back</u> <u>N</u> ext> <u>Finish</u>	<u>Cancel</u>	Sheet

Note: Working with automatically created measurement sheets is explained in chapter '11.2 Setting up an online measurement'.

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



11.4.3 Assigning channels to the group adjustment

1. Double-click on the created channel (e.g. 'grp_adj_channel') in the Project Tree. In the Main Area, an overview of the available adjustment channels opens.

2. To add measurement channel(s) to the group adjustement event, check the 'Calibrate' box of the desired channel(s).



The selected measurement channels are added to the group adjustment event.

11.4.4 Triggering the group adjustment

- 1. Connect the input pin to GND using a push-button.
- 2. Make sure the pullup-resistor is enabled, if you selected 'active low' trigger polarity.
- 3. Double-click on the input channel 'grp_adj_channel' of the group adjustment.
- 4. Download the configuration on the DDU 8. To connect the DD8 to RaceCon, see chapter '7.1.4 Connecting the DDU 8 to RaceCon'.
- 5. Open a measurement sheet by clicking on the desired measurement sheet in the Project Tree.
- 6. Drag the 'grp_adj_channel' and the 'input_grp_adj_channel' to the online measurement sheet.
- 7. Press and release the push-button.
- 8. The measurement labels indicate the state of the input pin and the state of the adjustment.







Hint: A display alarm can be linked to the trigger channel to indicate that the trigger has been detected.

11.5 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





1. Create a multipoint adjustment measurement channel. To create a multipoint channel, see chapter '10.3.4 Configuring a multipoint adjustment'.

2. Download the configuration on the DDU 8. To connect the DDU 8 to RaceCon, see chapter '7.1.4 Connecting the DDU 8 to RaceCon'.

- 3. Click on the desired channel in the DDU 8 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	745	Ν	Calibrate
2	12548	Ν	Calibrate
3	34075	Ν	Calibrate
4	45050	Ν	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





12 Recording and telemetry

This function requires the installation of Software Upgrade 1.

12.1 DDU 8 features

Recording

- Synchronized recording of DDU 8 analog and digital input channels, DDU 8 internal measurement channels, ECU data, Data from external sensor interfaces
- Up to two independent recordings
- Measurement rate 1 ms...1 s
- Two global start conditions (thresholds)
- Up to 16 measurement conditions (fast-slow-switches)

Telemetry

- Support for long-range online telemetry
- Individual programmable team code
- Fast block slow block mechanism
- Programmable data rate

Burst telemetry

- Support for burst telemetry (BT 60)
- Programmable IP configuration
- BT 60 diagnosis via DDU 8



12.2 Configuration of recordings

1. Expand the list of 'Loggers' by clicking on '+' in the DDU 8 Project Tree.

2. Double-click on 'Recording' in DDU 8 Project Tree.

The recording configuration is displayed in the Main Area.



Tabs to access conditions, settings and statistics

3. To add measurement channels to a recording, click 'DDU 8' in the DDU 8 Project Tree. In the Data Area, the measurement channels are displayed.



4. Drag and drop desired measurement channels into recording group.



5. To edit channel's settings, mark the channel(s) and click 'Edit Channel'.

An 'Edit Recording Channels' window opens.

	Edit Recording Channels Edit Recording Channels	×	
List of channels selected	Change the rate or condition of the recording of Recording channels: [wheel_rr [_wheel_rf [_wheel_f	Bate:	Recording rate 1 ms1 s
	L_wiree_fi	Condition:	<i>Condition to switch between fast / slow rate</i>
		True rate:	Recording rate if condition is 'true'
		Ielemetry: None	Settings for long range telemetry 'None / Fast / Slow'
	<u>R</u> eset	<u>k</u> ancel	(only if telemetry unit is available)

Note: 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'.

6. Click 'OK' when done.



Using fast block / slow block transmission

DDU 8 telemetry uses available bandwidth of Telemetry Unit FM 40 (19200 baud -> approx. 1700 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).

Transmission Scheme



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 '12.2.4 Recording statistics' for more information.

12.2.1 Adding a recording

DDU 8 supports up to two independent recordings.

To add a recording, select 'Add Recording' from the context menu of the Logger in the DDU 8 Project Tree.





12.2.2 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.



12.2.3 Global DDU 8 settings

To display the global DDU 8 settings, select the 'Settings' Tab.





a) Choose setting for outing counter mode:

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- 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) Choose Baud rate of CAN bus 1 and 2.

d) Select 'Statusblock' (optional). 'Statusblocks' contain information of channels specially adapted by Bosch Motorsport.

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!

12.2.4 Recording statistics

The tab 'Statistics' shows the channels' allocation and their current data rate related to the transmission frequency of the DDU 8 and the whole transmission system.

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

The data rate of the whole system is often less than the data rate of the DDU 8 and limits the overall transmission speed.

DDU8 statistics												
												000 22
DDU8 1 ms	2 ms	5 ms	10 ms	20 ms	50 ms	100 ms	200 ms	500 ms	1 s	sync	Total	Data rate [KB/s]
Channels 0	0	0	4	0	0	0	0	0	0	0	4	0,80
Limit 720	720	720	720	720	720	720	720	720	720	0	720	200
System												
Channels												0,80
Limit												300



12.2.5 Recording diagnosis

The channel 'statectrl_ok' of the DDU 8 can be used for online monitoring of recording status.

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

Content of status bits

Name	Bit set	Bit cleared
RECORD	Measurement data is recorded.	No measurement data will be stored because measurement 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 correctly.	Some measurement blocks have not been set up correctly.
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.

12.2.6 Displaying online recording diagnosis ('statectrl_ok')

1. To add a Recording Diagnosis element to a measurement sheet, 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.

🗬 volles_display.rlp - RaceCon	<u> </u>
: File Edit View Extras Help	
🍸 😂 🖟 🛃 🖄 🛝 🖏 🍼 💎 🕫 🖉 Synchronize 😻 Design model 🕨 💿 🕲 🕲 100% 💿 🔍 Race model 🗈 🍓 🥹 📄 昌 斫 业 份 名 邮 按 弊 仰 움	꽃 왕 송 한 다 떠 💿 🗧
Project # X Image: Mark Project Image: Mark Project Image: Mark Project <td< th=""><th>Toolbox # X Devices Display elements Measurement elements Image: Constraints Image: Constraints Image: Constraints Image: Constraints Image: Constraints Image: Constraints Image: Constraints</th></td<>	Toolbox # X Devices Display elements Measurement elements Image: Constraints Image: Constraints Image: Constraints Image: Constraints Image: Constraints Image: Constraints Image: Constraints
Data-DDU8 p x GI Sheet 3 G2 Sheet 1 G3 Sheet 2	Measurement List
Istatecti_ok 🛛 🕒 📴 📴 🛃 🚽 Info/Status 📮 📮	
Used Type Name V 🖍 🗋 Crors 🔥 Marings 🕐 Messages 0/0 🗡	Magaziloscope
🜃 📑 statectrijck Type Time Sender Message	Controls
	Measurement sources
	Macro actions
Ready. No errors detected - all cleared or state :	unknown 📃 New Project/DDU8 🔡



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, DDU 8 is recording data: 255
- Values less than 254 indicate an error state
- 'statectrl_ok' can be linked to an alarm on the display. See chapter '8.2.3 'Alarm' display element' for details.

12.3 Configuration of online telemetry

12.3.1 Long range telemetry system FM 40



- 440 MHz band
- 25 KHz bandwidth
- 10 W max. RF output
- 19.2 kBit/s data rate unidirectional
- RS232 interface
- Full online track coverage on almost all tracks

Link quality at Hockenheim





12.3.2 Hardware setup









12.3.3 Software setup

1. Drop FM 40 from Toolbox into system overview.



2. Click on FM 40 in Project Tree to display the Properties Menu.





Adding channels to telemetry

1. Expand the list of 'Loggers' by clicking on '+' in the DDU 8 Project Tree.

2. Double-click on 'Recording' in DDU 8 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.

See chapter '12.2.2 Adding a recording group' for information about 'Fast/Slow block'.

dit Hecording Channels	cording channels. You may also change the televi	
Change the rate of condition of the re-	cording channels. You may also change the telef	ietry mode.
Recording channels:	<u>R</u> ate:	
f_wheel_rr f_wheel_rl	10 ms	•
f_wheel_fr		
I_wrieei_ii	Condition:	
		-
	True rate:	
		T
	,	
	None	
	Slow	
Barrah	Fast	Connect

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



12.3.4 Telemetry channels with special functionality

The FM 40 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.: distlap, fuelcons, lapctr, laptime. Different channel names are possible between different devices (e.g. ECU MS 3 Sport, ECU MS 5.1).

1. Double-click on FM 40 in Project Tree.

An overview of all available telemetry channels is displayed.

- 2. Click on the telemetry channel you want to assign a special functionality.
- 3. Click 'Edit channel(s)'.
- An 'Edit Telemetry Channel' window appears.

Edit Telemetry Channel	×
Edit Telemetry Channel	
Change the channel or telemetry mode of the telemetry	channel. You may also change the channel type.
<u>C</u> hannel:	
🐖 🗎 fuellap 💌	
I elemetry mode:	
Fast	
Channel tune:	
1 sp. su subor	
Lap fuel	
Lap time	
Lap addance	
Prot	Other Connect
Heset	

4. Choose the channel type. The table below shows the function of the available channel types.

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

5. Click 'Ok' when done.

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

Welcome to RaceCon		New Project	FM40			4 ۵
FM40 configuration &	managen	nent				
Add a new channel	Ed	it channel(s)	Delete channel(s)			
Name	-	Source	Vidth [Byte]	Telemetry mod	de 🛛 😽 Channel type	~
acc_lat		DDU8		Slow		
distlap		MS5.1	2	Fast	Lap distance	
fuelcons		MS5.1	2	Fast	Lap fuel	
lapctr		DDU8	1	Fast	Lap number	
laptime		MS5.1	2	Fast	Lap time	
xtime		FM40	4	Fast	Time	
E FM40						



12.4 Configuration of burst telemetry

12.4.1 Burst telemetry system BT 60



- 5 GHz ISM band 20 MHz bandwidth
- 0.4 W max. RF output
- 802.11a OFDM system; proprietary protocol
- max 12 MBit/s data rate bidirectional
- Ethernet interface to DDU 8 / C 60 / C 55
- Partial track coverage
- Approx. 300 m reception range
- High speed burst transmission of recorded data

Link quality at Hockenheim







12.4.2 Hardware setup





12.4.3 Software setup

The IP address of the DDU 8 must be compatible with the address range of the pit PC, the BT 60 and the BR 60.

1. Drop BT 60 from Toolbox into system overview.



- 2. Open a measurement sheet.
- 3. Drag the channel 'BURST_DEVICE_IP' to the measurement sheet.



- 4. Switch to 'Race Mode'.
- 5. Enter the desired IP address.





12.4.4 Diagnostic channels

Diagnosis of BT 60 is possible through channels on DDU 8.

To display a channel, drag a channel from Data Area to the measurement sheet.



12.5 Setup for USB recording

This function requires the installation of Software Upgrade 1 and 4.

Enable the Software Upgrade for USB recording

USB recording is enabled by Software Upgrade 4.

Note: For USB recording, Software Upgrade 1 also has to be enabled.

To activate Software Upgrade 4, enter the license key as described in the chapter '7.2 Feature activation'.



Wiring harness

Bit	Value
Pin 23	Power (red)
Pin 24	D + (green)
Pin 25	D – (white)
Pin 26	GND (black)

Note: Colors matching a standard USB cable.



Storage device

The recording function can be used with a dedicated Bosch Motorsport USB device. The USB device has to 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:

- 1. Insert the USB device into the PC and wait until it has been installed by Windows.
- 2. In RaceCon, select 'Extras' and choose 'Format USB stick'.
- 3. 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.

12.5.1 Recording data on USB device

- 1. Plug an USB device to DDU 8.
- 2. Prepare a recording configuration in RaceCon.
- 3. Power on the system and connect with RaceCon to the vehicle.
- 4. Download the configuration to the DDU 8.

5. Record measurement data. If an USB device is present, the DDU 8 stores the data in parallel on the internal memory and the USB device.





- 6. Power off the system.
- 7. Remove USB device from the vehicle.
- 8. Start the WinDarab software.
- 9. Click on the 'Import/Export' icon.
- 10. Select 'Data logger C50/C55/C60/DDU7/DDU8' and click 'OK' when done.

	WipDarab v7	Free Graph Display					- = X
	Start Tools Winc	lows Channel					Style 🔻 🔞
Click	New	Time x-Avis	Select Display	Data Area × Bit Area Time-Diff Areas	Channel Kaptrigg	ker ▼ er ▼	
CIICK	File Explorer # ×	Measured Data #1	bipidy	Areas (Overa	xi	Channels	4 ×
'Import/	💕 X 🖓 • Q, 💁 • 🙀	Heasticu Data #1)	> >		
Export'	Out Lap Laptime					Name Source	Description
							,
			lection of the bardware	V			
			nection of the hardware				
		W	hich hardware should be used ?				
		(Data logger C50/C55/C60/DDU7/DDU8				
			> CardMemory C40/C5 > Others: CanCard				
			,				
		EC	CU devices (Examples)				
		D	LS, MS17, MS15, MS14, MS5.x, MS12, MS2	4, C50, C60, DDU7, I			
		5 10 1	<u>0</u> k	Cancel	xtime [s] 15.477		
			show dialog only if shift-key is pressed	-			
	Standard - Empty Segmenta 4 ×	Events			ά×		
		Time Car From	To Duration Channel Min M	lax			
						ا	•
							1914 MB free

The 'Read measurement data' dialog opens.

- 11. Click on 'Modify' button and select the base folder.
- 12. Choose 'Flashcard' as data transmission method.
- 13. Choose 'DDU8 10.10.0.207' in the Vehicle dropdown list.
- 14. Activate 'Auto save'.
- 15. Click 'Save' when done.

	Data logger C55/C60/DDU8: Read measurement data	<u>_ </u>
	Templates for folder- and filenames	<u>M</u> odify
	Basefolder: C:/Bosch/WinDarab 7/DATA/DataFiles	
	Subfolder: File: [cardinfo] outing (outing03]-[lap03]-[fragment03]	
	Linked files:	*
	Force password, if not set by recording configuration	
	Data transmission: 🖉 Flashcard 🛛 🖉 FTP 🔄 Burst	
Choose 'DDU8' in dropdown list	Datatransfer with vehicle Data to read and convert Vehicle: DDU8 - 10.10.0.207 • Timeout Waiting for connection Image: Connection Connecti	Close



16. Insert the USB device into the PC.

Data transmission from device starts automatically.

Measurement files are stored automatically in the base folder.

			ouny
7/DATA/DataFile:	3		
ng03]-[lap03]-[fragi	ment03]		.*
			*
f not set by record	ing configuration		
	Data to read and con	vert	
	Engine 29/2.10: Engine 29/2.11:	Waiting for conversion	
] •	Engine 29/2.12:	Waiting for conversion	
	Engine 29/2.13:	Waiting for conversion	
	jengine 20/2.14.	waiting for conversion	_
	ng03}-[lap03]-[fragr f not set by record and	ng03]-[lap03]-[fragment03] f not set by recording configuration ard FTP Burst Data to read and com Engine 29/2.10: Engine 29/2.11: Engine 29/2.12: Engine 29/2.13: Engine 29/2.14:	ng03]-[lap03]-[fragment03] f not set by recording configuration ard FTP Burst Data to read and convert Engine 29/2.10: Engine 29/2.11: Waiting for conversion Engine 29/2.12: Waiting for conversion Engine 29/2.13: Waiting for conversion

17. Click 'Close' when transmission has finished.

18. Click on the Start button and choose 'Open measurement file'.

19. Select the measurement files from the storage folder.

20. Click on 'Open'.

21. Click in 'New Desktop' to open a new measurement data window.

22. Drag the desired measurement channel from the Channel list and drop it into the measurement data window. The measurement channel's graph is displayed.

🔬 🗟 🔹 🗧 WinDarab v7	Free Graph Display		_ = ×
Start Tools Wind	lows Channel		Style 👻 😰
New Load ~ Edit Save Desktop Settings	Wide Cursor Wide Cursor Image: Channel	*	
File Explorer $\qquad P \times $	Measured Data #1	Thannels	ά×
💕 🗙 🖓 - 🔍 💁 - 🔜 👘	((()))))) () () () () () (
🔶 Out Lap Laptime			
4 189	12.53	Name	Source Description
189 01:44.41 DIST FAST		accx N	455.0 longitudinal accel
		accy N	155.0 lateral acceleration
		accz M	455.0 Vertical acceleration
	Active and a second sec	ub D	DUB battery voltage
		lapdist	
		🗟 laptime	
		LAS1_Acc_X C	560
		LAS1_Acc_X C	560
		LAS1_Acc_Z C	60
		pmot	.ou 455.0 engine speed
		PItch rate CC	160
		PItch_rate_CC	160
Standard - Empty Segmenta $~~\oplus~~\times~$		🛂 Ride_height_FL (560
		Ride_height_FR C	560
		Ride_height_RL C	260
		Ride_heightC	.60
		Roll_rate_CAN1C	60
	H 4 P H X Worksheet #1	samples	
	Events a X	vwheel_fl N	455.0 wheel speed fron.
· · · · · · · · · · · · · · · · · · ·	Time Car From To Duration Channel Min Max	🛂 vwheel_fr 🛛 🛚	455.0 wheel speed fron.
		vwheel_rl N	455.0 wheel speed rear
		Vwheel_rr N	155.0 wheel speed rear
		vtime	
		- Adding	I
		d	
			1910 MB free

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



12.5.2 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, the existing recording is saved.
- Data recorded on the DDU 8 before the USB device is plugged in will not be saved.

Removing the USB device

Always power off the system before unplugging the USB device!

- If the USB device is unplugged while recording is active, parts of the measurement data may be missing.
- If the USB device is unplugged and re-inserted for < 4 s while the DDU 8 is powered up, the DDU 8 still records data.
- If the USB device is unplugged and re-inserted for > 4 s while the DDU 8 is powered up or a different USB device is plugged in, the DDU 8 restarts. In this case, the DDU 8 is not operational for 1.5 s.

12.5.3 Troubleshooting

When no data on the USB device is recorded:

Configure the measurement label **usb_mediastate** on a RaceCon measurement view or on a DDU 8 display page.

The value of **usb_mediastate** reflects the operating condition of the USB bus:

State	Description
0: Wait: Device not found	The USB device is not found (also: waiting for re-plug stick). No USB device inserted. USB device is defect. No electrical connection or wiring harness problem. USB software upgrade not activated (Purchase of unlock code needed).
1: Wait: Device detected	An USB device is found, but not yet installed.
2: Ok: Media installed	The USB device is found and is operational (idle). This does not imply that recording data is written!
3: Stop: Device unplugged	The USB device has been removed. The DDU 8 performs a restart when an USB device is re-plugged in.
4: Ok: Media access	Data is currently read from/written to the USB device.
5: Error: Media error	The communication to the USB device broke down. The USB device is defect. The USB device is not supported by DDU 8.
6: Error: Media corrupt	The USB device is not in valid BFS format. (Hint: Re-format the USB device in RaceCon.)



13 Lap trigger

13.1 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

System consists of

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



Types of systems

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



13.1.1 Electrical trigger signal

In DDU 8 all sources of measurement channels can be used as trigger signal.

- Analog input
- Digital input
- CAN input

Signal (measurement channel) properties

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



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



Two types of trigger signal

- Main trigger (end-of-lap at start/finish line)
- Sub-trigger (segment time, optional)

Bosch standard:

- Main trigger > 20 ms, < 40 ms, low active (Recommendation for Bosch triggers: 15 ms)
- Sub trigger > 40 ms, low active (Recommendation for Bosch triggers: 30 ms)

13.1.2 Software functionality

- Race track topology and transmitter location frequently cause false triggers. Software functionality prevents acceptance of false triggers.
- Under race conditions, trigger signals are sometimes missed. Software functionality introduces 'forced trigger'.

13.1.3 Prevention 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 main straight.
- Lap distance based retrigger protection prevents false triggers due to track topology.

13.1.4 Forced triggers

Lap distance based insertion of 'forced trigger'.



13.1.5 Setting up a lap trigger for DDU 8

- 1. Click 'Measurement Sources' in Toolbox.
- 2. Drag 'Laptrigger' into 'System Overview' and drop it on vehicle. Do not drop it on 'DDU 8'!



A 'Laptrigger Wizard' window opens.

Laptrigger Wizard - Add	New	×	
Laptrigger Configurati	ion	Ō	
Configure on device:	a speed input or the lapingger and adjust the track distance.		Choose the signal device for the trigger signal
Signal <u>s</u> ource:	🔳 🕫 Laptrigger pin	•	Choose the signal channel for the trigger signal
Speed input:	🗰 😁 speed	•	Choose the source for vehicle speed
Track <u>d</u> istance:	4000		Enter the distance of the racetrack
	< Back Next > Einish	<u>C</u> ancel	

Note: In this example, the Rx is connected to the dedicated lap trigger pin of DDU 8. The channel 'speed' is calculated from 4 wheel speeds.

3. Click 'Finish' to complete the operation.



A pre-configured lap trigger window opens.

	Lap	trigger Configuration					
a) b)	 * * *	Configure on Signal source Signal threshold	DDU8	- Countdown Mode Start time	None	•	g)
c) d) e) f)	 → → 	Release threshold Main trigger settings Detection time Retrigger lock time Intermediate trigger setting C Active	2500	Laptrigger conditions	√fzg_w 20	+ + +	h) i) j)
		Detection time Retrigger lock time Segment timing	30 🚅 ms	Enforce laptrigger Max. distance	120 <u>**</u> % 4800 m] ∢	k)
		Mode Lap segment distance from main trigger [m]	None	Laptrigger presettings Lap counter start value Outing counter start value Lap time threshold Lap time best preset	1 1 laps 1 1 outs 10 1 5 100,00 1 5	•	IJ

a) Change signal device, if desired.

b) Change signal channel, if desired.

c) Choose signal threshold. See chapter '13.1.1 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 settings for lap timing (main trigger). See chapter '13.3 Lap timing' for details.

f) Define settings for segmented timing (sub trigger). See chapter '13.4 Segment timing' for details.

g) Define settings for countdown timer. See chapter '13.5 Countdown timer' for details.

h) Change signal for vehicle speed, if desired.

i) Enter minimum speed for trigger release.

j) Define settings for distance based retrigger protection. See chapter '13.3.2 Distance based retrigger protection' for details.

k) Define settings for distance based forced trigger. See chapter '13.3.3 Distance based forced trigger' for details.

I) Define presettings for trigger. See chapter '13.1.7 Lap trigger presettings' for details.



13.1.6 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.

ttings	Measurements			
Track Conditions Distance 4000 m	Vehicle Speed	1 <u>3</u> . 1 km	ı/h	Button to reset lap distance to 0
Accept Trigger at 20 %	Lap Distance	224 m	Reset	Button to reset lap counter
hinorce i ngger at 120 %	Lap Counter	9 lap	S Reset to 1	
etection Time 15 ms	Outing Counter	l ou	ts Reset to 1	 Button to reset outing counter
ignal Timeout 5000 ms	Main Trigger	no	ne Test Trigger	Putton to generate trigger signal
termediate Trigger	Intermediate Trigger	[] no	ne	Dullon lo generale l'igger Signar
etection Time 30 ms	Best Laptime	s 2.8.2 ۲	Reset to 100.00	Button to reset best lan time
	Reset seg	ment times and best laptime		Dutton to reset best hap time
				Button to reset best lap time and distance-based segmentation

Lap trigger diagnosis scheme





13.1.7 Lap trigger presettings

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

Lapt	rigger Configuration							
	Configure on	DDU8	•	Countdown			1	
	Signal source	n 🔄 beacon	-	Mode	None	~		
	Signal threshold	Low Active Signal	_	Start time	12	0 🕂 S		
	Release threshold	2500 🛨 🕚	/	Laptrigger conditions				
	Main trigger settings			Speed source	💼 📑 vfzg_w	•		
	Detection time	15 🛨 r	ns	Min. speed	2	0 <mark>∃</mark> km/h	r i	
	Retrigger lock time	5000 -	ns	Track distance	400	0 🛨 m		
	Intermediate trigger setting	js		Min. distance	8	i0 :		
	C Active					3200 m		
	Detection time	30 r	ns	Enforce laptrigger	,			
	Retrigger lock time	5000 r	ns	Max. distance	12	0 🕂 %		
	Segment timing					4800 m		Preset values for lap counter
	Mode	Distance		 Laptrigger presettings 			1	and outing counter
	Lap segment distance	▶ <u>250</u> ▲		Lap counter start value	· · ·	1 🕂 laps		C
	nom main trigger (mj	750		Outing counter start value	· ·	1 🛨 outs		Minimum laptime that a new
		1000 💌		Lap time threshold		8🛨 s🗲		'best laptime' is accepted
	~			Lap time best preset	100,0	0 🛨 🛛		
	\land Hide details							Preset value for 'best laptime



13.2 Counting outings / 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: recording of lap completed, system shutdown

The system is counting:

Outing: one or several laps from leaving the garage to entering the garage

Lap (min. 20% of lap distance travelled)

- Leaving the pits to lap trigger
- Lap trigger to lap trigger
- Lap trigger to entering the pits

Fragment (less than 20% of lap distance travelled)

- Testbench operation
- Engine warm-up
- Power cycle on track (e.g. engine stalled)



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'.

13.3 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_lapcurr_dls	Current lap number
Laptrigger_lapctr_dls	Number of completed laps
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




13.3.1 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.

Configure on		Countdown		
Signal source		Mode	None	-
Signal threshold	Low Active Signal	Start time	120	s
Release threshold	2500 ÷ V	Laptrigger conditions		
Main trigger settings		Speed source	🔲 🕒 vfzg_w	
Detection time	15 🛨 ms	Min. speed	20	km
Retrigger lock time	5000 🛨 ms	Track distance	4000	m
Intermediate trigger settir	ngs	Min. distance	80	3 %
Active			320	JŪ m
Detection time	30 픚 ms	Enforce laptrigger		
Retrigger lock time	5000 📻 ms	Max. distance	120	3 %
Segment timing			480	10 m
Mode	Distance	Laptrigger presettings		
Lap segment distance	250	Lap counter start value	1-	ap lap
from main trigger [m]	500	Outing counter start value	1	- - - - ou
	1000 -	Lap time threshold	8	s 🗧
-		Lap time best preset	100.00	s E





13.3.2 Distance based retrigger protection

Trigger is locked until 80% of track distance has been covered (3200 m).

To deactivate distance based retrigger protection, set min distance to 0%.

Configure on		•	Countdown			
Signal source			Mode	None	-	
Signal threshold	Low Active Signal	-	Start time		120 🛨	s
Release threshold	25	500 ; V	Laptrigger conditions			
Main trigger settings			Speed source	💼 🕒 vfzg_w		
Detection time		15 🛨 ms	Min. speed		20 🗧	kг
Retrigger lock time	5	000 🛨 ms	Track distance		4000 🗧	m
Intermediate trigger setti	ngs		Min. distance		80 ÷	%
Active					3200	m
Detection time		30 🗧 ms	Enforce laptrigger	,		
Retrigger lock time	50	000 🕂 ms	Max. distance		120 🗧	%
Segment timing					4800	m
Mode	Distance	•	Laptrigger presettings			
Lap segment distance	250	_	Lap counter start value		1÷	la
trom main trigger [m]	500	_	Outing counter start value		1 🗄	o
	1000	•	Lap time threshold		8 🗧	s
<u> </u>			Lap time best preset	1	00,00	s





13.3.3 Distance based forced trigger

After a missed main trigger, a forced trigger is inserted, if 120% of the track distance has been covered (4800 m). In this case, the channel 'Laptrigger_distlap_dls' starts at 800 m.

To deactivate distance based forced trigger, uncheck box.

Configure on		•	Countdown			_
Signal source			Mode	None	-	
Signal threshold	Low Active Signal	- -	Start time		120 🚊	s
- Release threshold	2500	 ∃ ∨	Laptrigger conditions			
Main trigger settings —	,		Speed source	💼 🕒 vfzg_w		
Detection time	15	🕂 ms	Min. speed		20 🛟	kn
Retrigger lock time	5000	🕂 ms	Track distance		4000 🛨	m
-Intermediate trigger settir	ngs		Min. distance		80 🛨	%
C Active					3200	m
Detection time	30	📑 ms	Enforce laptrigger	,		_
Retrigger lock time	5000	📑 ms	Max. distance		120 🛨	%
Segment timing					4800	m
Mode	Distance	•	Laptrigger presettings			
Lap segment distance	250	_	Lap counter start value		1 🕂	la
from main trigger [m]	500	-	Outing counter start value		1 🕂	οι
	1000	-	Lap time threshold		8 🗧	s
~			Lap time best preset	1	00,00	s





13.4 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_dlast	Difference of lap segment time compared to last lap
Laptrigger_dbest	Difference of lap segment time compared to best lap



13.4.1 Sub trigger mode

Using main trigger (20 ms pulse) at Start-Finish-Line. 3 sub triggers (40 ms pulse) positioned at 1000 m, 2000 m and 3000 m.

To deactivate sub trigger mode uncheck box.

Configure on		Countdown		
Signal source		Mode	None	·
Signal threshold	Low Active Signal	Start time	120	s
Release threshold	2500 🕂 V	Laptrigger conditions		
Main trigger settings		Speed source	💼 🕒 vízg_w	-
Detection time	15 🛨 ms	Min. speed	20	km/
Retrigger lock time	5000 🛨 ms	Track distance	4000	m
Intermediate trigger setti	ngs	Min. distance	80	%
Active			320	10 m
Detection time	30 🗾 ms	Enforce laptrigger		
Retrigger lock time	5000 🗾 ms	Max. distance	120	3 %
Segment timing			480	10 m
Mode	Intermediate trigger	Laptrigger presettings		
Lap segment distance	*	Lap counter start value	1	laps
nom main digger (M)		Outing counter start value	1	outs
		Lap time threshold	8	s
		Lan time best preset	100.00	Ξ.





13.4.2 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'.

rigger Configuration					
Configure on		-	Countdown		
Signal source	Deacon	-	Mode	None	
Signal threshold	Low Active Signal		Start time	120 🗧	s
Release threshold	2500 -	v	Laptrigger conditions		
Main trigger settings —	,		Speed source	💼 🛄 vfzg_w	-
Detection time	15 🗮	ms	Min. speed	20-	km/h
Retrigger lock time	5000 -	ms			
	,		Track distance	4000 🛨	m
Intermediate trigger setti	ngs		Min. distance	80 🛨	%
Active				3200	m
Detection time	30 🐳	ms	Enforce laptrigger		
Retrigger lock time	5000 🛨	ms	Max. distance	120 🕂	%
Segment timing				4800	m
Mode	Distance 💌		Laptrigger presettings		
Lap segment distance	> 250 -		Lan counter start value	12	lans
from main trigger [m]	500		Duting counter start value		oute
	750		Lap time threshold		ours
	1000		Lap une meshold		2
			Lap time best preset	100,00	s





13.5 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.

Configure on			- Countdown		
conligate on			Mode	Intermediate Trigger	
Signal source	💼 💁 beacon	-	Short time		
Signal threshold	Low Active Signal 📃 💌		Start une	120	\$
Release threshold	2500 🛨	V	Laptrigger conditions		
– Main trigger settings –			Speed source	💼 🕒 vfzg_w	-
Detection time	h5 🕂	ms	Min. speed	0	km/ł
Retrigger lock time	5000 🛨	ms	Track distance	4100	m
Intermediate trigger setti	าตร		Min distance	4100	
	.9.		Min. distance		10
M Active		.		0	m
Detection time	30 🛨	ms	Enforce laptrigger		
Retrigger lock time	5000 🛨	ms	Max. distance	0 😴	%
Segment timing				0	m
Mode	Distance 💌	1	Laptrigger presettings		
Lap segment distance	▶ 250 ▲		Lap counter start value	1=	laps
from main trigger [m]	500	1	Outing counter start value		outo
	750		outing counter staft value		ouis
	1000		Lap time threshold	8 🛨	s
			Lap time best preset	100.00	s



14 Firmware

14.1 Firmware and configuration

DDU 8 holds 4 types of data:

- Firmware: the software (PST program file) of the DDU 8
- Configuration: the configuration of Input channels, CAN I/O, PWM, display configuration, recording + telemetry configuration
- Calibration data: Characteristic curves and offsets created by online calibration at the vehicle
- Recorded data: Measurement data recorded during vehicle operation





14.2 Firmware update

The scheme shows the process during each connection between RaceCon and DDU 8.



14.2.1 Performing the firmware update

Firmware update is only possible if the DDU 8 is connected to RaceCon. The configuration of Input channels, CAN I/O, display, recording + telemetry will not be changed.

1. In the DDU 8 Project Tree, right-click on 'DDU 8' and choose 'Synchronize' then 'Update firmware'.





A pop-up menu opens.

2. Select the destination of the firmware archive (PST).



3. Click 'OK' when done.

The firmware update starts. The DDU 8 displays the message 'Updating firmware'. Do not switch off the car's ignition or interrupt the power supply of the DDU 8!



When the firmware update is complete, the DDU 8 displays the message 'Updating firmware finished. Do a powercycle.'

4. Switch the car's ignition off and on again to cycle the power of the DDU 8.







15 GPS sensor

This function requires the installation of Software Upgrade 2.

15.1 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 DDU 8 (not covered here)
- Serial output -> Read in messages via RS232 Interface of DDU 8 (serial interface 2)

15.1.1 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: 9600 is standard for GPS, DDU 8 supports 1200...115200 baud. GPS Rx interface baud rate must match DDU interface baud rate. DDU 8 Baud rate can be set with the 'GPS_BAUDRATE' characteristic
- Data format: DDU 8 expects 8 data bits, no parity bit, 1 stop bit (8N1)

15.2 Protocol

DDU 8 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.



15.3 Sensor recommendation

The system has been tested with a Navilock NL 403P serial GPS receiver. This sensor is based on an UBlox5 chipset and is fully configurable with UCenter SW.

15.4 Measurement labels

The decoded NMEA messages are copied to these DDU 8 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 in NDEG - +/-[degree][min].[sec/60]
gps_long	Longitude in NDEG - +/-[degree][min].[sec/60]
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
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	Mask specifying types of packages from which data has been obtained
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



15.5 GPS troubleshooting

Electrical

- Is the transmitter signal of the GPS sensor connected to the receiver pin of serial interface 2 of the DDU 8 ?
- Is the GPS sensor powered up?
- Does the GPS sensor deliver RS232 signal levels?

Interface

- Do the baudrates of the GPS sensor and the DDU 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?
- With a correctly wired and powered GPS sensor the changing GPS time information (gps_sec) can be immediately observed.
- Is Software Upgrade 2 activated in the DDU 8 ?

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'.



16 Fuel consumption calculation

16.1 Setting up fuel consumption calculation and tank management for DDU 8

- 1. Select 'Measurement Sources' in Toolbox.
- 2. Drag 'Fuel' element and drop it on the vehicle in System Overview. Do not drop it on the DDU 8!



A 'fuel consumption wizard' opens.

General	
Configure on device	DDU8
Tank capacity	80,0 📑 🛯 🔸
Fuel consumption calculation -	
Mode	Using fuel consumed
Fuel input	Im 🔤 fuelcons 🗸 🗸 0,001 Adaption factor to [m]
Consumption correction factor	1,000
Remaining laps calculation	
Mode	Last lap's consumption
Target lap consumption	3.00 🛫 I
Reset fuel consumption	
Mode	By RaceCon
Reset signal source	- <i>D</i>
Reset signal threshold	Low active signal
Release threshold	2500 🕂 mV



- 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 DDU 8 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)
- 3. Press 'Finish' when done.



16.2 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 Tank capacity 80.0 Consumption correction factor 1.000 Target lap consumption 3.00	Messurements Total consumption 948.7 Reset to 0 Fuel consumption 25.80 Evel remaining 54.20	Button to reset total fuel consumption (Reset with RaceCon only)
Reset fuel consumption Last sign 2 consumption	Last lap's consumption Last lap's Last lap's	Button to reset fuel consumption manually (Can also be triggered 'by signal source' or

16.3 Example



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



17 RaceCon shortcuts

The table shows important shortcuts simplify controlling the DDU 8 in RaceCon.

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

Contact

Europe:

Bosch Engineering GmbH Motorsport Robert-Bosch-Allee 1 74232 Abstatt Germany Phone: +49 7062 911 79101 Fax: +49 7062 911 79104

North and South America:

Bosch Engineering North America Motorsports 38000 Hills Tech Drive Farmington Hills, MI 48331-3417 United States of America Phone: +1 248 876 2977 Fax: +1 248 876 7373

Asia Pacific:

Bosch Engineering K.K. Motorsport 18th Floor, Queen's Tower C, 2-3-5 Minatomirai Nishi-ku, Yokohama, 220-6218 Kanagawa Japan Tel.: +81 45 650 5610 Fax: +81 45 650 5611

> E-Mail: motorsport@bosch.com www.bosch-motorsport.com

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