Bosch Motorsport

Display DDU 8

Manual

F 02U 002 643-02

BOSCH
Invented for life

Content

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:

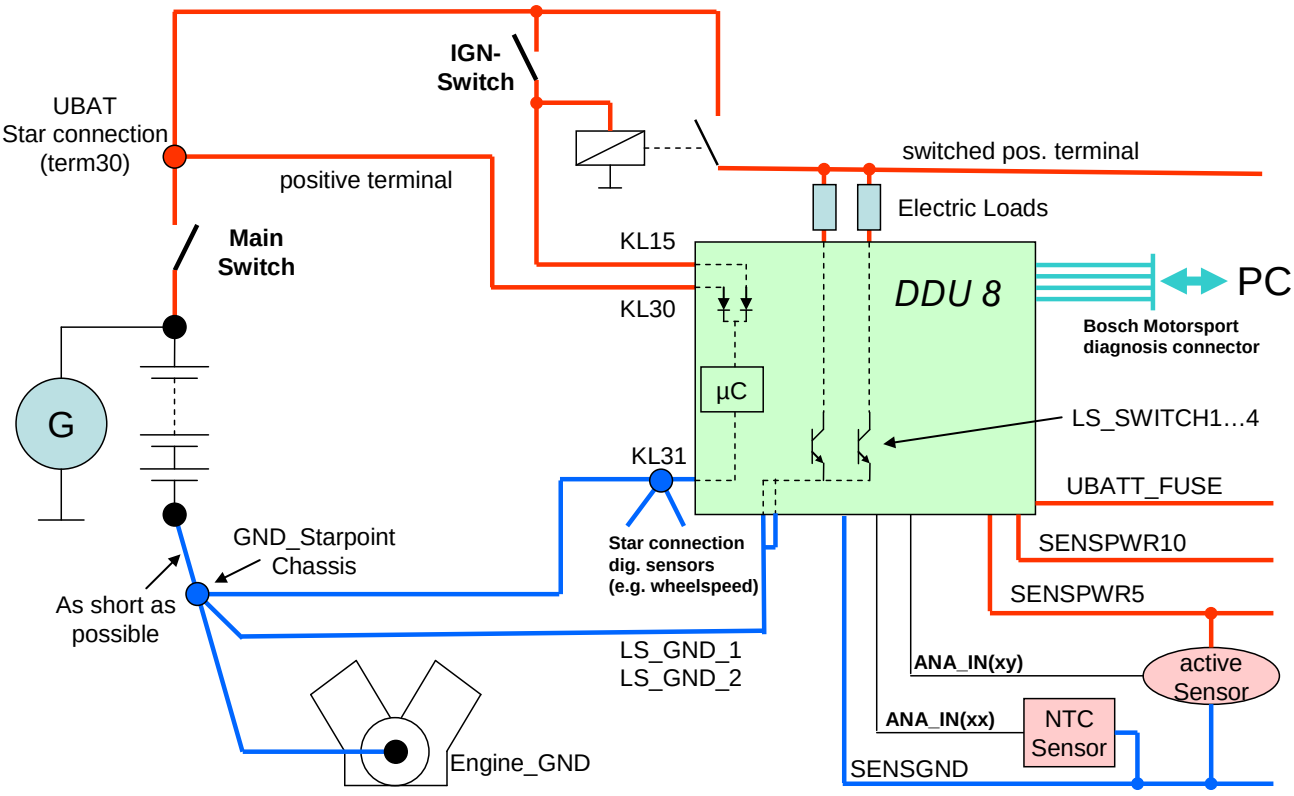
- A ground that has a solid, low resistance connection to the negative battery terminal.
- Connection should be free from dirt, grease, paint, anodizing, etc.
- Use large diameter wire
- More metal-to-metal contact is better!

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 1 (see www.bosch-motorsport.com)

Connectors	
Autosport connectors double 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 each)	4
Sensor supply 5 V/350 mA	1
Communication Interfaces	
CAN	2
Ethernet 100BaseT	3
Laptrigger input (on yellow connector, always active)	1

Application Hints
Internal battery for data preservation included
Required service interval 12 months (internal battery is replaced)

Accessories	
External switch for page selection (12 step switch)	**B 261 209 658**
External switch for brightness adjustment or page selection (6 step switch)	**B 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 (Input Hall/inductive)	4
Additional sensor supplies 5 V/350 mA	3
Additional sensor supply 10 V/350 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 manufacturer required)	
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

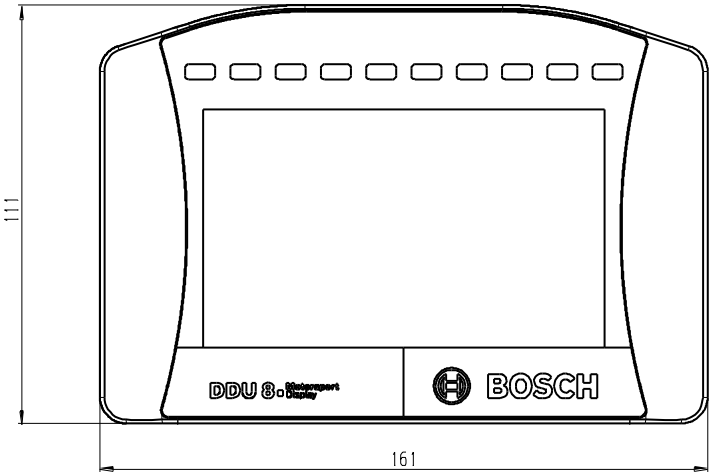
Life Connector ASDD-2-12-41PN (Red)

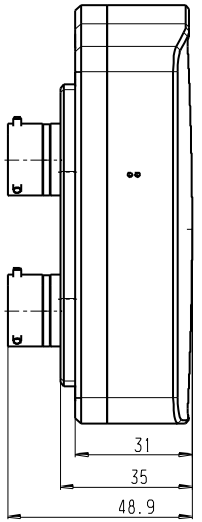
Pin	Name	Description	Direction	Remark
1	UBATT (Kl. 30)	power supply Ubat	input	
2	switched positive Kl.15	switched power supply Ubat	input	
3	switched positive Kl.15	switched power supply Ubat	input	
4	unit ground (Kl. 31)	ground power supply	input	
5	unit ground	ground power supply	input	
6 7 8 9	ETH1_TX+ 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	

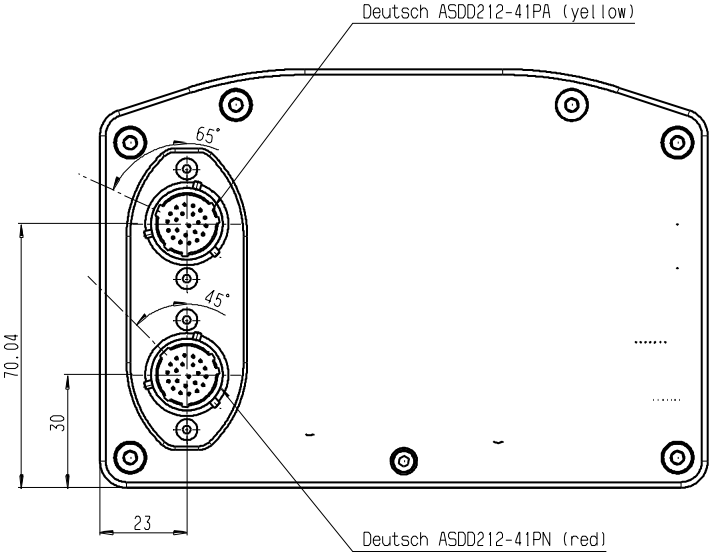
5.5 Pin layout sensor connector

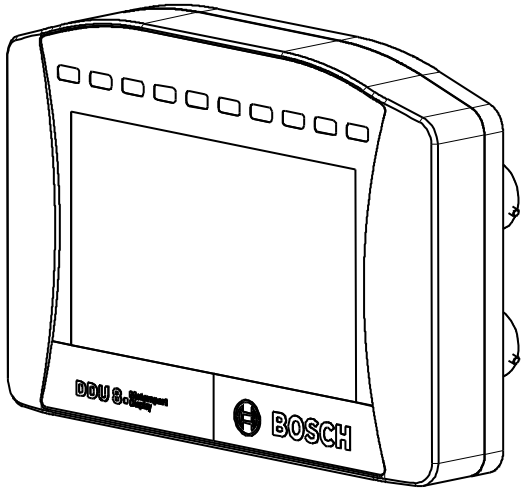
Sensor Connector ASDD-2-12-41PA (Yellow)

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	









Surf.roughn. N12A D53:2003-08 Rauheitsäng.: N12A D53/1:2003-08		
Edges: DIN ISO 13715: 2000-12 Kanten:		
Metr. ISO Metr. ISO	w/o surface ohne Oberfl.	with surface mit Oberfl.
Ext. thread Aussengew.	.	.
Int. thread Innengew.	.	.

Non-toleranced dimensions
Nicht tolerierte Masse

>0,2 ...0,5	>0,5 ...3	>3 ...6	>6 ...30	>30 ..120	>120
±0,1	±0,1	±0,1	±0,2	±0,3	±0,5

Radii, chamfers
Rundungen, Fasen

±0,1	±0,2	±0,5	±1	±2	±4

Angles, dim. of the shorter side
Winkel, Masse der kuerzeren Schenkel

...10	> 10 ...50	> 50 ...120	> 120 ...400	> 400
±1°	±30'	±20'	±10'	±5'

Tolerances of form and position
Form- und Lagetoleranzen
DIN ISO 2768-2-H:1991-04
(N13 B92/1: 2000-03)

ISO lim. of size
ISO-Grenzmasse

Size over Mass ueber	to bis	Tol. class Toleranz-klasse	Lim. deviations Grenz-abmasse
.	.		. .
.	.		. .
.	.		. .

Connector Overview

Connector display	Mating connector harness
Deutsch ASDD212-41PA	Deutsch ASDD 6-12-41SA
Deutsch ASDD212-41PN	Deutsch ASDD 6-12-41PN

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw.Abt.	Add. info./Zus. Info.
01	F-Nr.	20091208	HrS	.	.	TOGE	BEG/EMS2	.
-	-	20090622	HrS	.	.	TOGE	BEG/EMS2	.

Treatment -
Behandlung -
Mat./Stoff -
Missed details/Fehlende Angaben -
From/Aus -
Size/Gst. 1

Leng./Spr. en/de
Wght./Gew. 0,660kg
Crit. P. --
Scale/M.stab 1:1
BOSCH
Display DDU8
Display DDU8
Offer Drawing
Sheet/Bl. 1/1
Doc.type DRW
F02U V00 320-02
DP/TD .
Ind. .
Format A2
Mat.meets/Stoffe s. -
Syst. CAT
MNR --
N2580-1
Repl. for .
Repl. by .

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

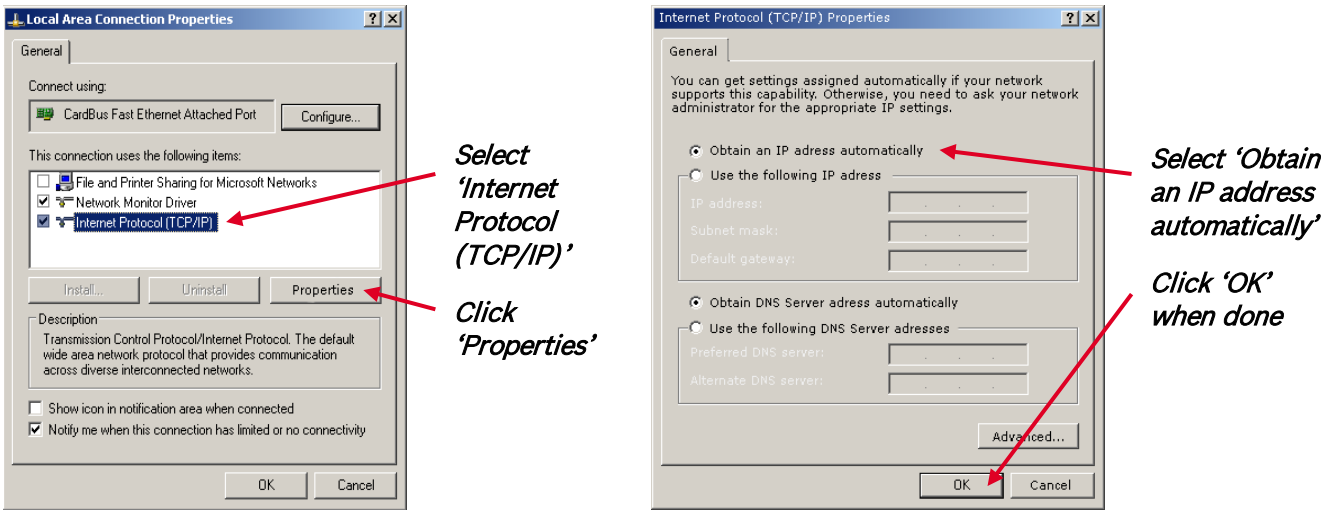
Minimum wiring loom of the Life connector (red):

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

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

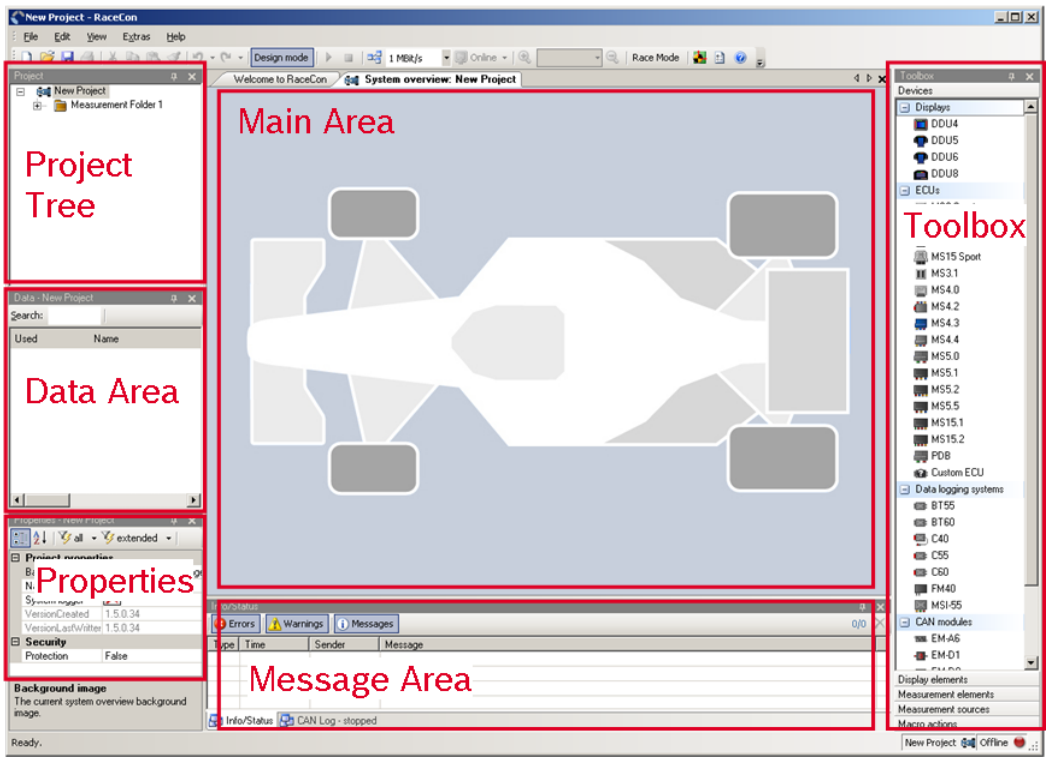
RaceCon is an all integrated software tool for configuration and calibration of Bosch Motorsport hardware products. It is used to set up, configure and calibrate the DDU 8.

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

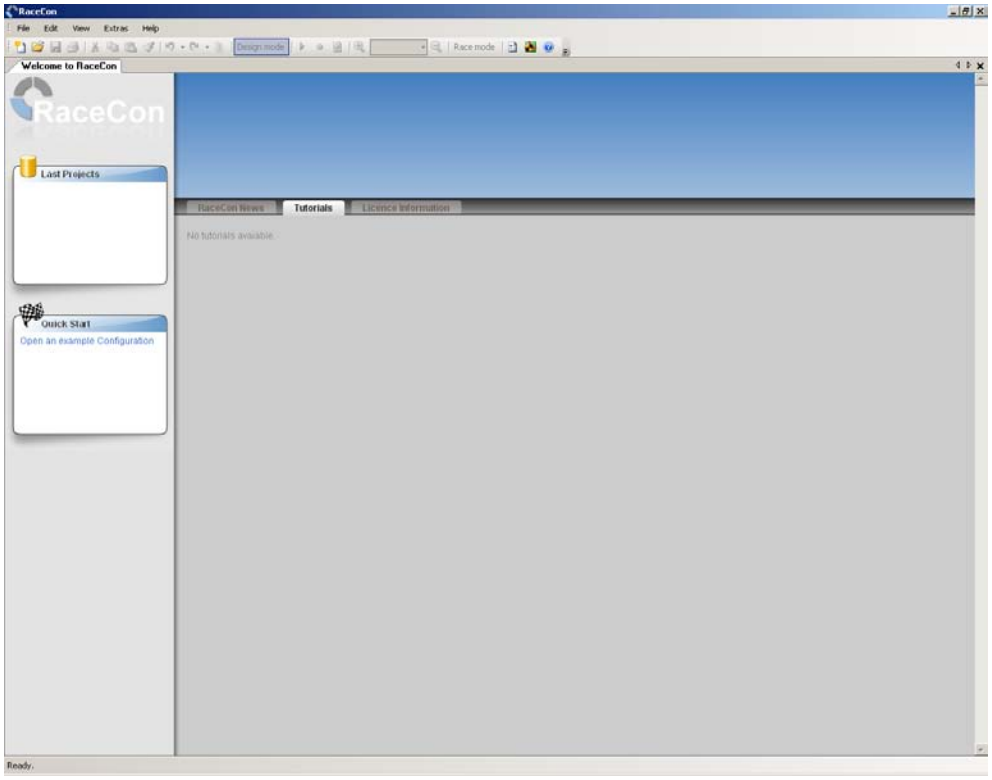
The video tutorial is available in the ‘Software Download’ section of www.bosch-motorsport.com.

7.1.4 Connecting the DDU 8 to RaceCon

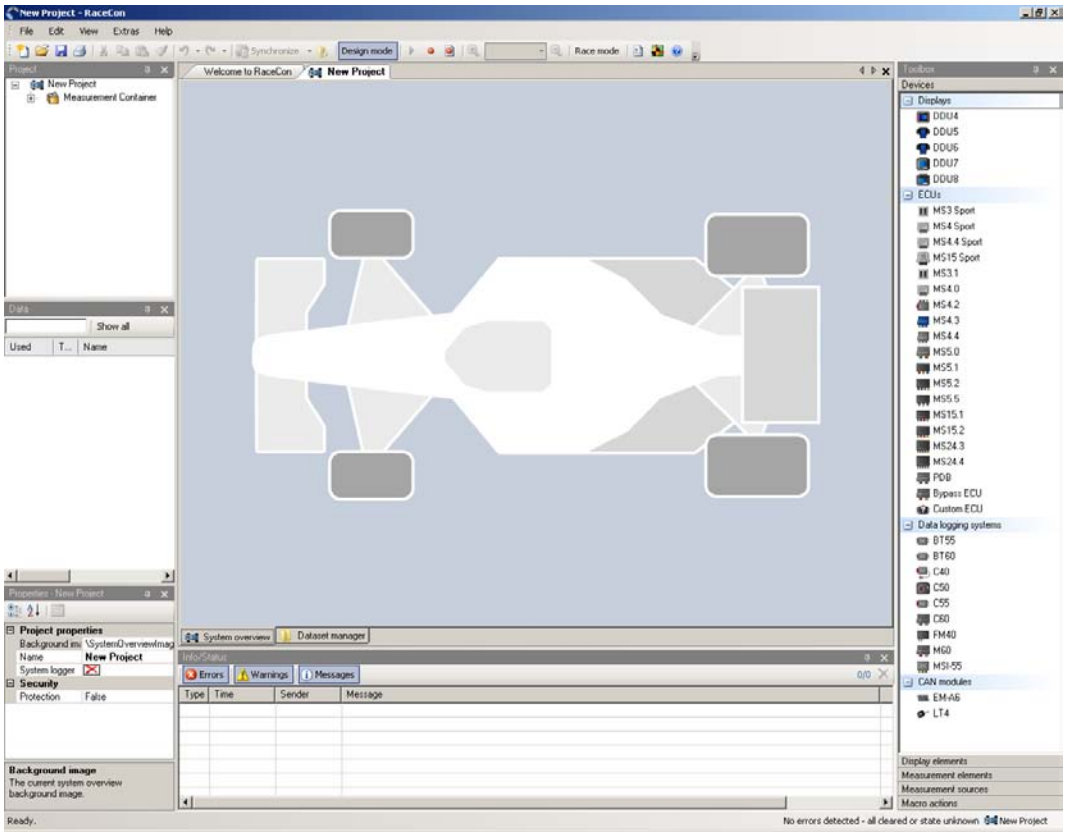
The following screenshot shows an overview of the RaceCon Main Screen with its areas.
All (sub-) windows are resizable and dockable.



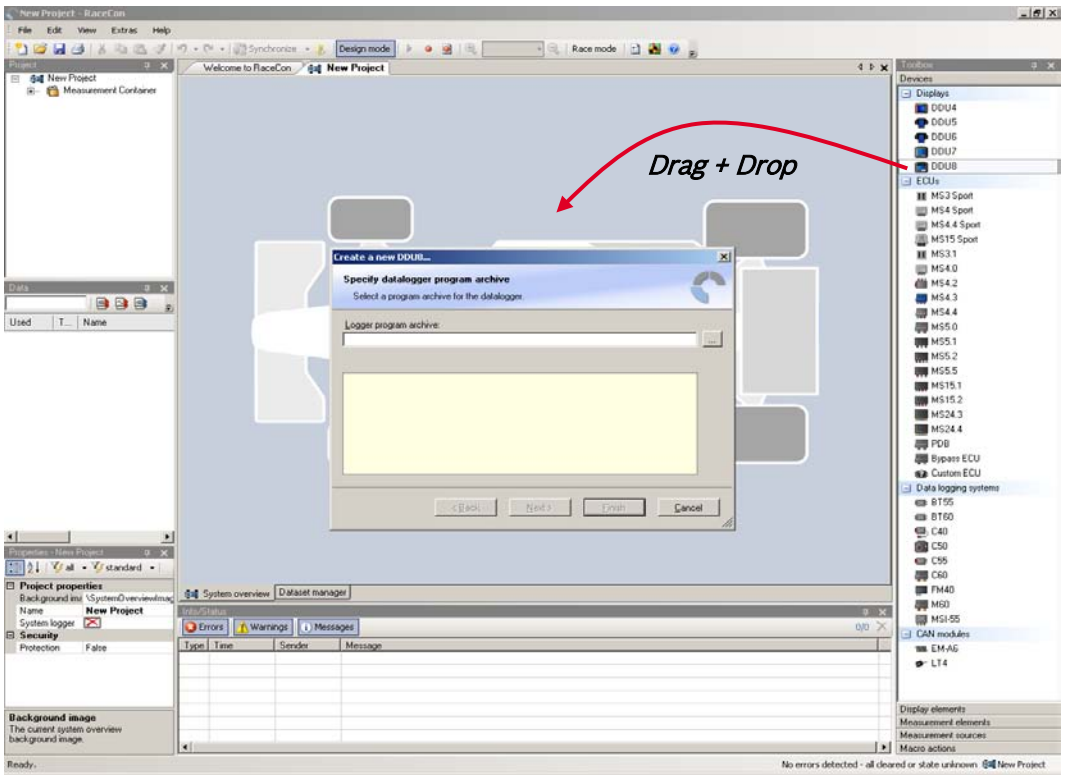
1. Start the RaceCon software.



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

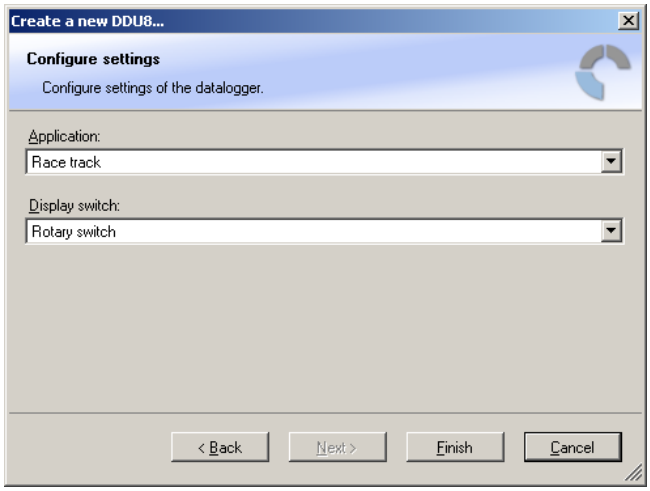


3. In the Toolbox select the DDU 8 and drag it into the Main Area.
A pop up window to specify the DDU 8 program archive appears.



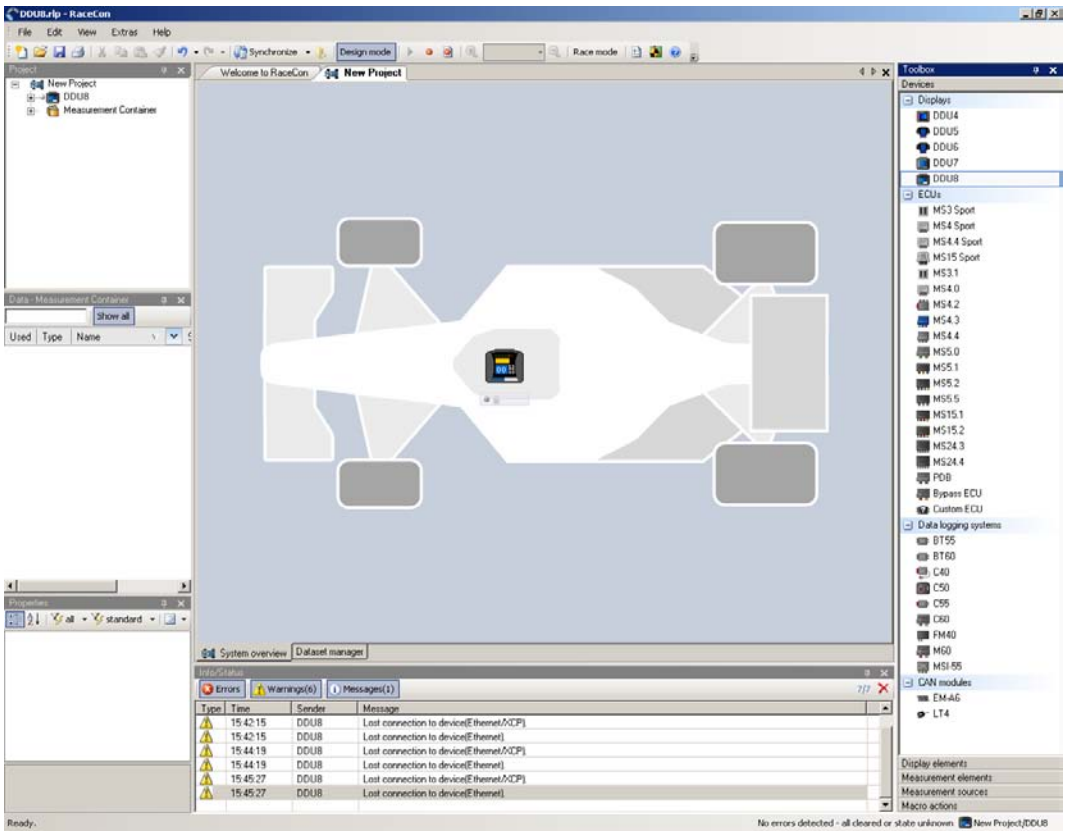
An information shows that the archive is valid or not.

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



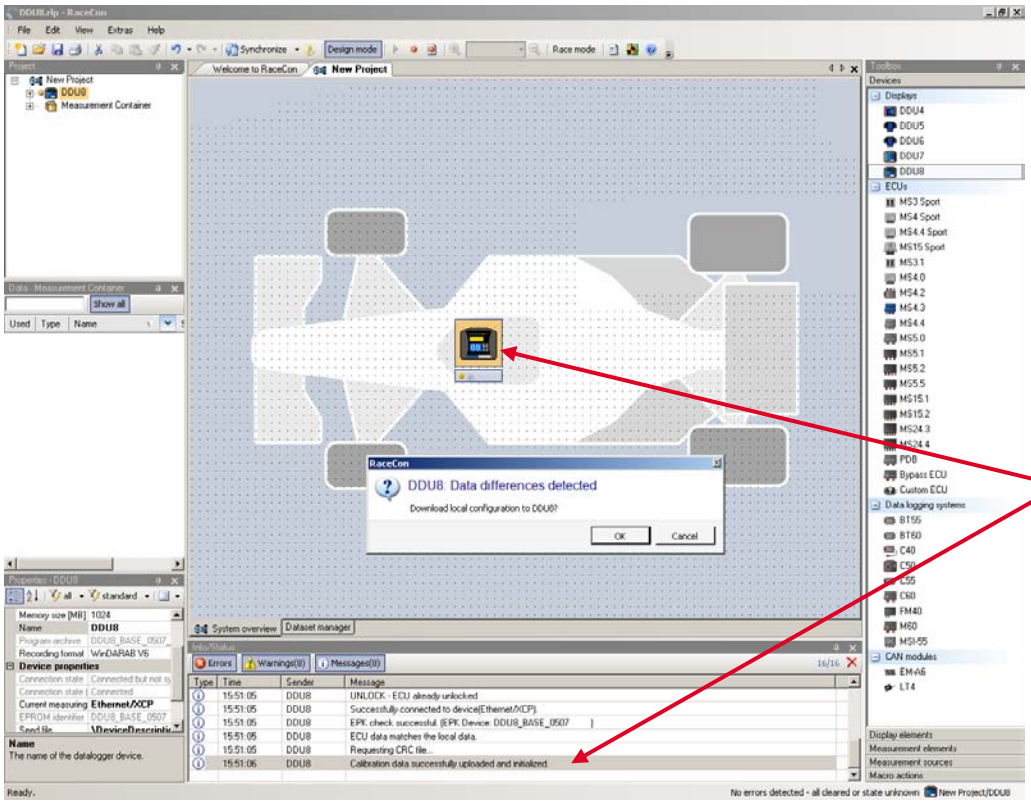
6. Select ‘Race track’.
7. Choose the way to switch display pages that fits to your hardware configuration. For more information see chapter ‘8.4 Page select.
8. Click ‘Finish’.

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



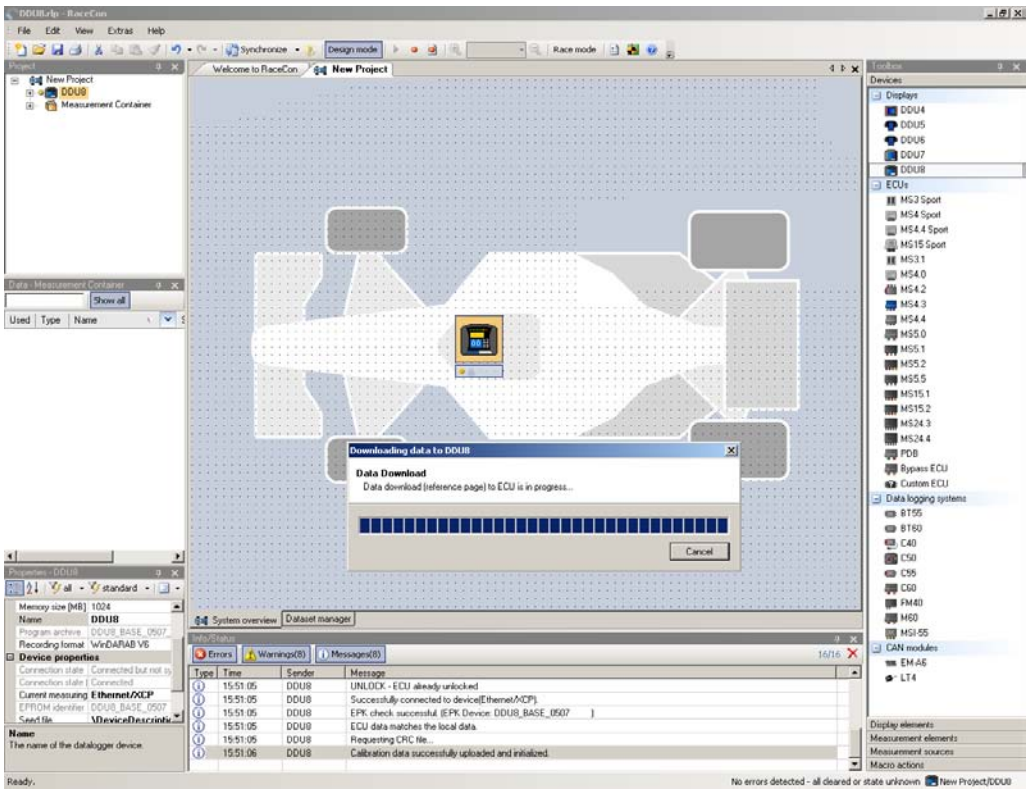
RaceCon detects configuration differences between the DDU 8 and the RaceCon project and asks for permission for data download.

9. Click ‘OK’ to proceed.

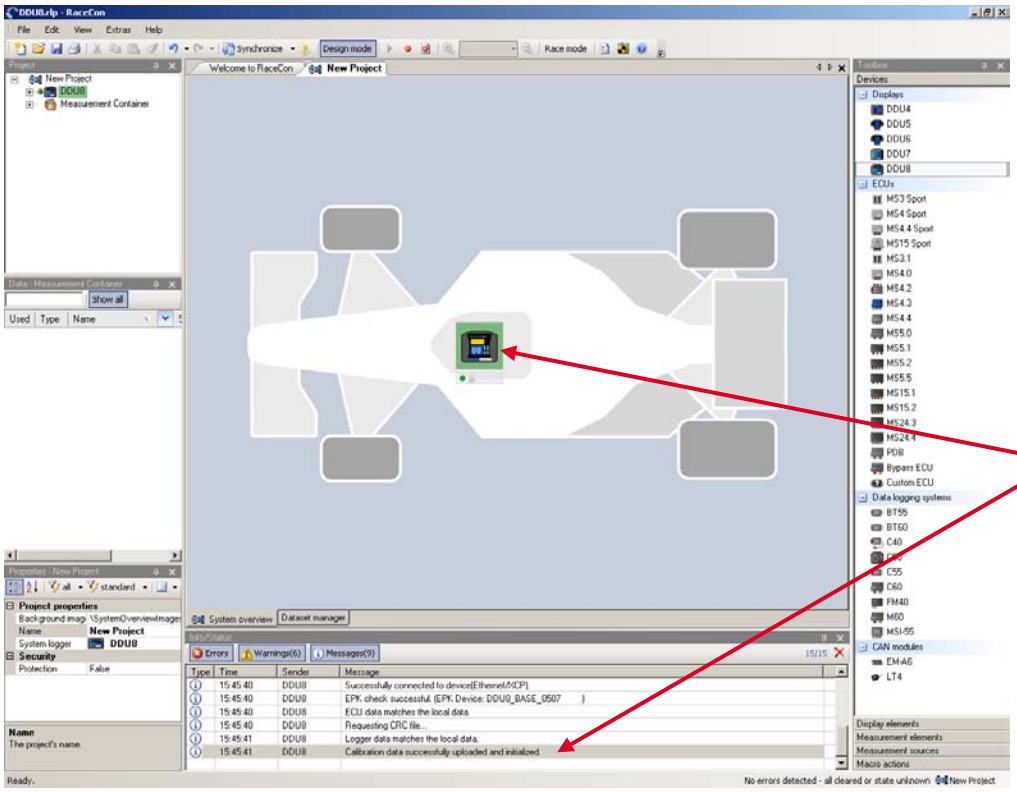


Successful Ethernet connection, DDU 8 ‘talks’ to PC

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.

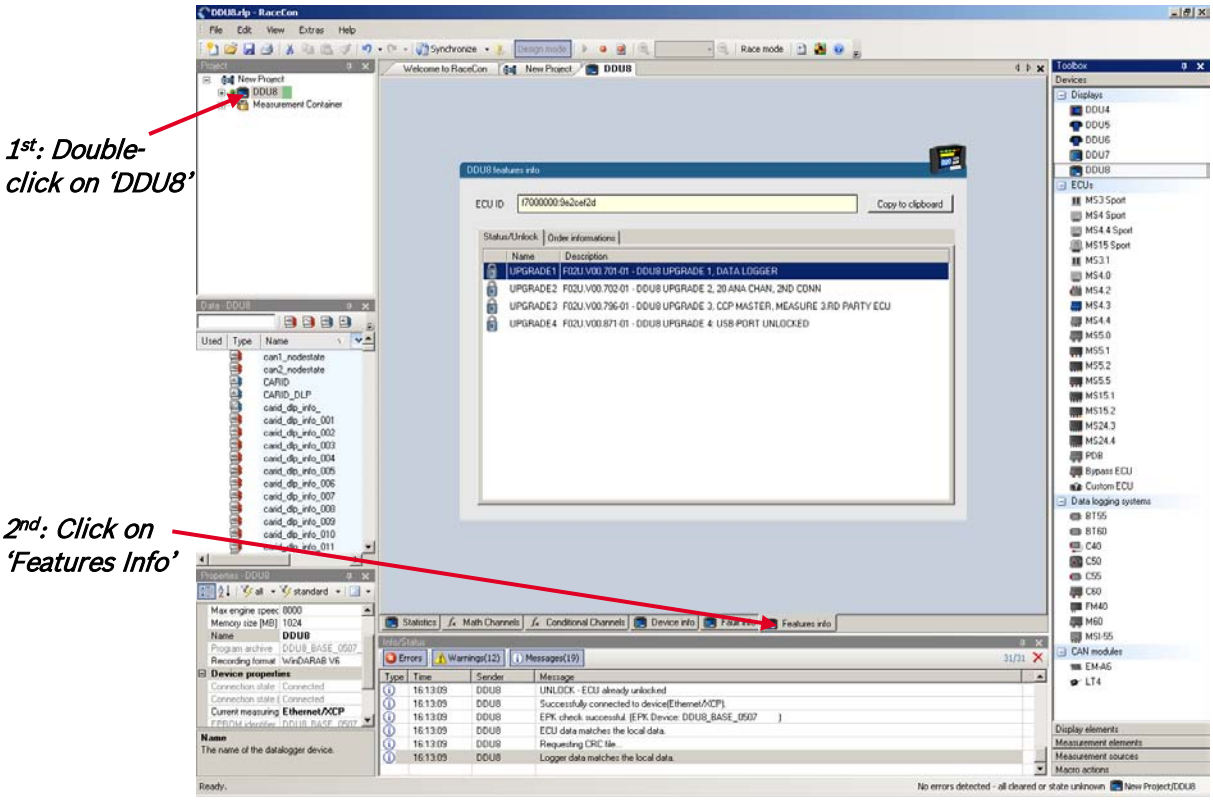


Green background and dot indicate matching configuration

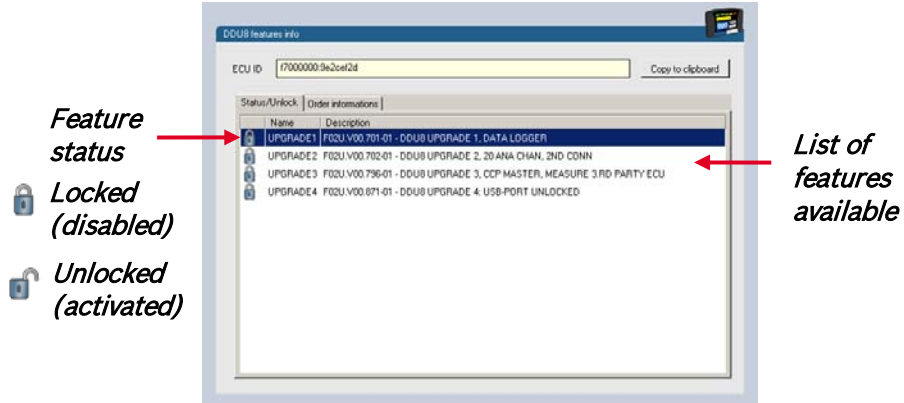
7.2 Feature activation

- 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.

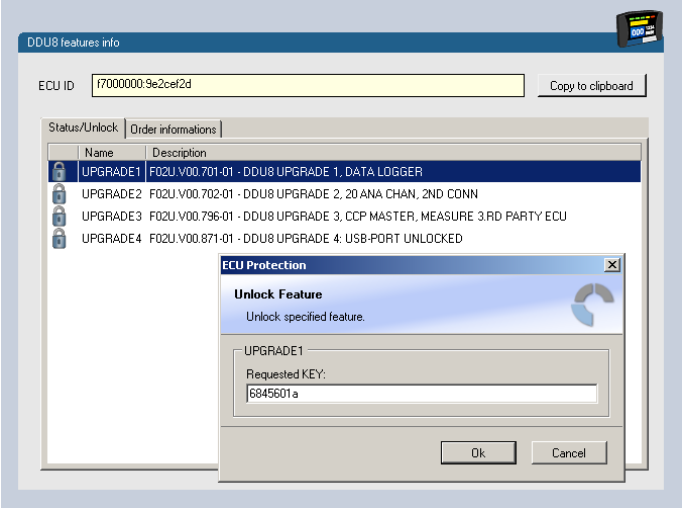
1. To activate a feature, double-click on ‘DDU 8’ in the Project Tree and click on the ‘Features info’ tab in the Main Area.



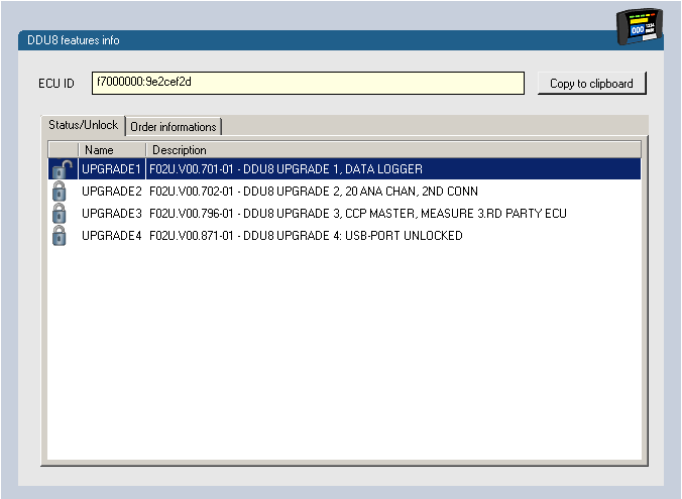
The ‘DDU 8 features info’ window appears.



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’.



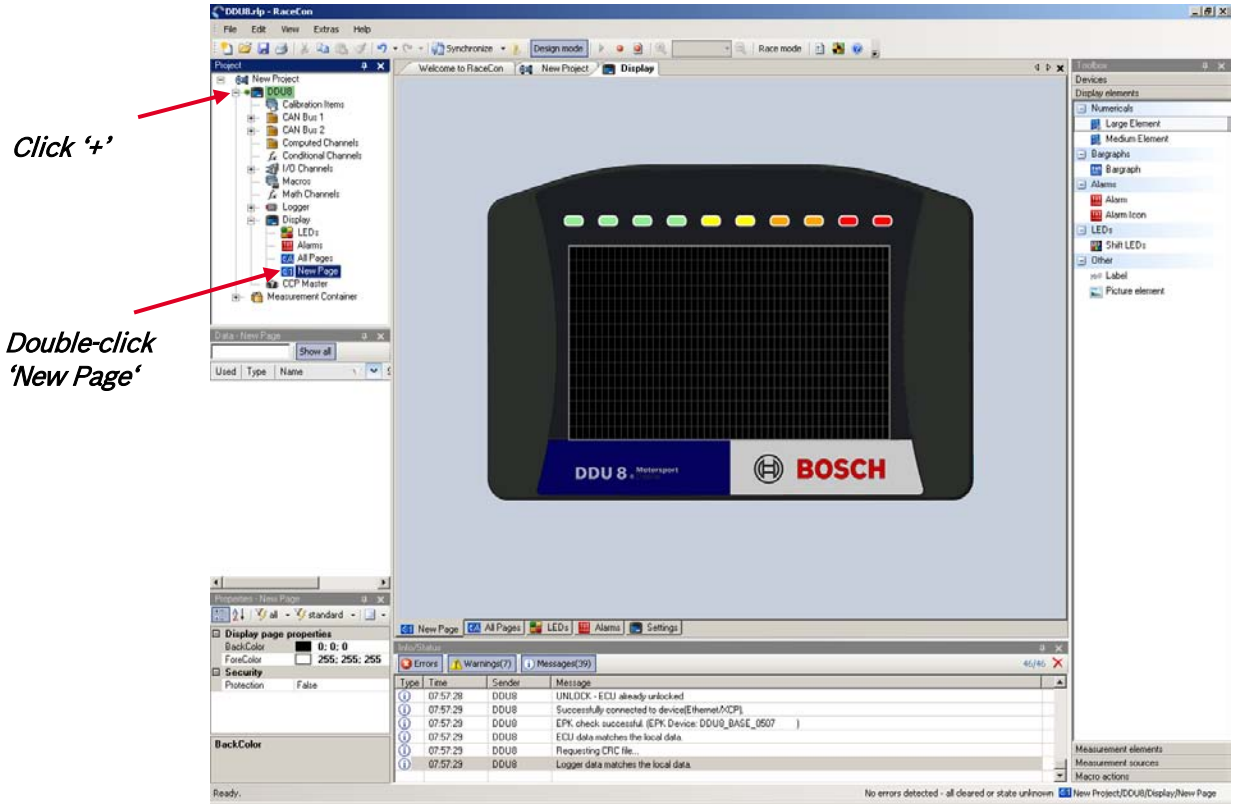
4. Perform these steps to activate other features you purchased.
5. Switch the car’s ignition off and on again to cycle the power of the DDU 8.

7.3 1st display configuration (Quick Start)

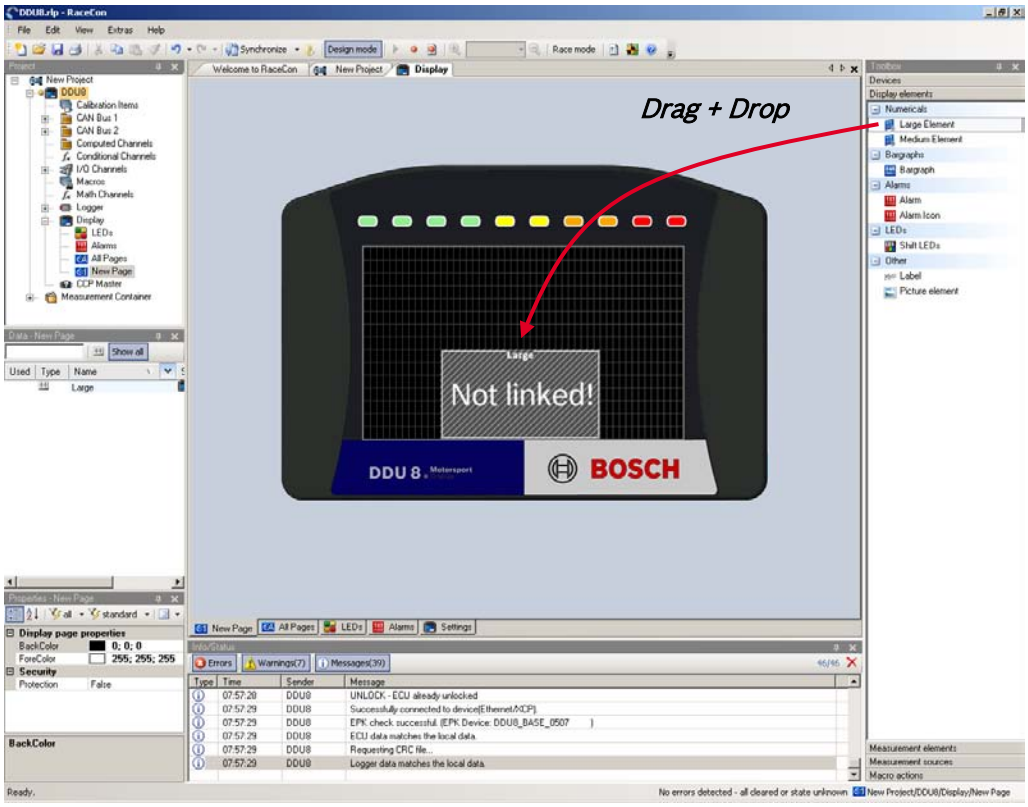
This chapter explains the configuration of a display element showing the battery voltage.
See chapter '8.2 Display element configuration' for a detailed instruction to configure display elements.

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

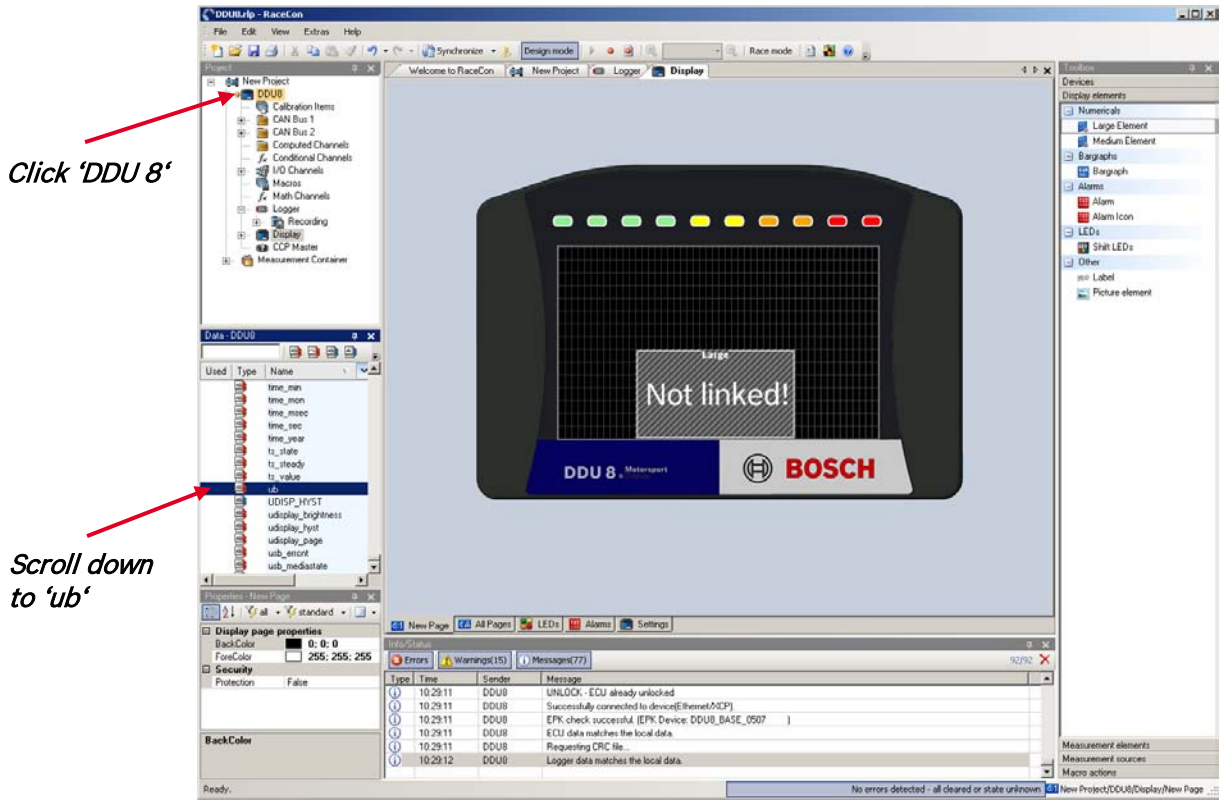
The DDU 8 display configuration area opens.



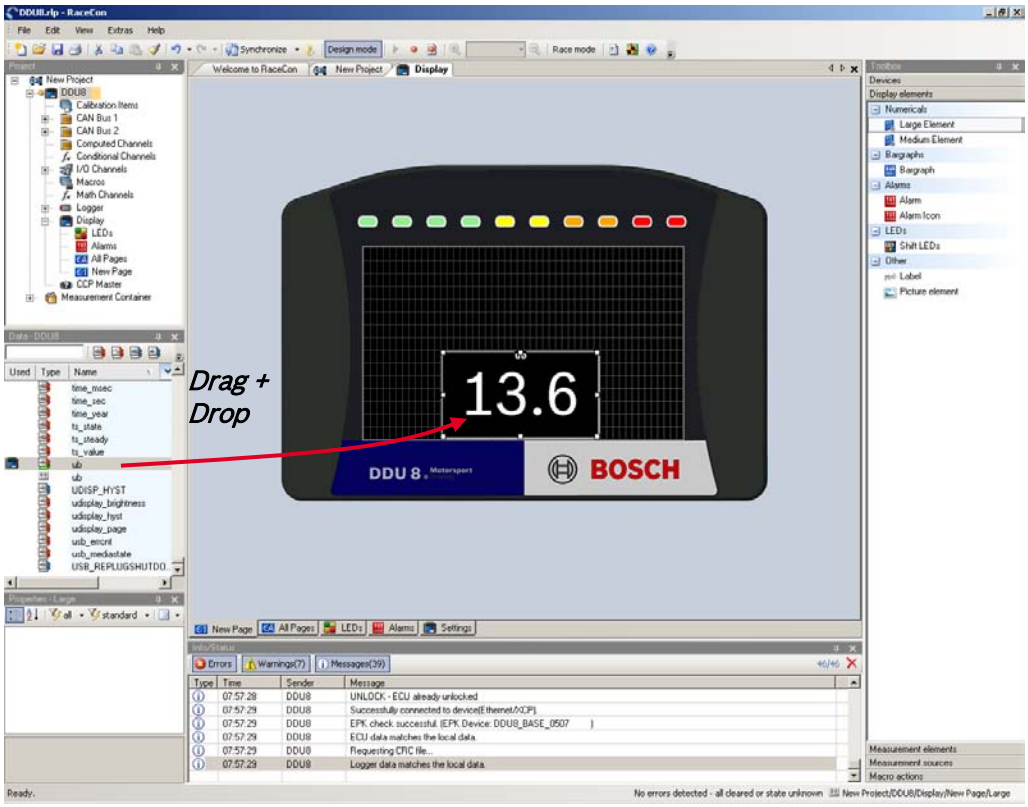
3. Drag a ‘Large Element’ from the Toolbox and drop it on the display page.
A message in the ‘Large Element’ box shows that it is not linked to a measurement channel.



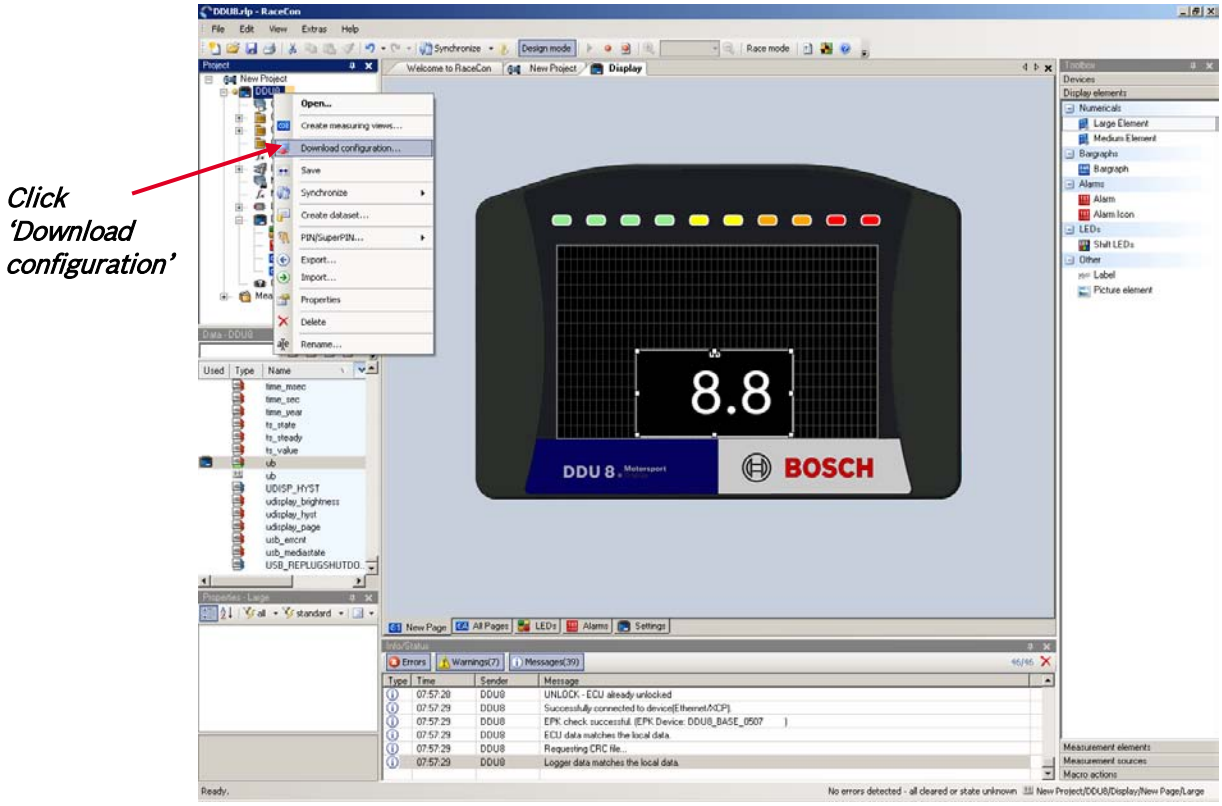
4. In the DDU 8 Project Tree, click on ‘DDU 8’ to display the available measurement channels.
5. In the data window, scroll down to ‘ub’ (measurement channel for battery voltage).



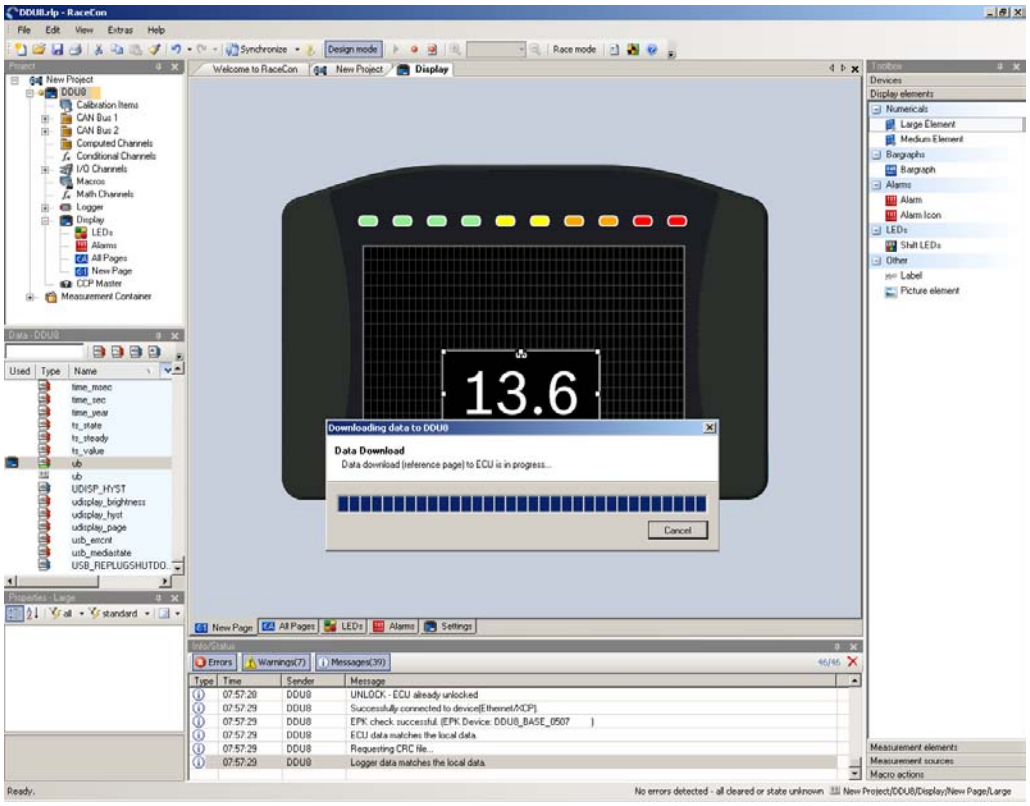
6. Drag the ‘ub’ measurement channel from the Data Area and drop it on the ‘Large Element’.



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



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



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

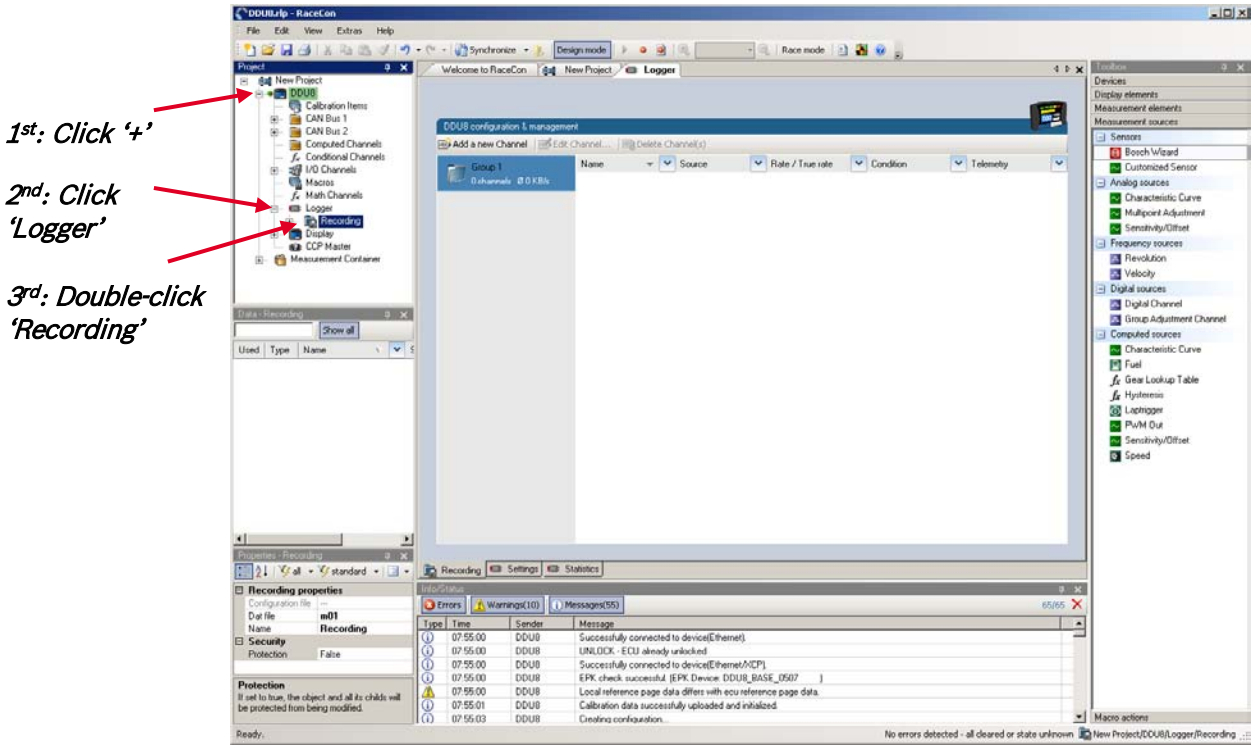
7.4 1st recording (Quick Start)

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.

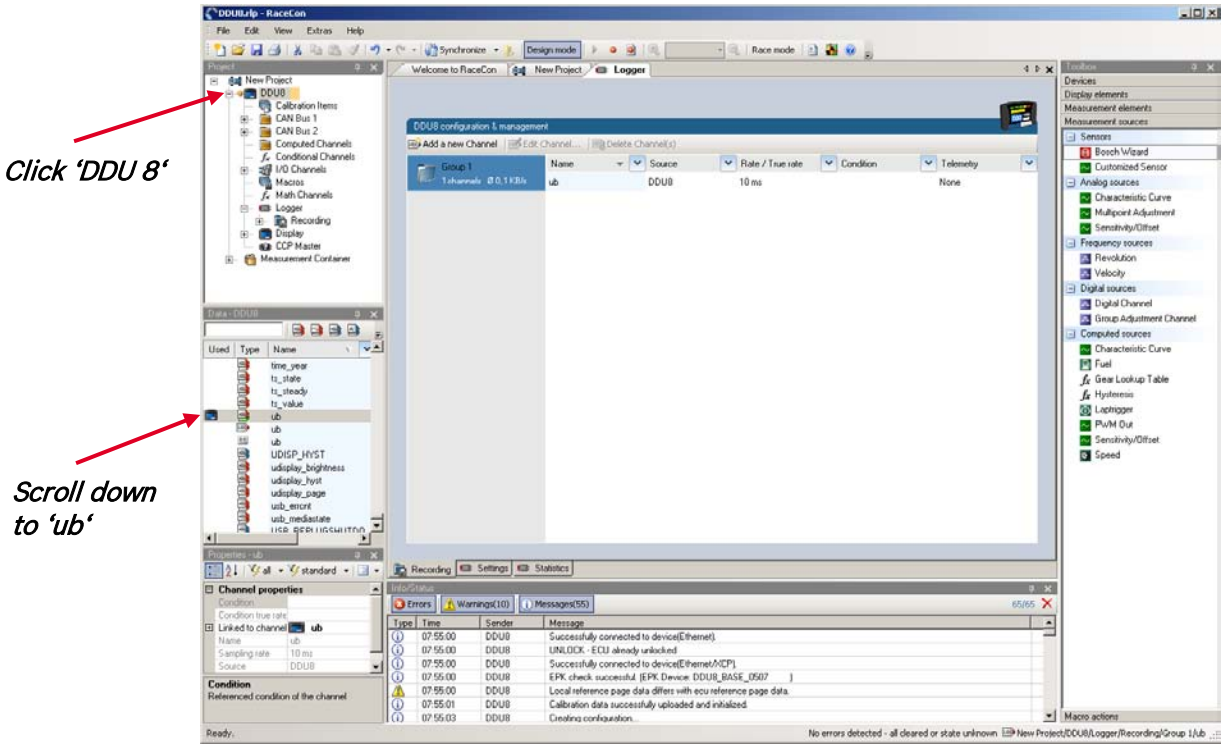
This function requires the installation of Software Upgrade 1.
For data recording on the DDU 8, the software upgrade ‘DDU 8 Datalogger’ must be activated.
See chapter ‘7.2 Feature activation’ for an instruction to activate software upgrades on DDU 8.

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

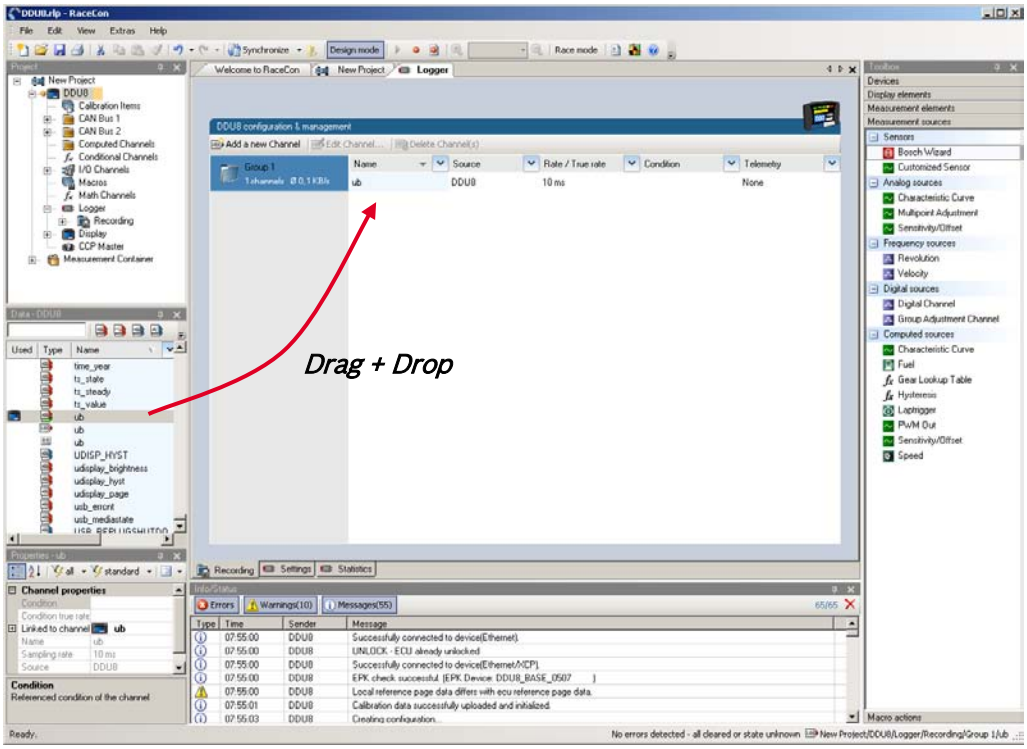
The DDU 8 recording configuration area opens.



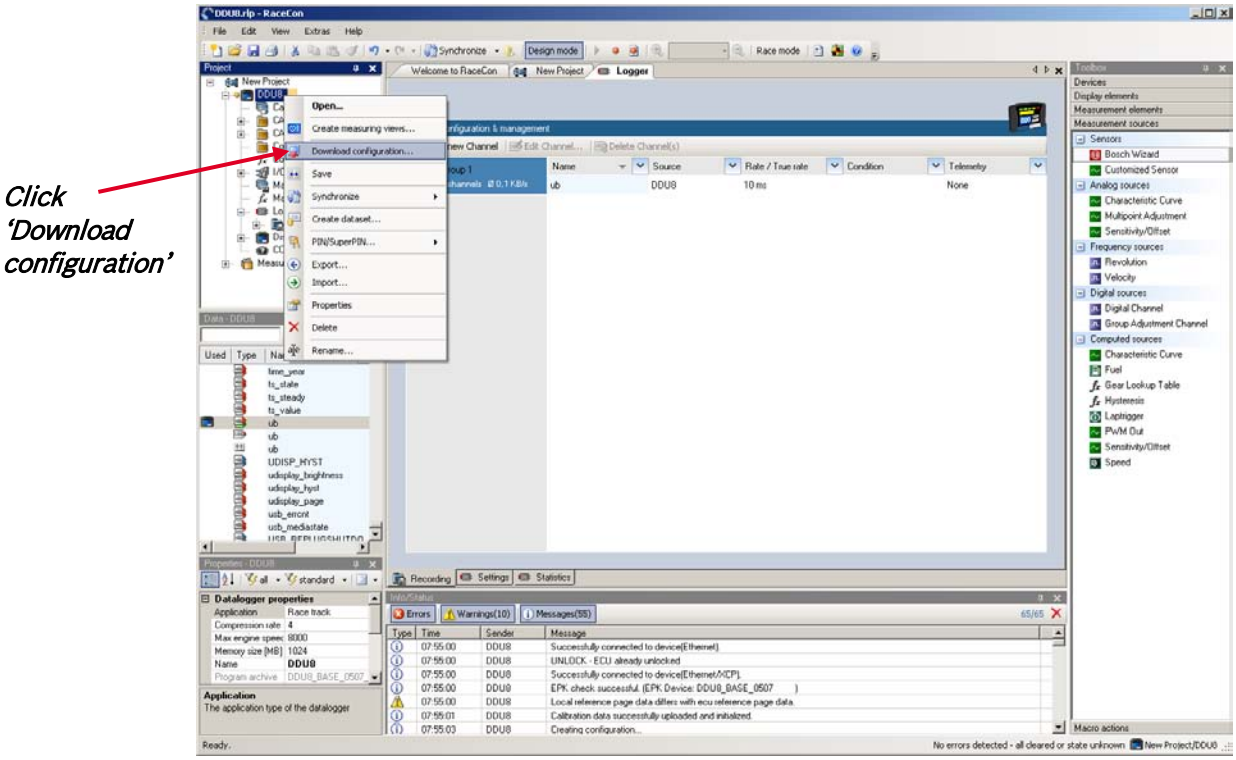
4. In the DDU 8 Project Tree, click on ‘DDU 8’ to display the available measurement channels.
5. In the data window, scroll down to ‘ub’ (measurement channel for battery voltage).



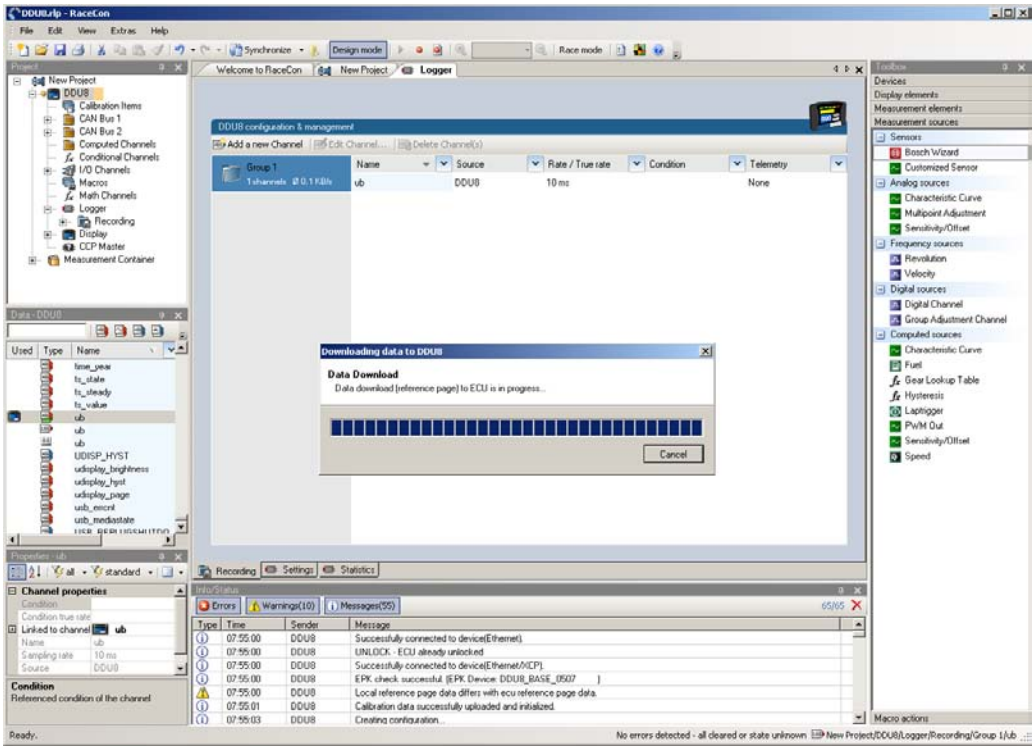
6. Drag + drop the ‘ub’ measurement channel into the recording area.



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



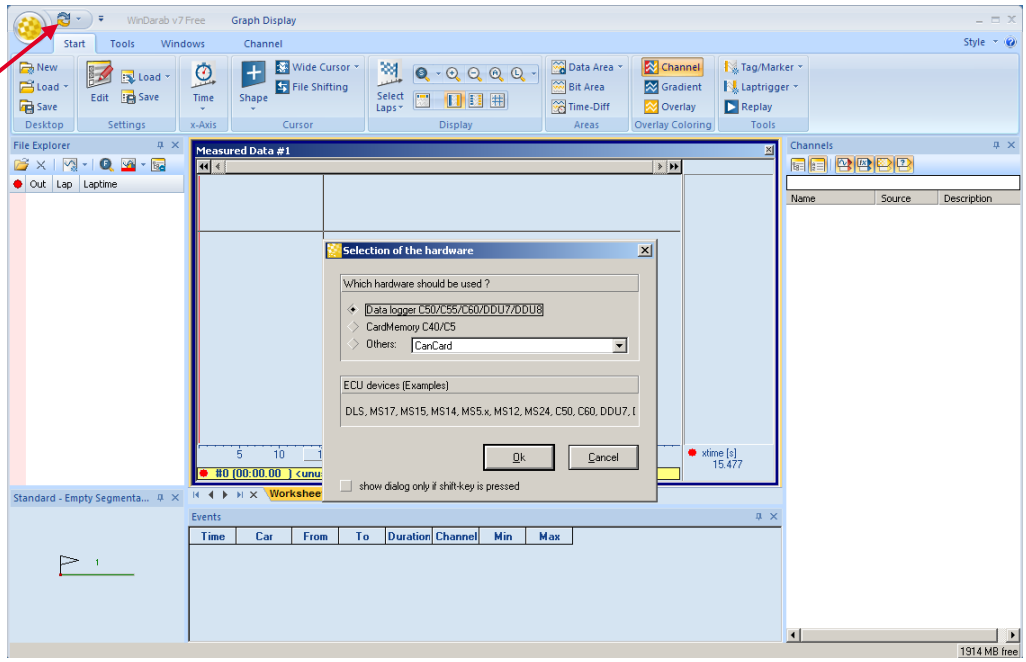
The configuration download starts and the DDU 8 carries out a reset.



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.

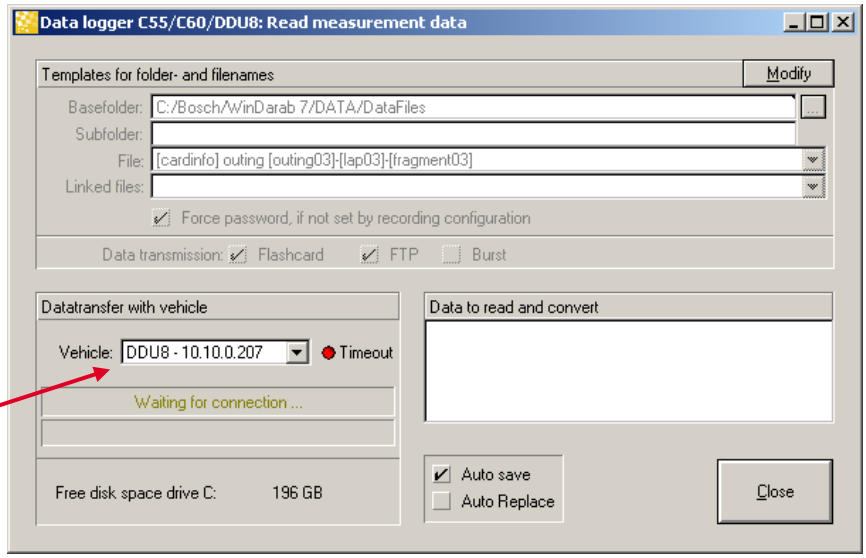
Click ‘Import/ Export’



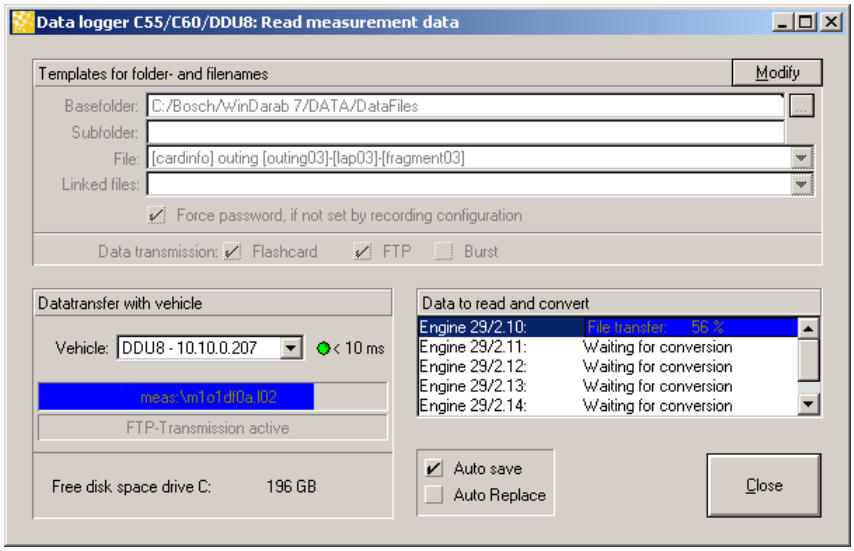
The ‘Read measurement Data’ dialog opens.

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.

Choose ‘DDU8‘ in dropdown list



17. Connect the DDU 8 network cable.
Data transmission from the DDU 8 starts automatically.
Measurement files are stored automatically in the base folder.



18. Click on ‘Close’ when transmission has finished.

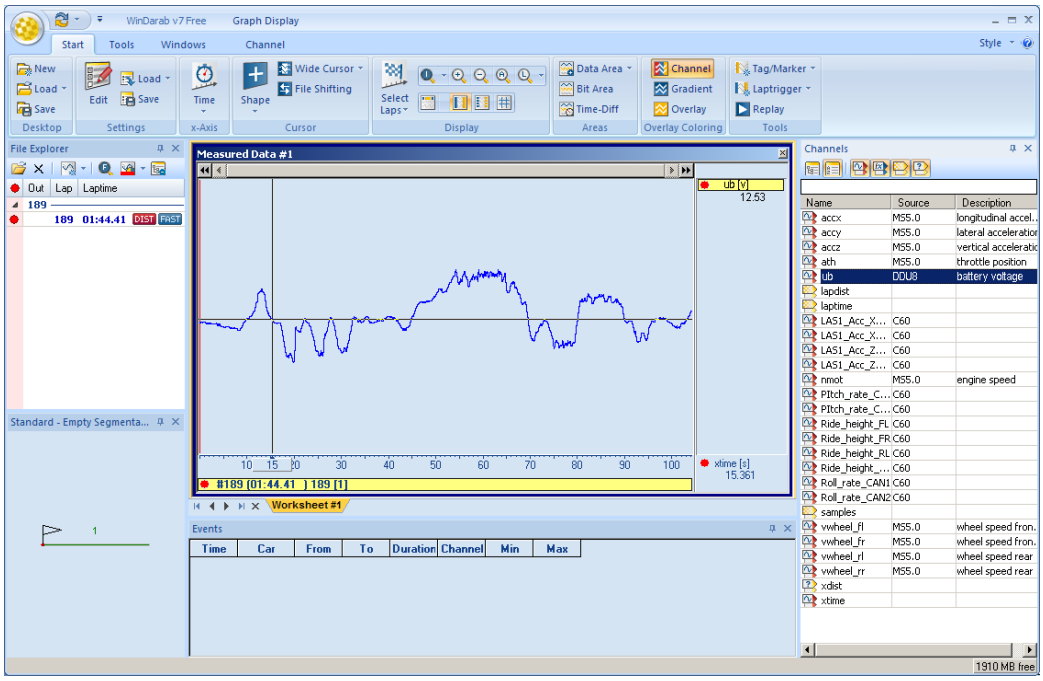
19. Click on the Start button and choose ‘Open measurement file’.

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.



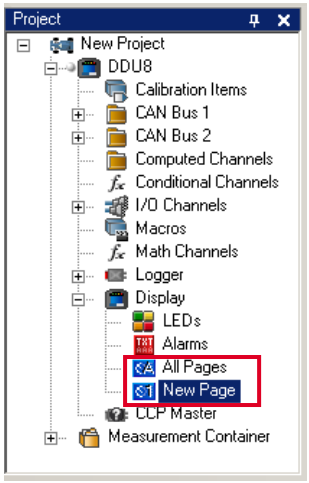
Note: For more detailed descriptions and instructions refer to the WinDarab V7 manual.

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



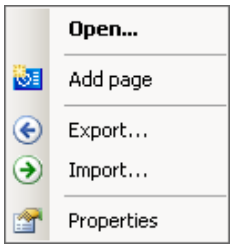
- All Pages: Display elements placed on this page are displayed on all pages. Recommended for “Alarm” display elements.
- Single Page: Display elements placed on this page are displayed only on this page.

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.

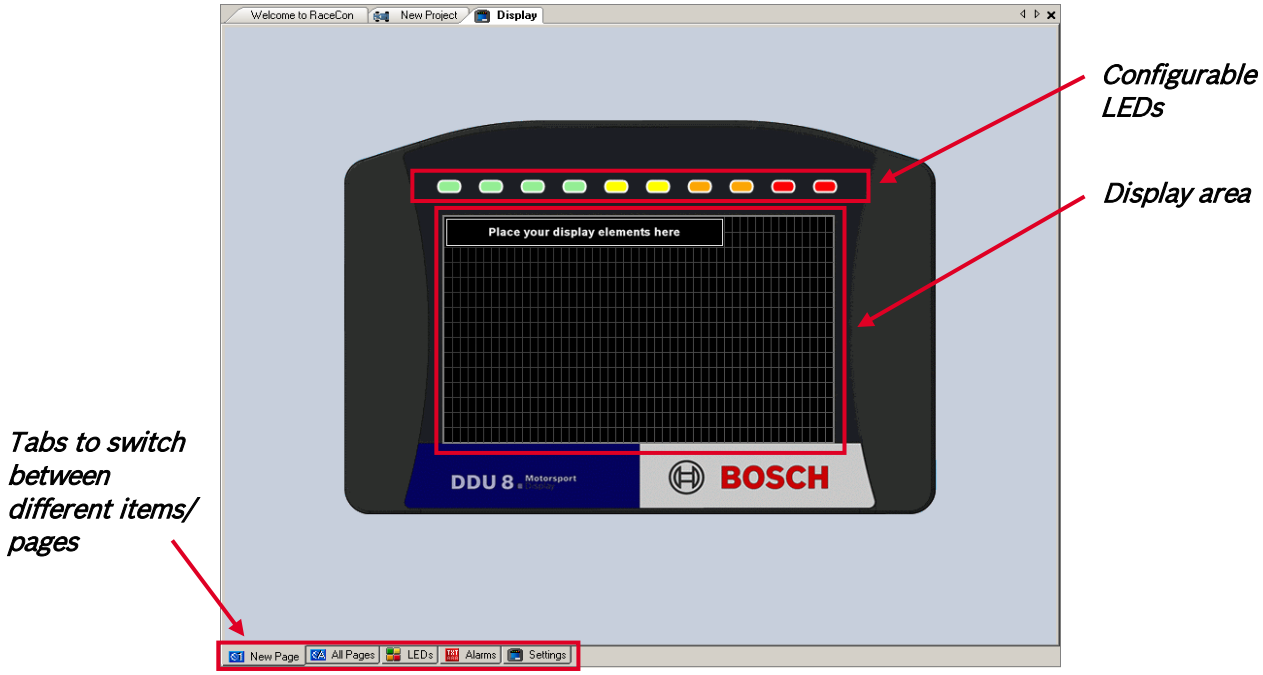


A new empty page opens.

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.



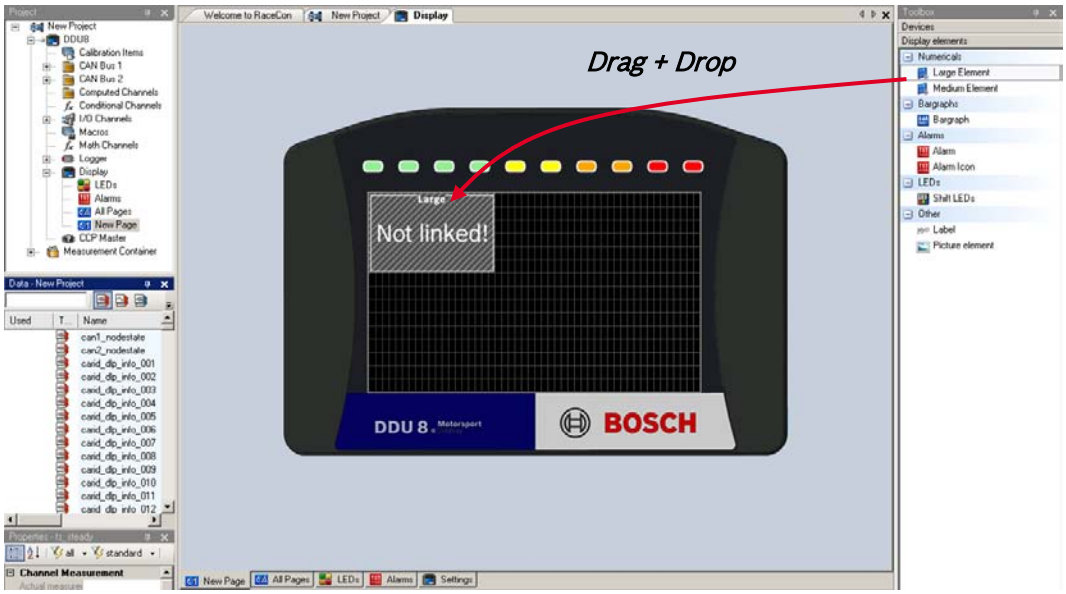
8.2 Display element configuration

8.2.1 Numeric display element

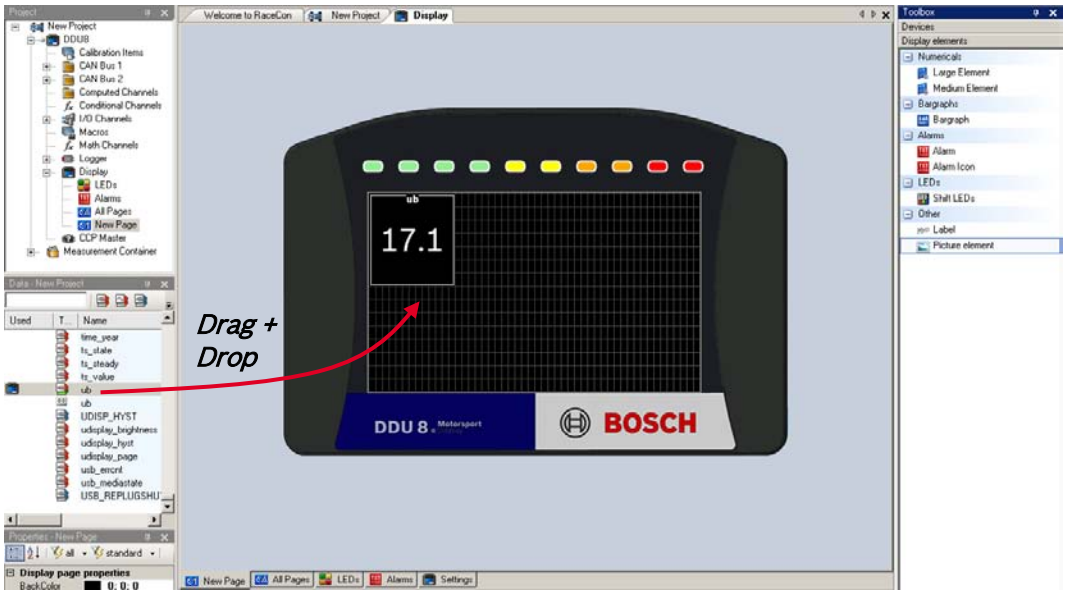
Adding a numeric display element to display page

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.

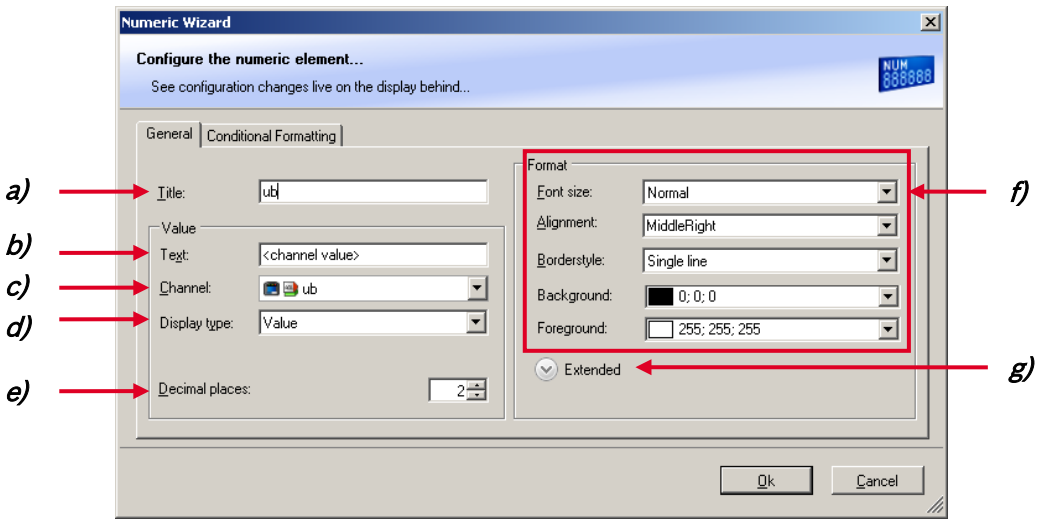


The measurement channel is linked to the numeric display element.

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.



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.

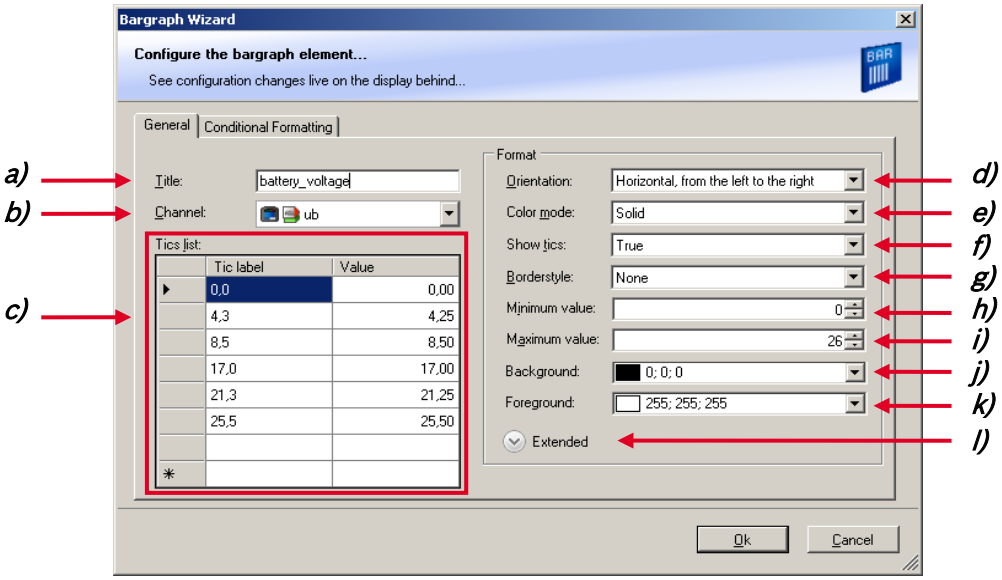
8.2.2 ‘Bargraph’ display element

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.



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.

l) 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:

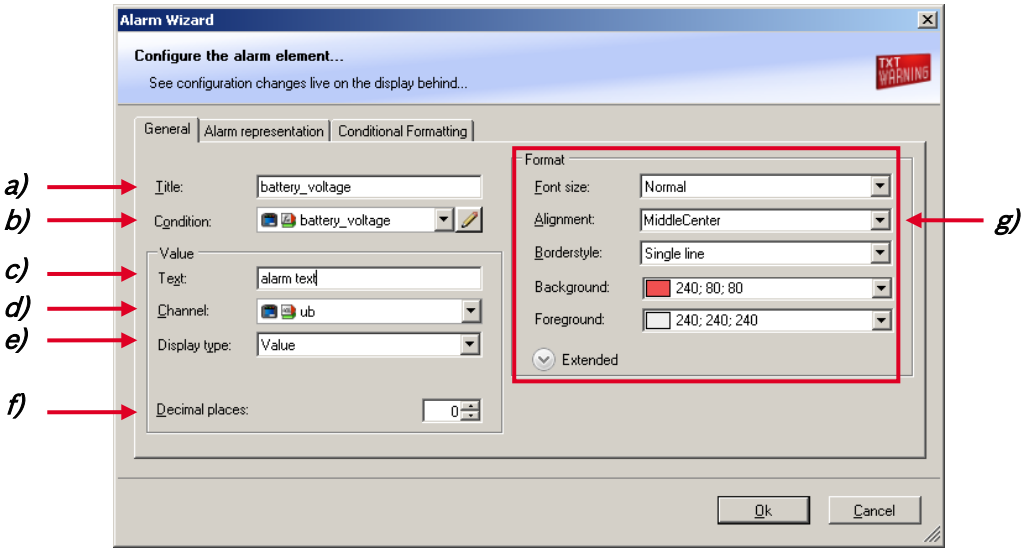
- Alarm: An alarm displaying a defined text
- Alarm Icon: An alarm displaying a defined image (e.g. a warning triangle)

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.



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.

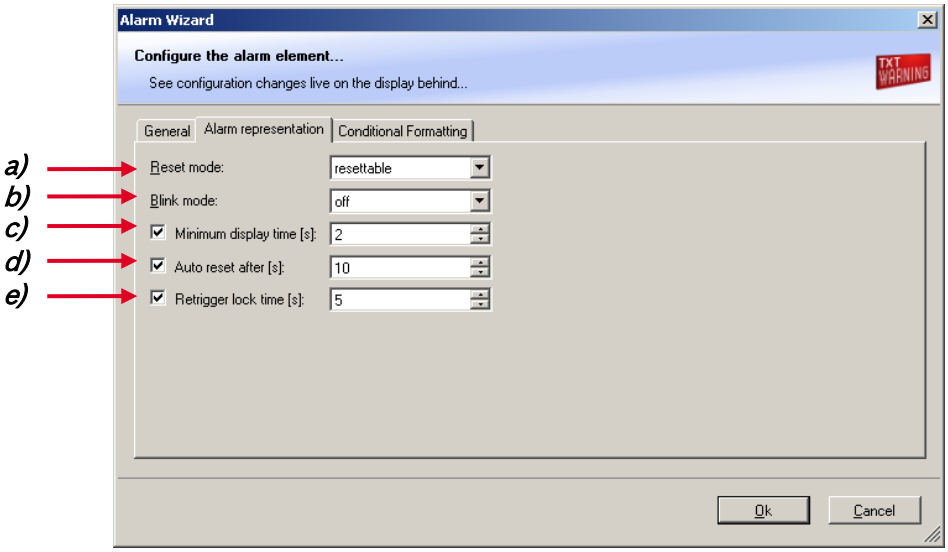
e) Choose the type of input data:

- 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’.



a) Choose if the alarm can be reset or not.

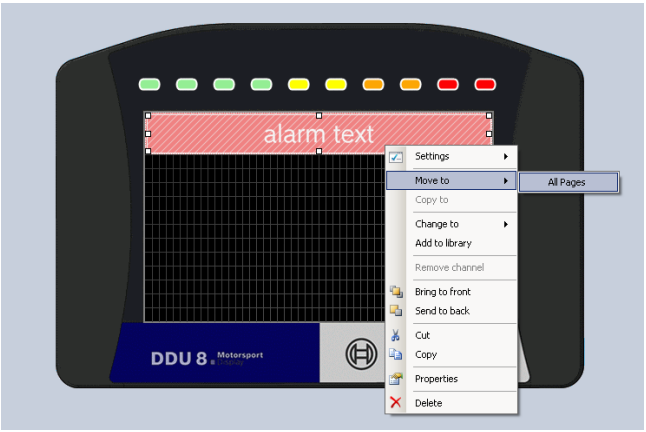
b) Choose if the alarm blinks slowly, fast or does not blink.

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.

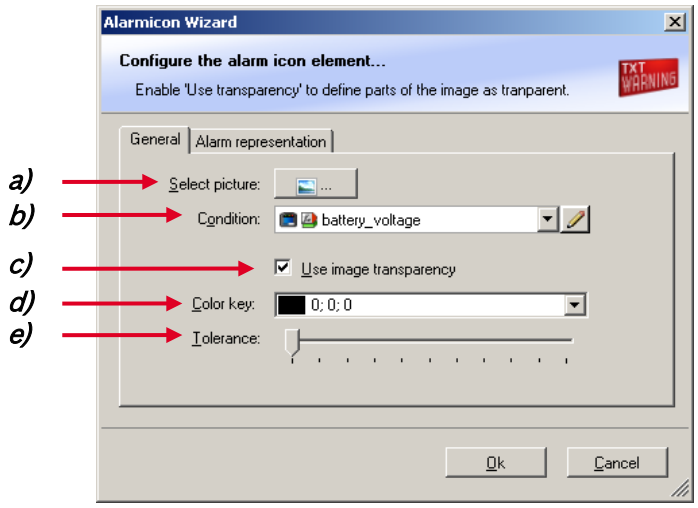
e) Enter the time until the Alarm can appear again after a reset.

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.



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:

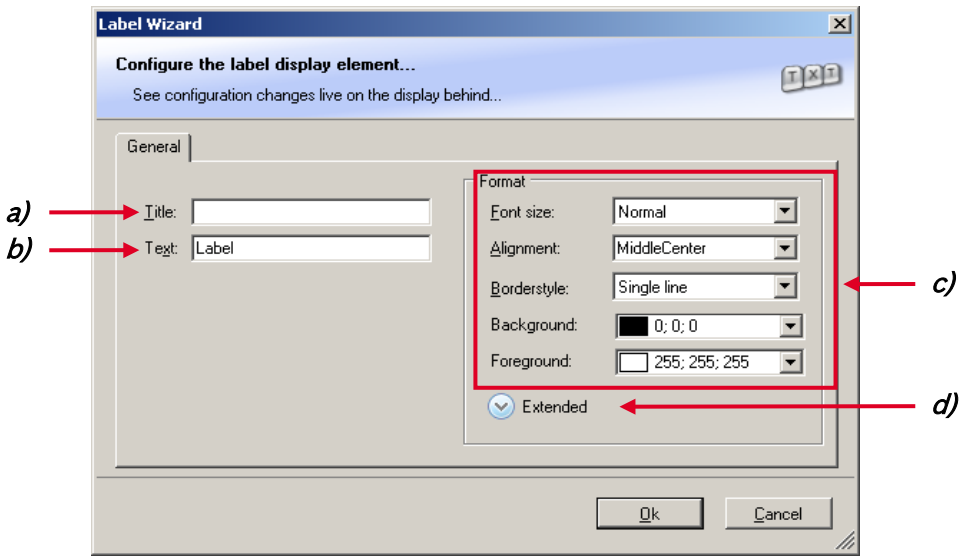
- Label: A label displaying a specified text
- Picture element: An element displaying a static picture (e.g. temperature warning)

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.



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.

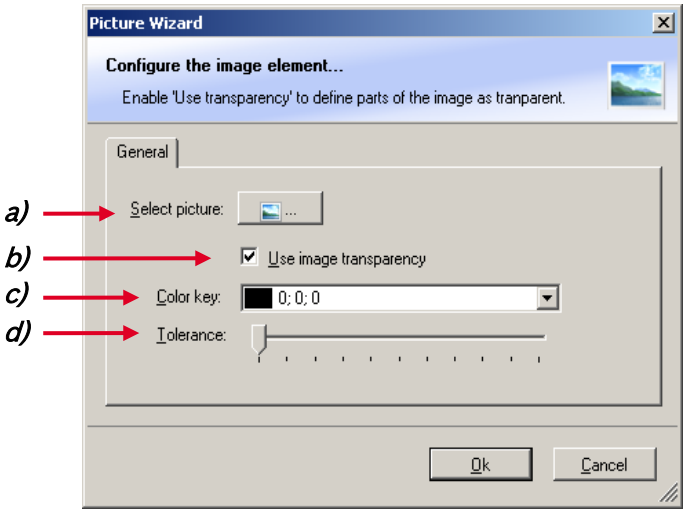
d) Click the Extended button to show further options to change the color of the title, border and text individually.

2. Click ‘OK’ when done.

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.



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.

2. Click ‘OK’ when done.

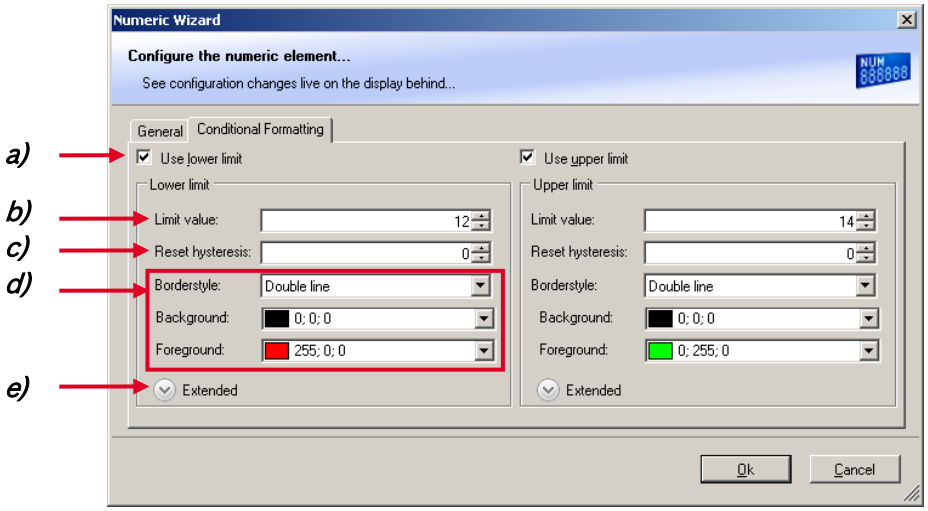
8.2.5 Conditional formatting

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’.



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.

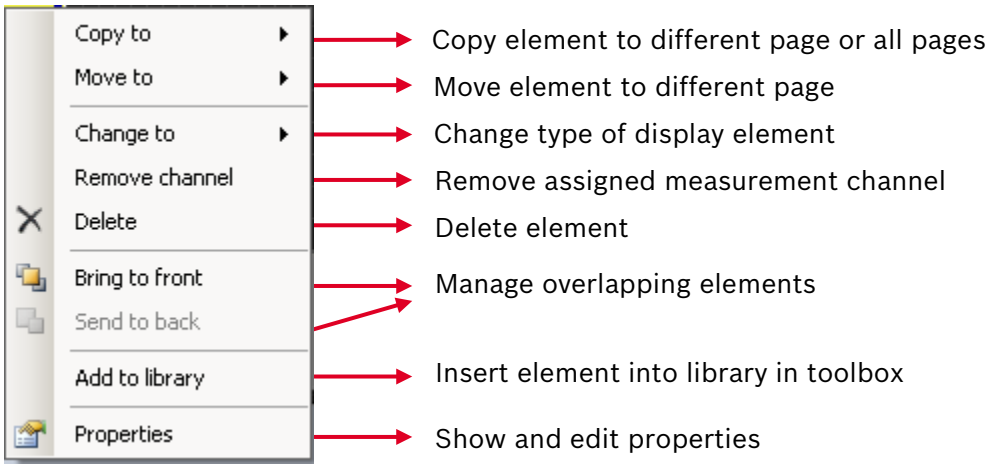
d) Choose the borderstyle, background and foreground color of the numeric display element.

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.

3. Click ‘OK’ when done.

8.2.6 Context menu

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



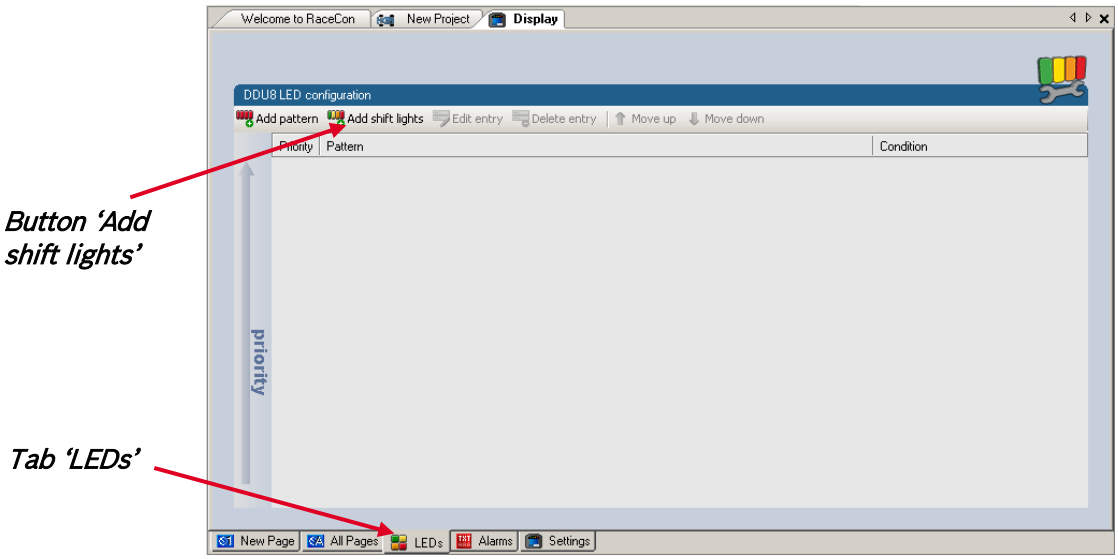
8.3 LEDs

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’.

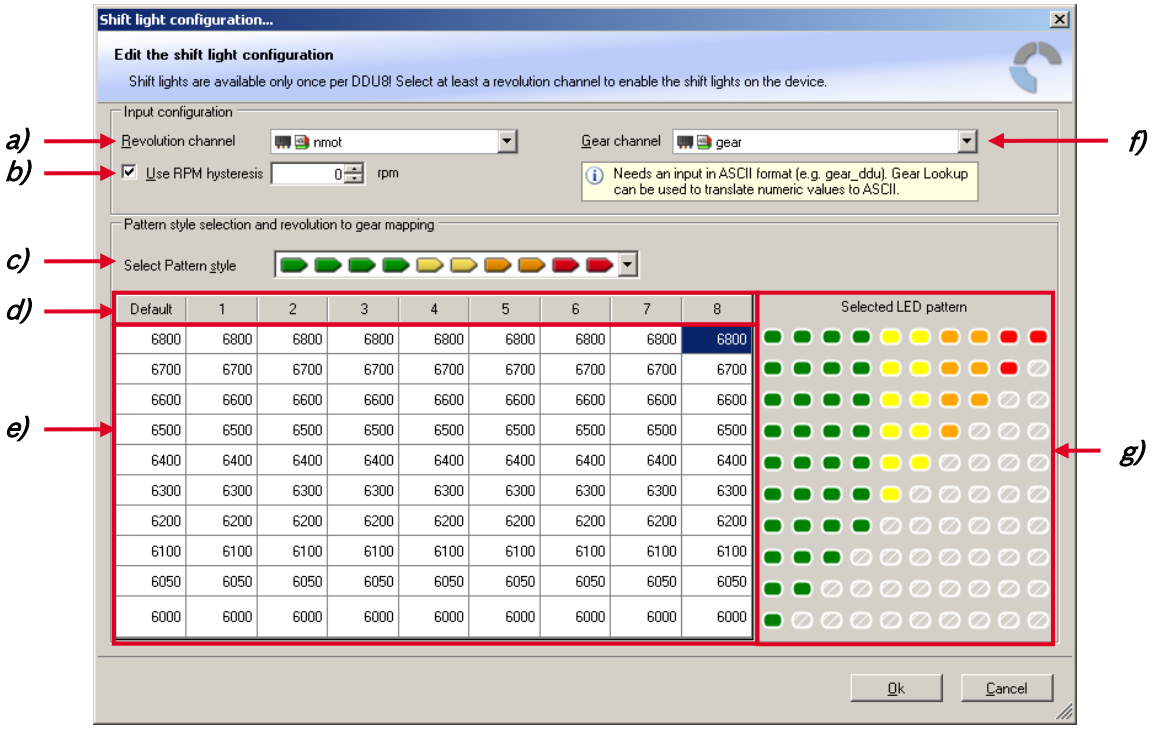
8.3.1 Configuring shift LEDs

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.



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.)

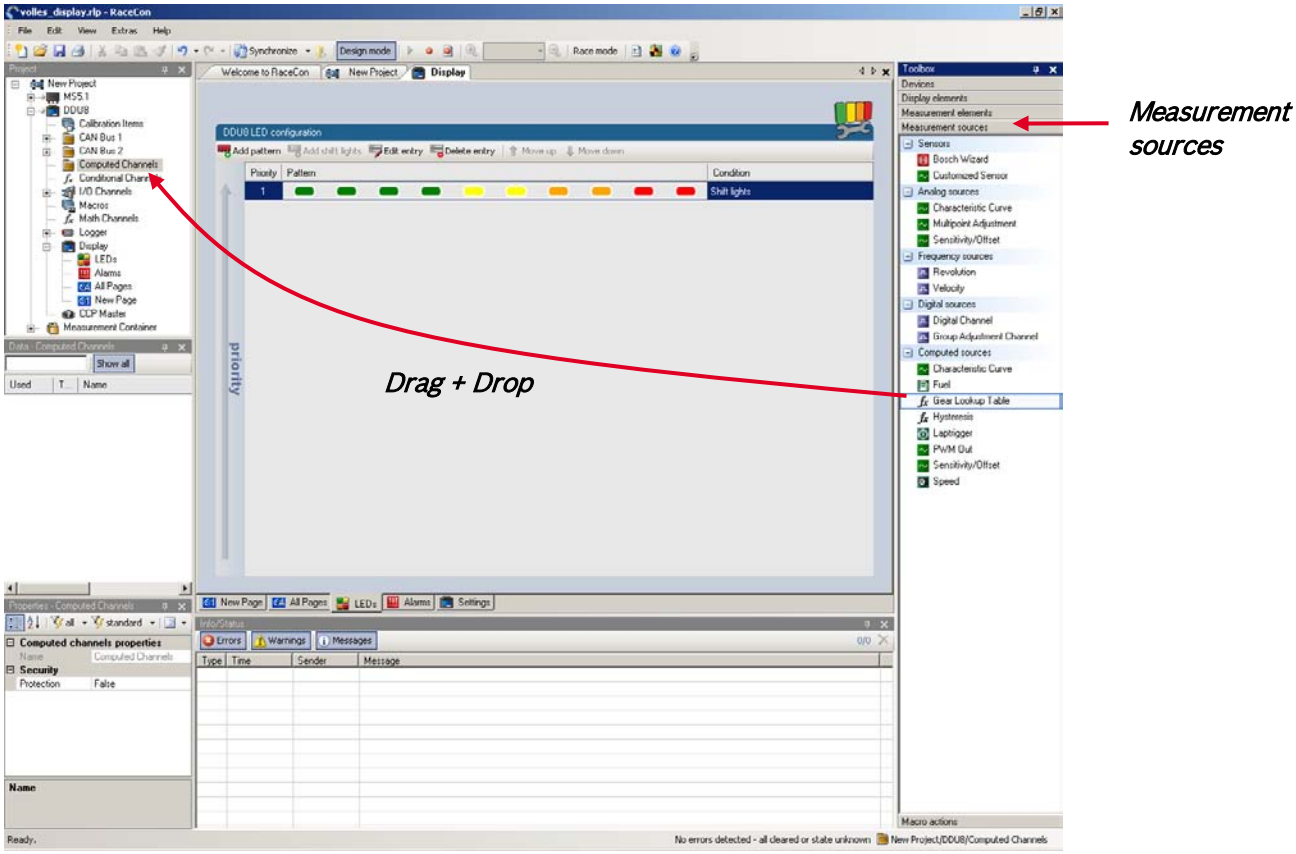
g) Choose the number and color of the LEDs corresponding to the RPM-limits shown in the table. You can choose the number and color of each LED individually by right-clicking.

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

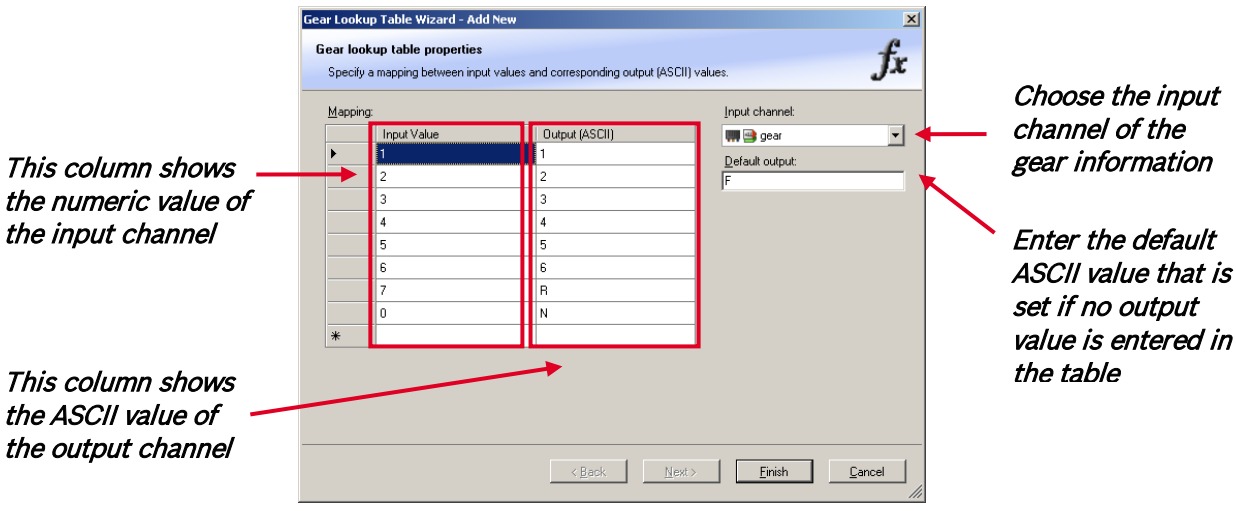
If you get the gear information of a different control unit as the Bosch ECU (e.g. a gearbox control unit), use the Gear Lookup Table to translate numeric values to ASCII format.

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.

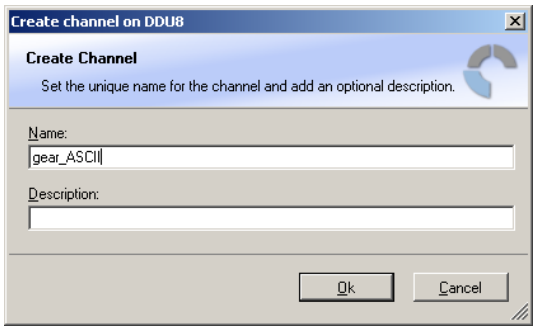
3. Set up the settings as shown in the screenshot.



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.



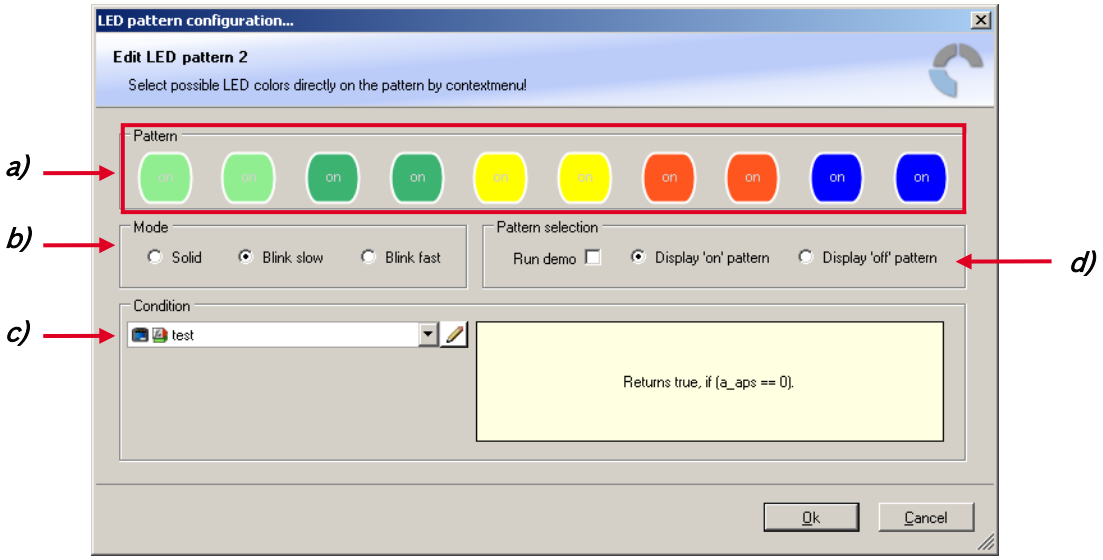
6. Click ‘Ok’ when done.

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.



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

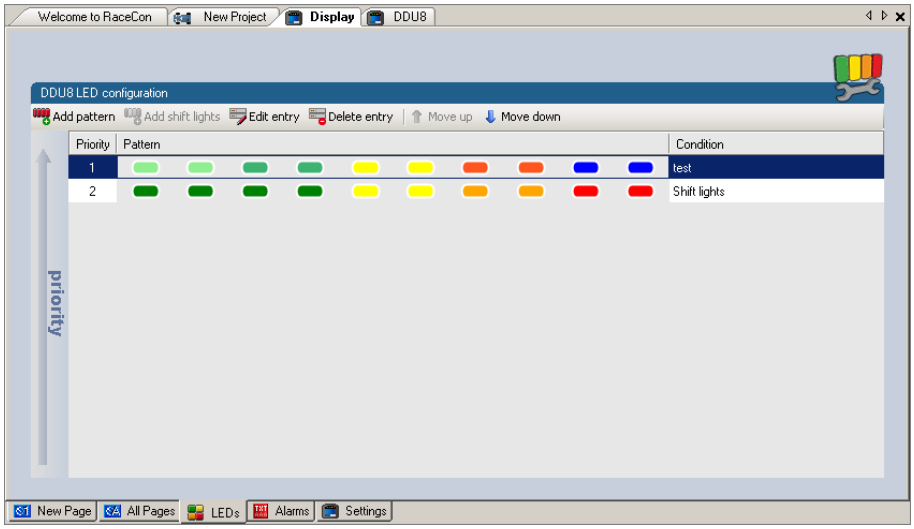
d) Check the box to show a demo of the LEDs. (Important to check blinking)
To create a LED that alternately blinks in two different colors, choose ‘Display “on” pattern’ and define the LEDs in the one color. Then choose ‘Display “off” pattern’ and define the LEDs in the other color.

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.

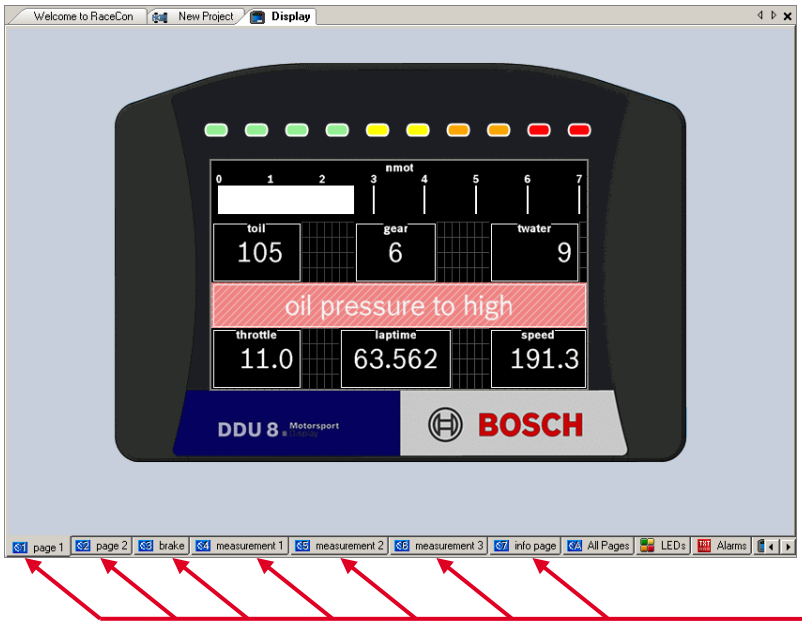
Change the priority by clicking the ‘Move up’ or ‘Move down’ button.



8.4 Page select

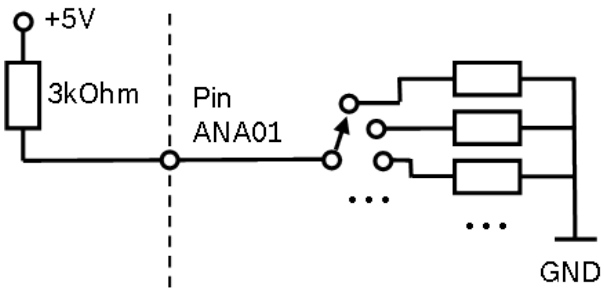
8.4.1 Option 1 – 12 position switch

- 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)



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

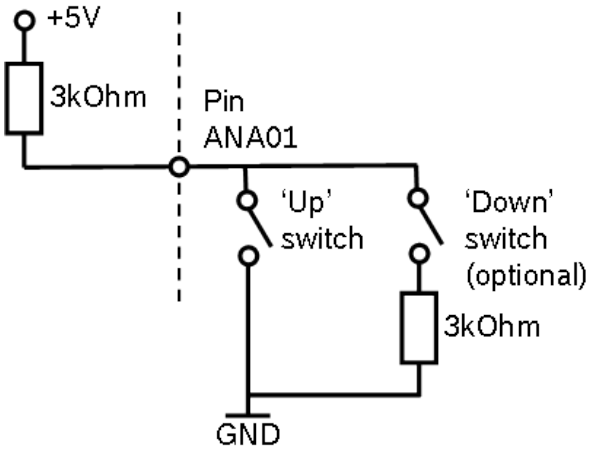
Display page selected at power-down will show up at next power up automatically.

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.

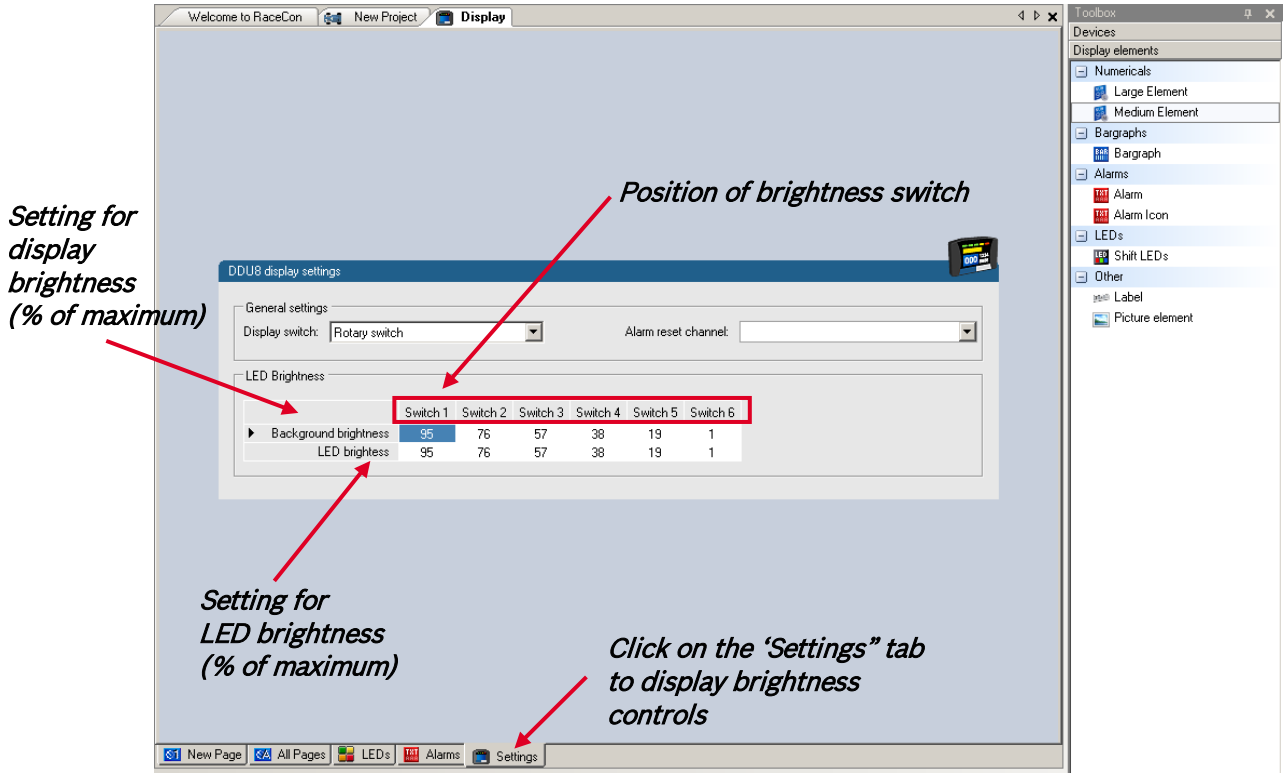
Connection diagram of up/down switches



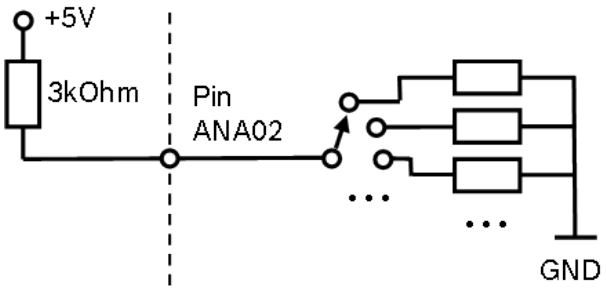
Note: De-bounce time of switches is 30 ms.

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

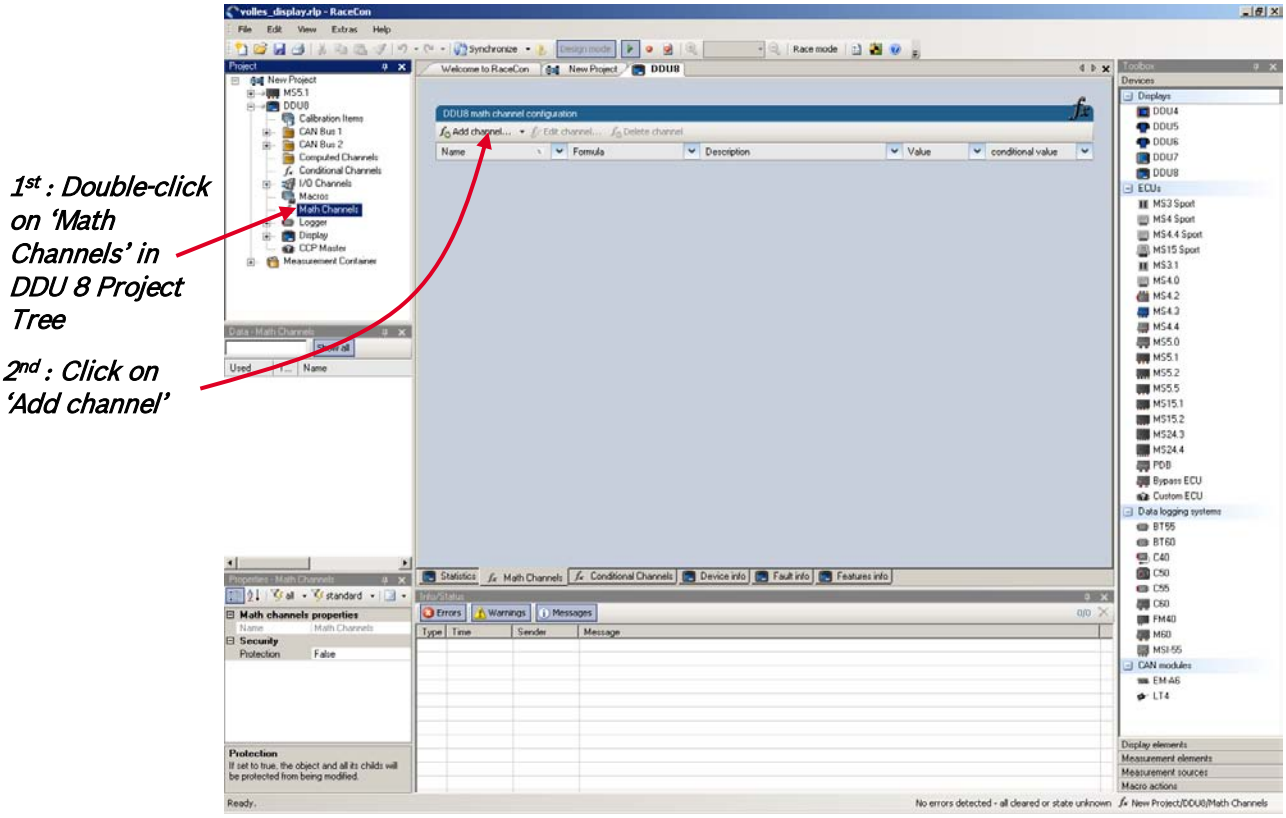
Conditional function

- 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

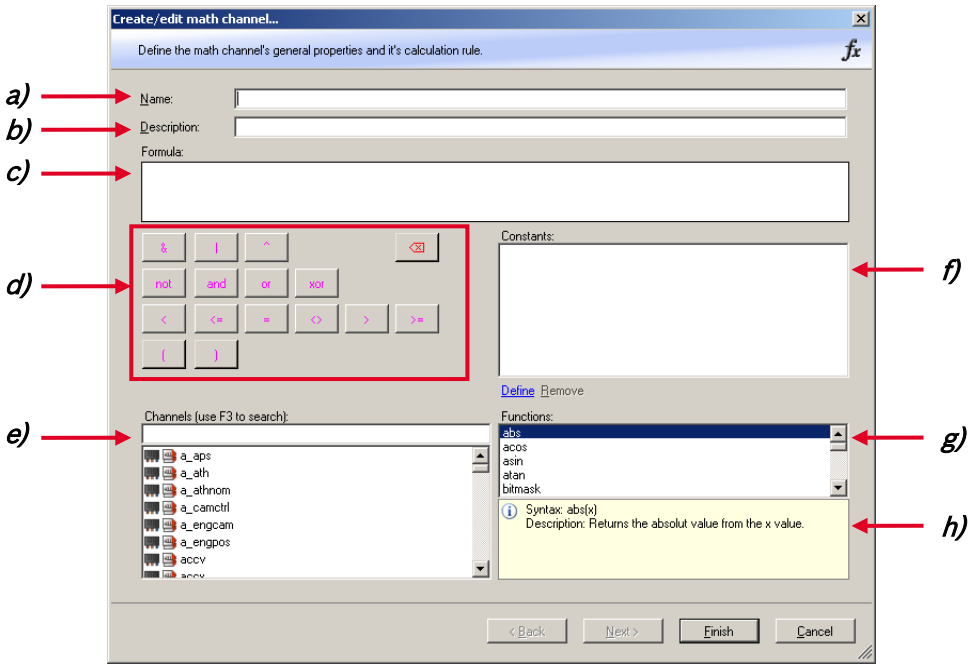
All math channels can be used globally in the whole DDU 8 project.

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.

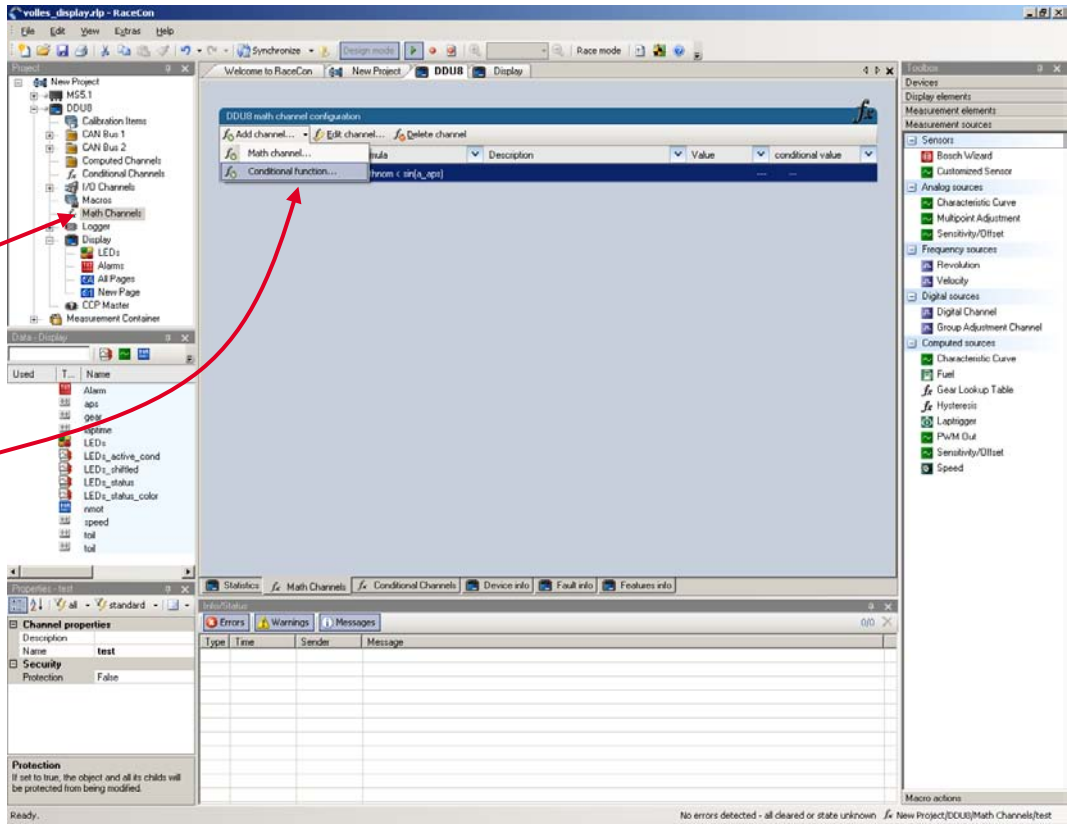
8.6.3 Creating a new conditional function

1. Follow the steps shown in the screenshot.

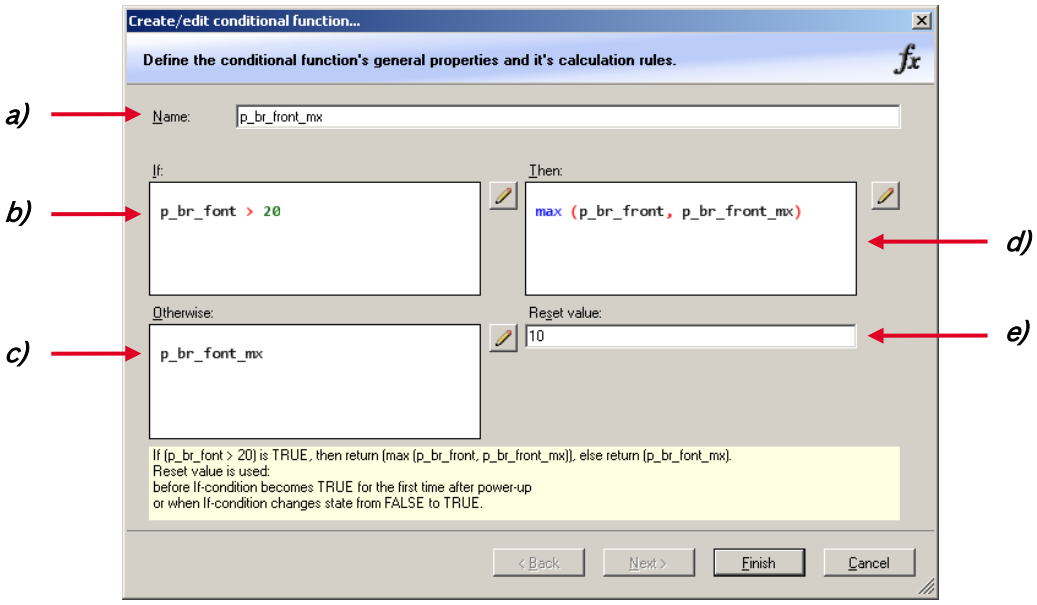
1st : Double-click on 'Math Channels' in Project Tree

2nd : Click on the dropdown arrow beside 'Add channel'

3rd : Choose 'Conditional Function'



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.

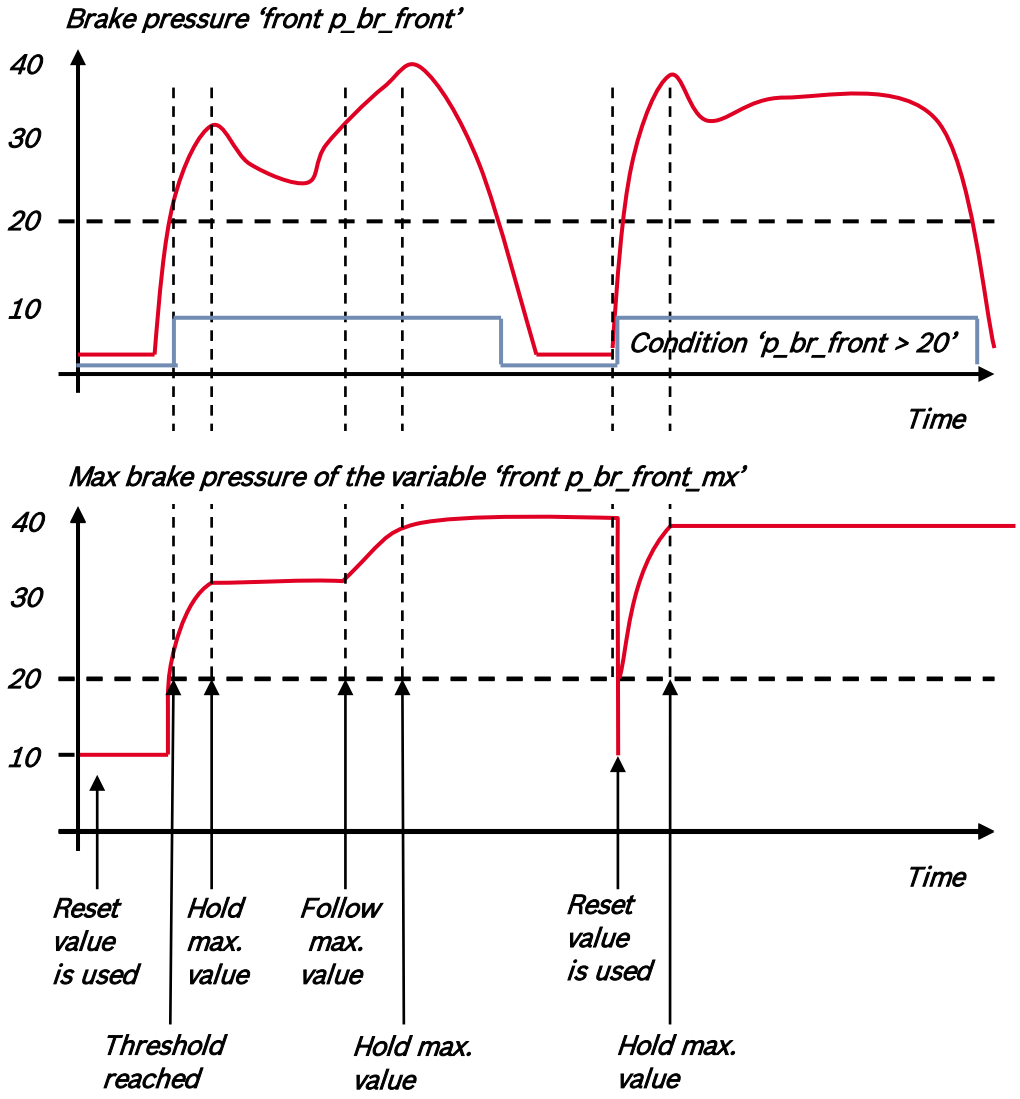
c) Enter the Then-condition. Click on the pencil symbol to open an editor to enter expressions.

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 OTHERWISE-condition 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 THEN-condition. 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

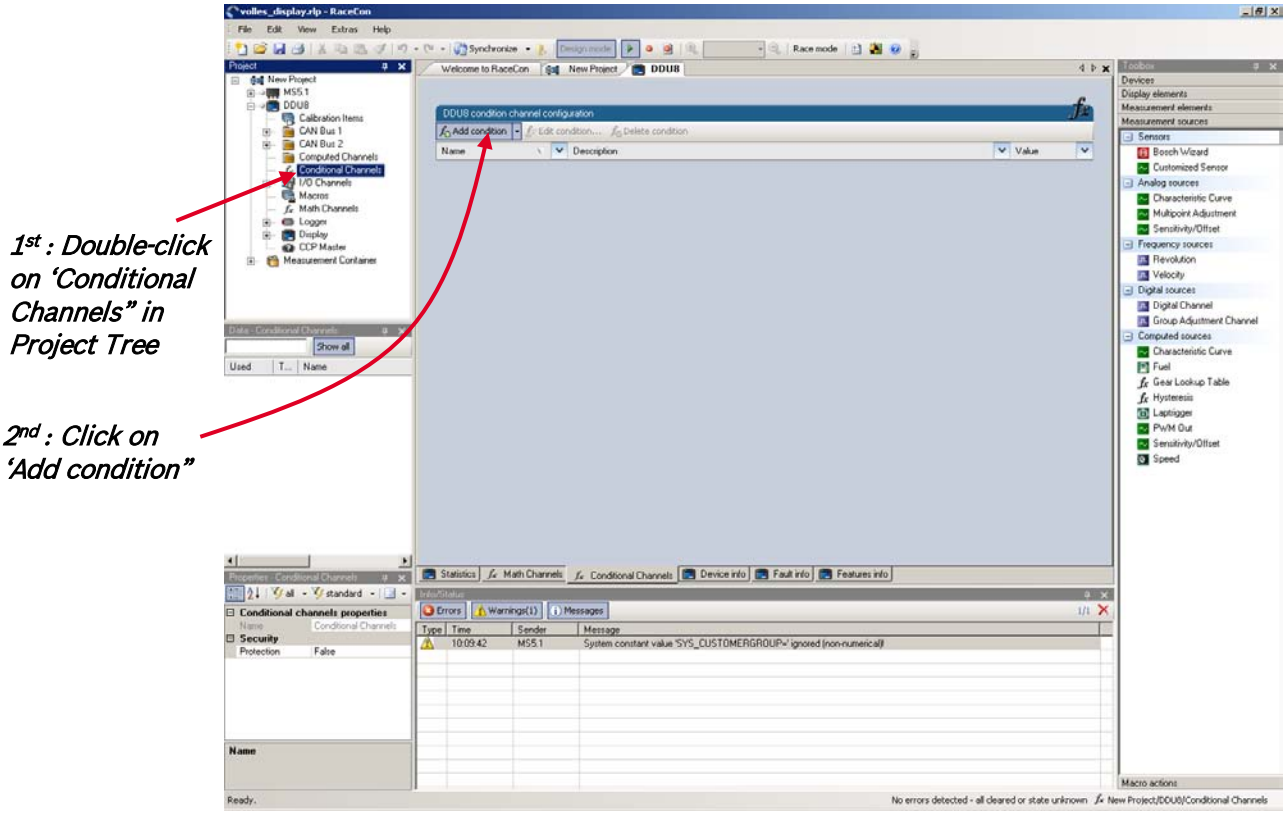
Condition combination

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

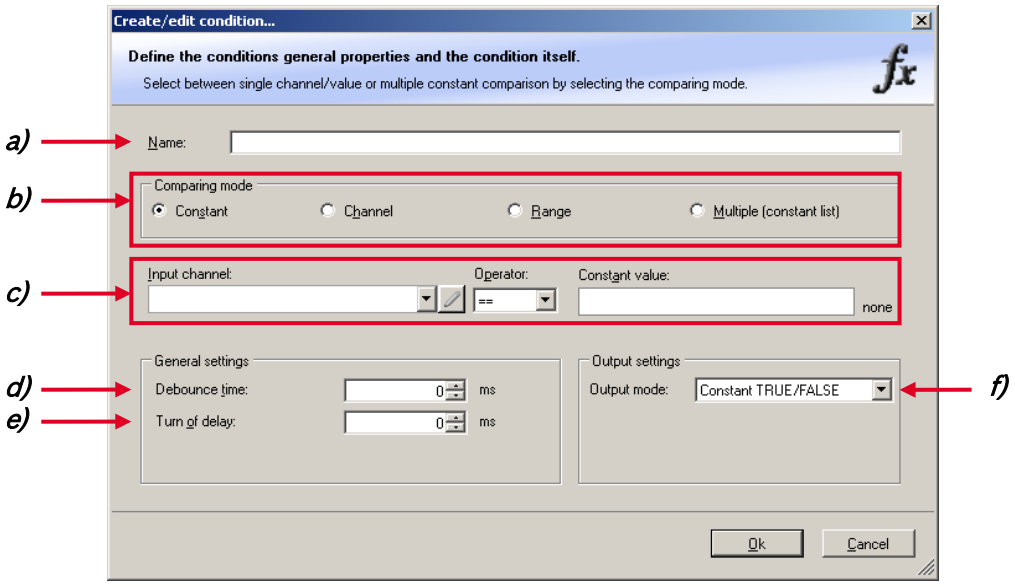
All condition channels can be used globally in the whole DDU 8 project.

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.

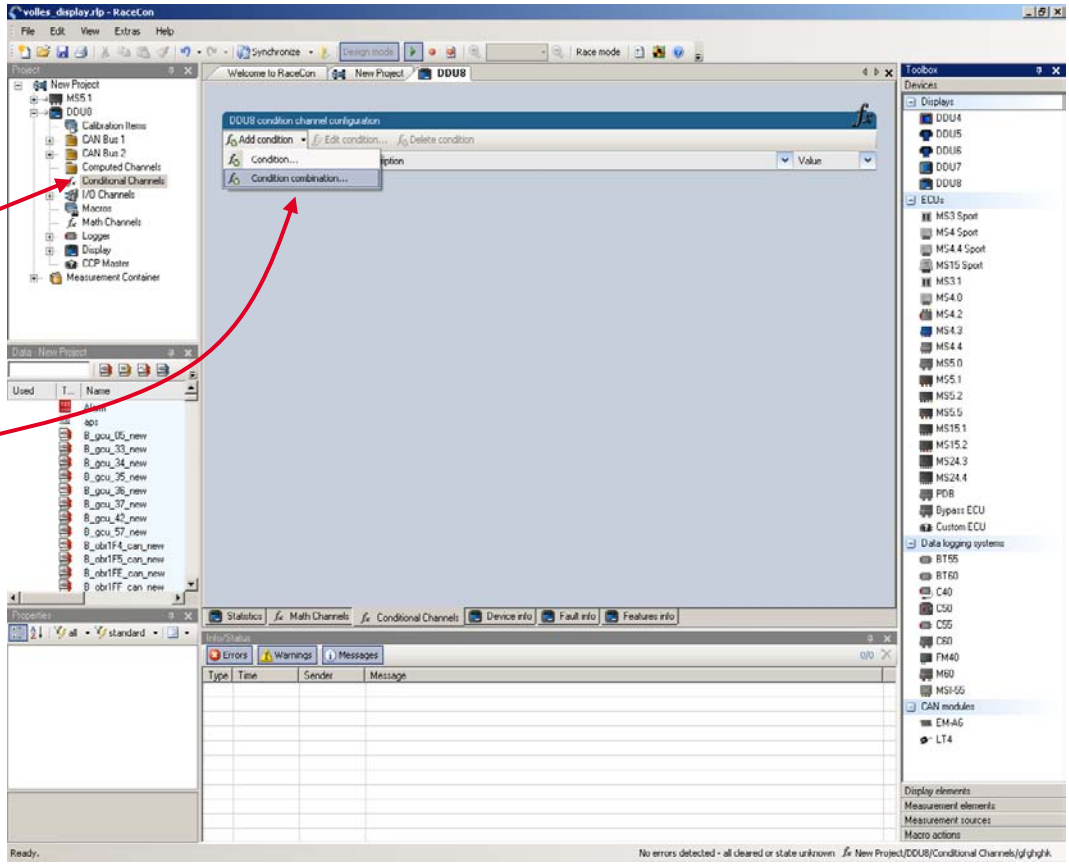
8.7.2 Creating a new condition combination

1. Follow the steps shown in the screenshot.

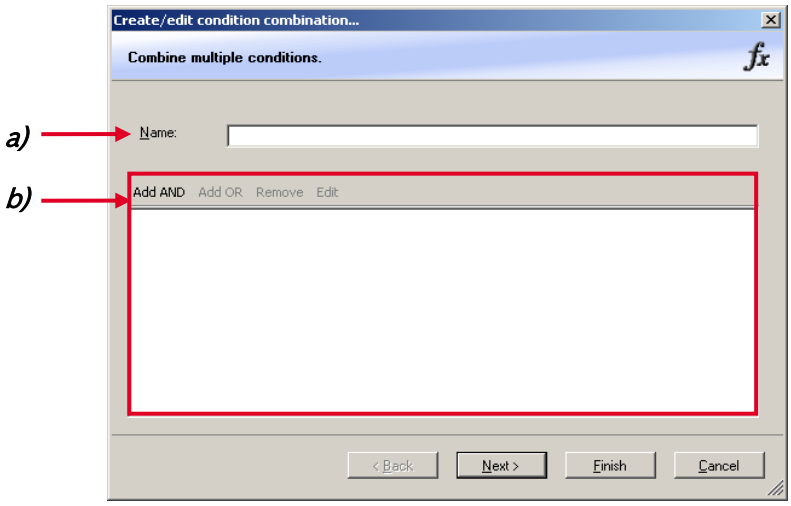
1st : Double-click on ‘Conditional Channels’ in Project Tree

2nd : Click on the dropdown arrow beside ‘Add condition’

3rd : Choose ‘Conditional combination’



The ‘create/edit condition combination’ window appears.



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

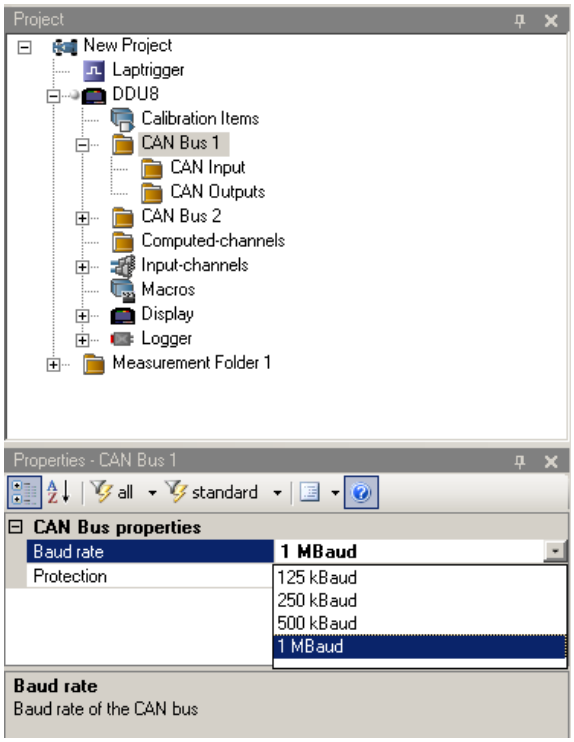
CAN message

- 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



Row counter concept

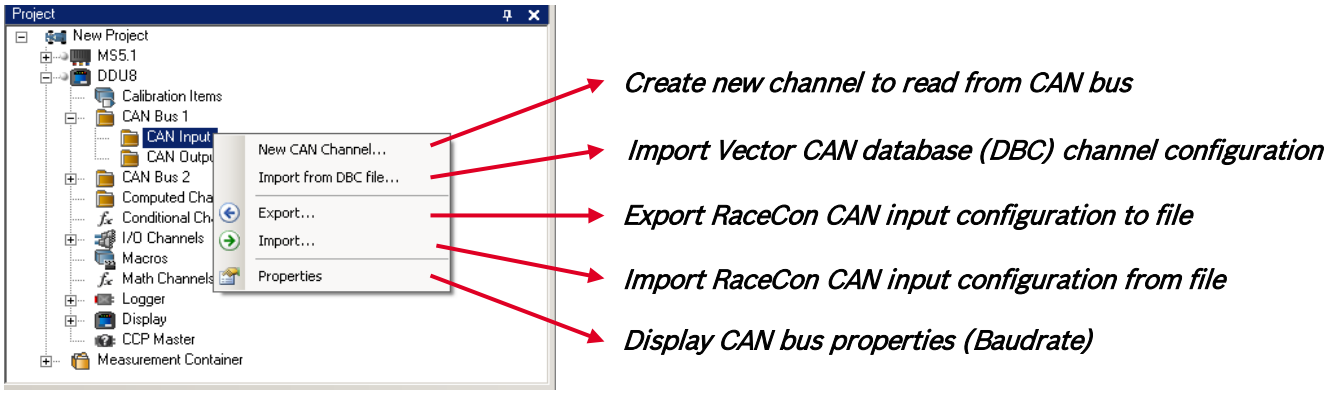
- Re-use (multiplex) of message identifiers
- One byte of message contains row counter
- 7 bytes payload remaining
- Position of row counter is configurable

	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*

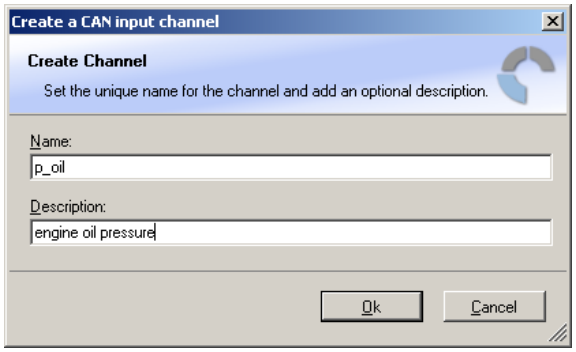
9.2 CAN input

9.2.1 Input configuration



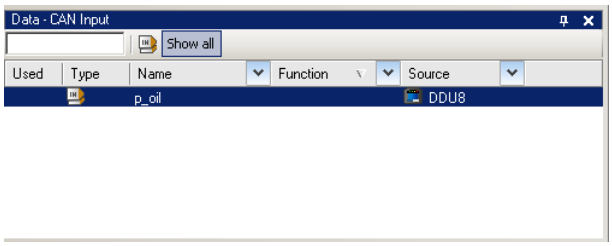
9.2.2 Create new CAN channel

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.

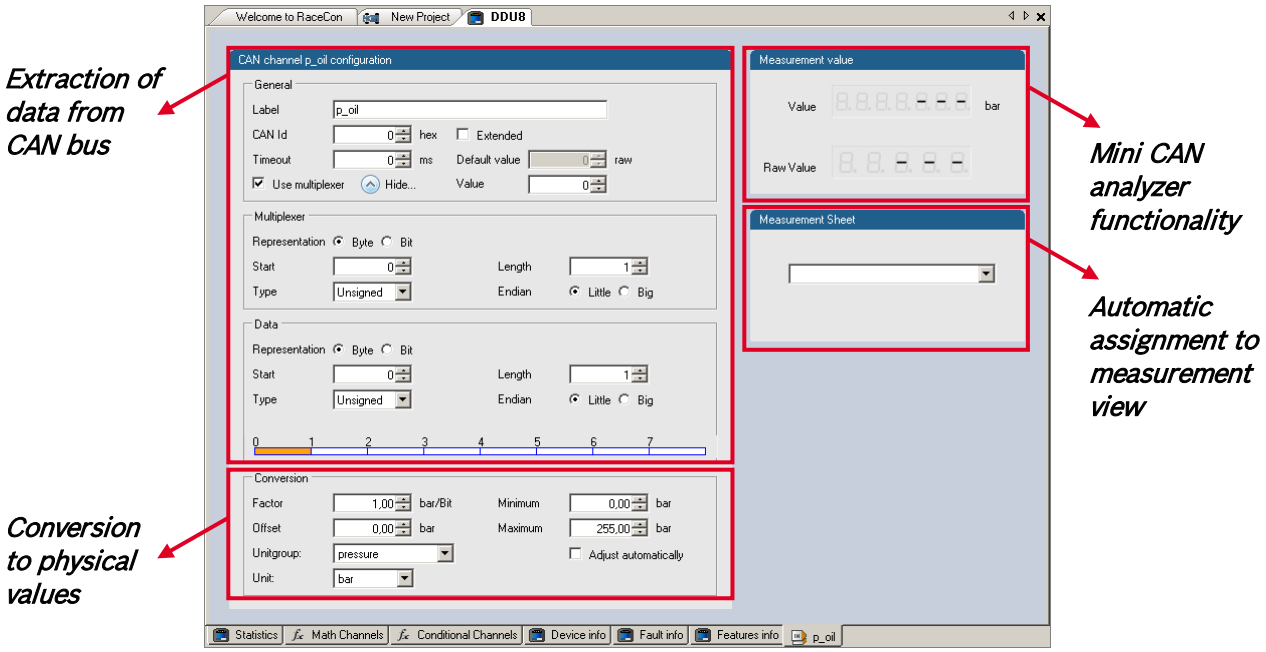


4. Click ‘OK’ when done.

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



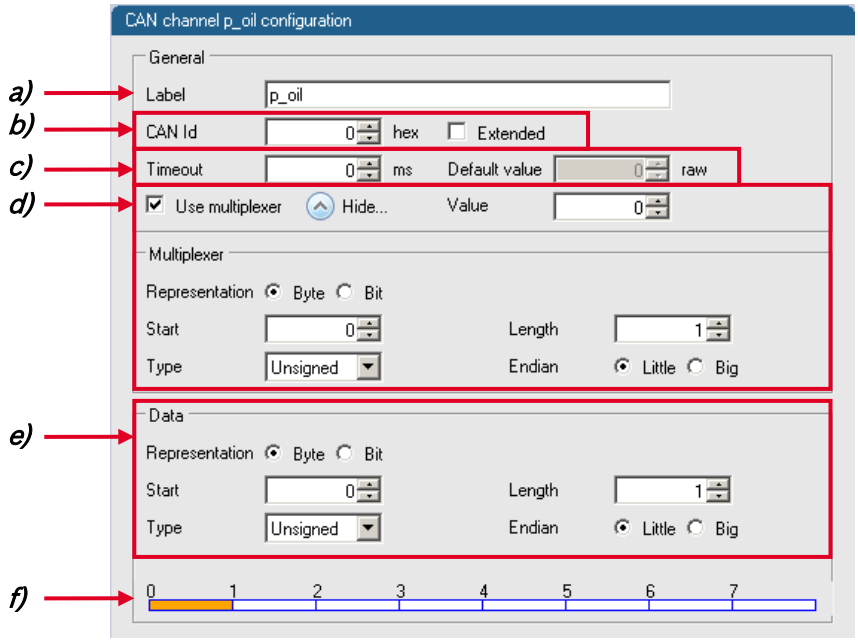
9.2.3 CAN channel configuration



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.



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.

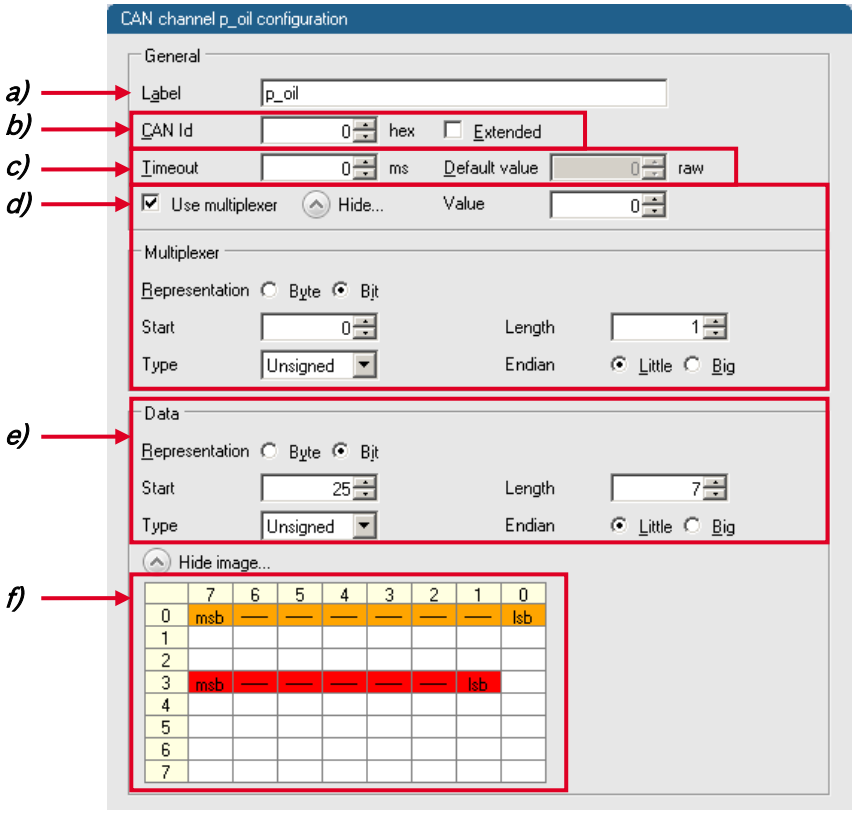
e) Enter data position, length and format.

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.



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.

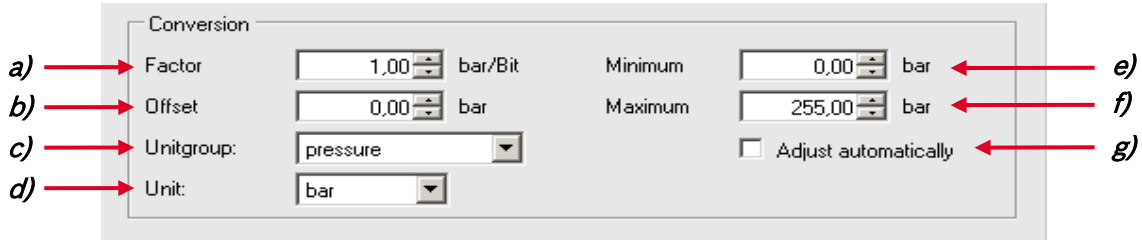
d) Check the box, if a multiplexer (row counter) is used.

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



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)

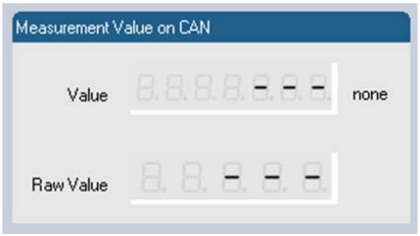
f) Enter maximum physical limit of the channel. (for manual setup)

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

9.2.6 Special features

CAN analyzer functionality

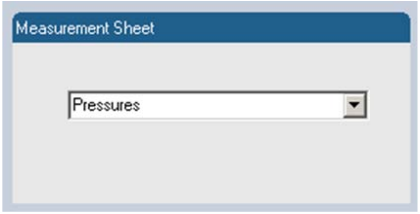
This functionality is only available, if a MSA-Box (I & II) is used to connect the DDU 8 to the PC. Choose the CAN bus that is connected to the MSA-Box to display the raw value and the converted physical value here.



Automatic creation of online measurement sheets

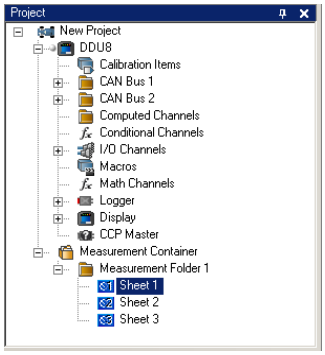
The CAN channel can be automatically inserted to a measurement sheet. Insert a name for a new sheet or select an existing sheet from the listbox.

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.



9.2.7 Online view of CAN channels in vehicle

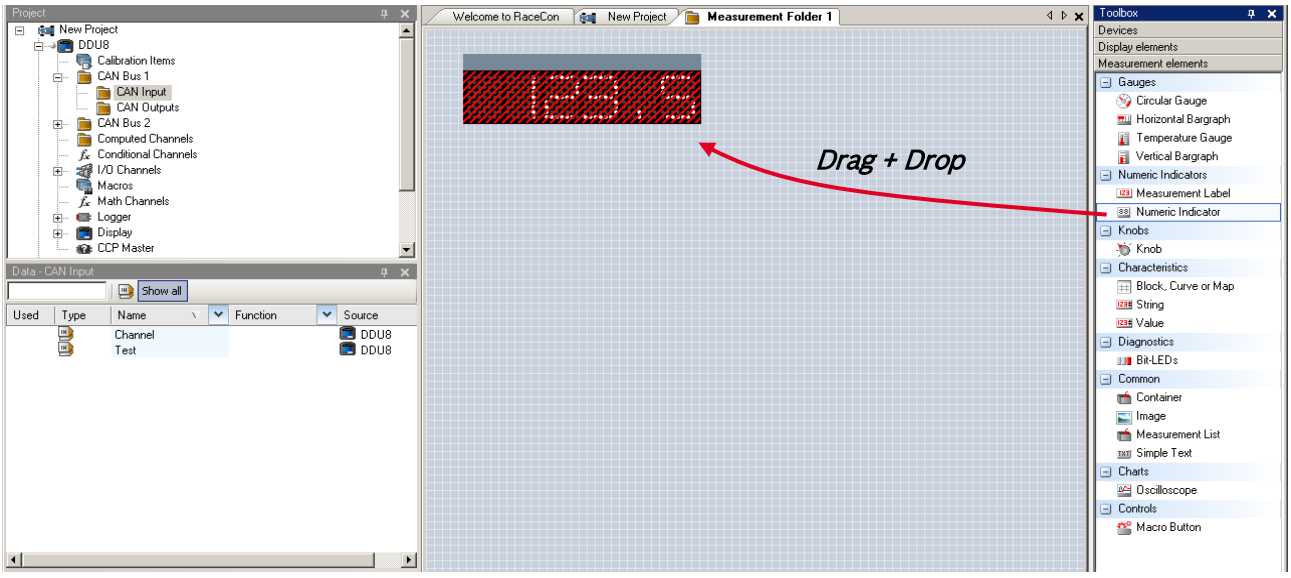
1. Double-click on ‘Sheet 1’ in Project Tree.



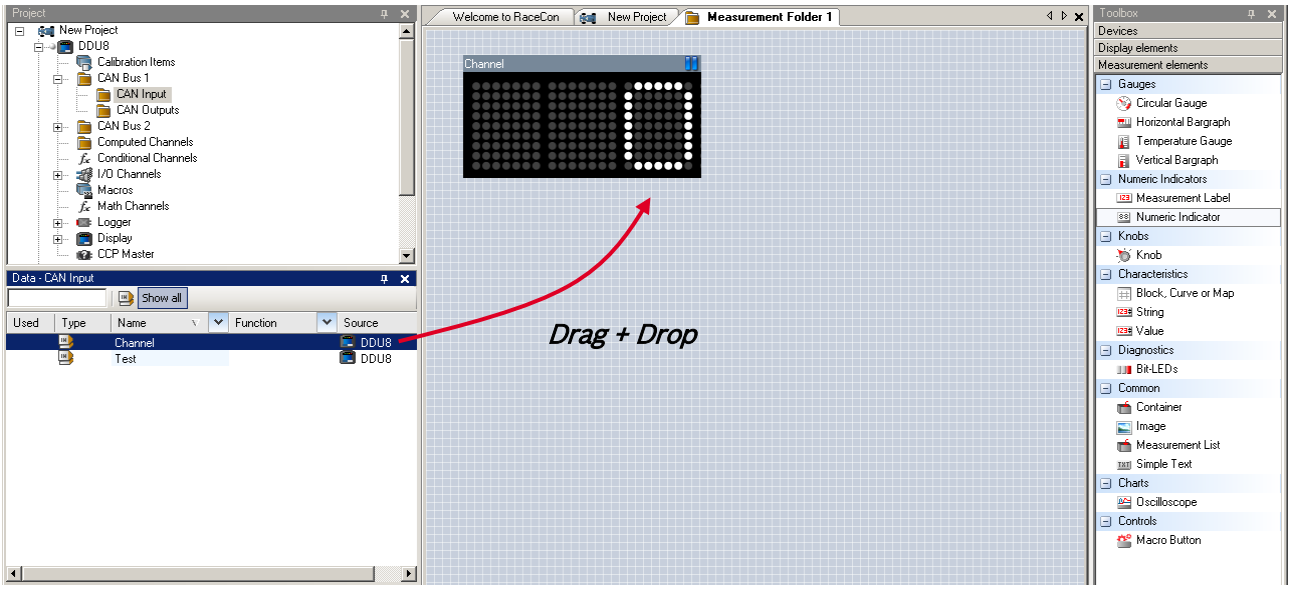
Measurement Sheet 1 is displayed in Main Area.

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.

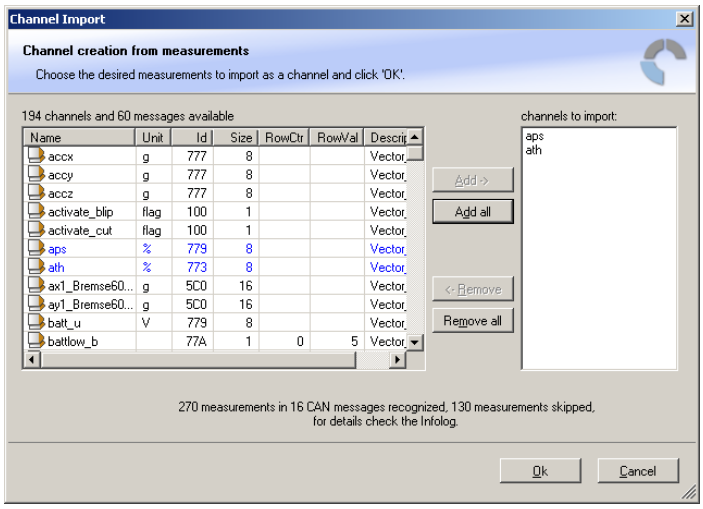
9.2.8 Import a CAN database (DBC) file

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.



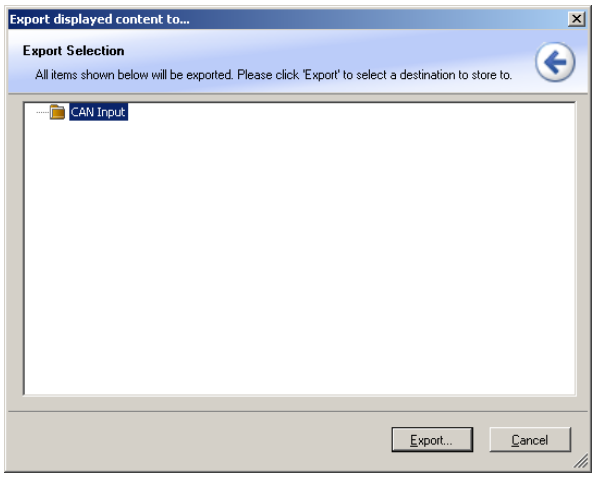
4. Select desired channels on the left and use the ‘Add’ button to add them to import list.
5. Click ‘OK’ when complete.

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.



3. Specify the filename.
4. Click ‘OK’ when done.

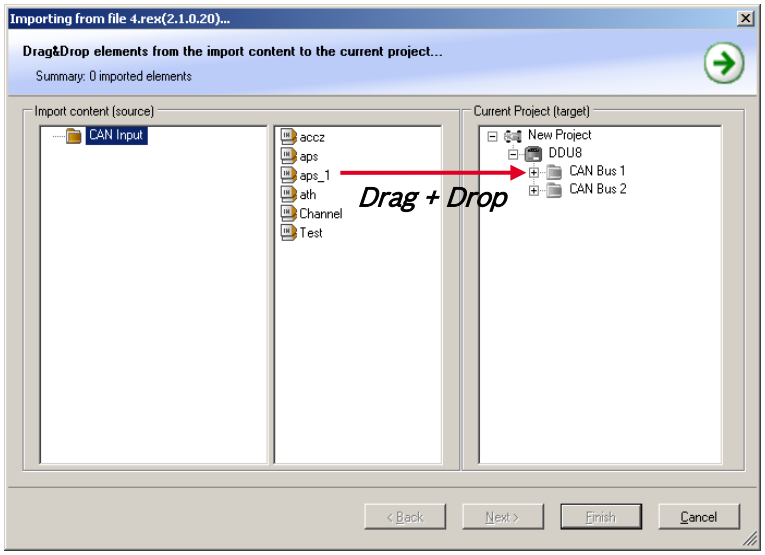
9.2.10 Import RaceCon CAN configuration

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

A file browser opens.

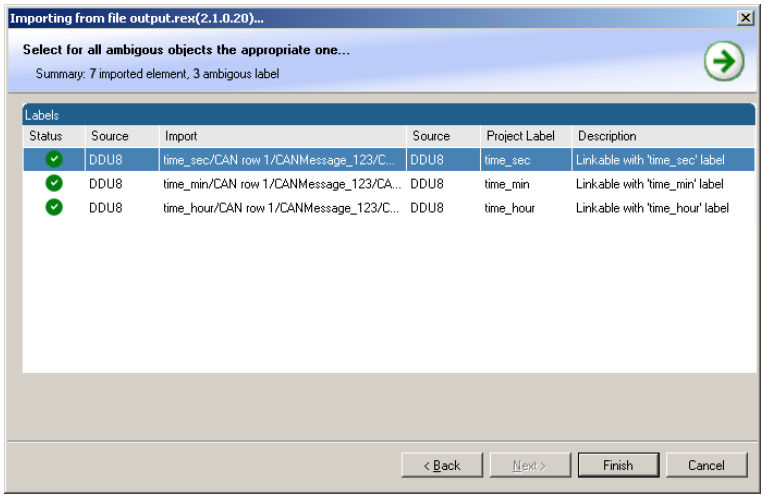
3. Select the input file and click ‘OK’.

An ‘Import Selection’ window opens.



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’.

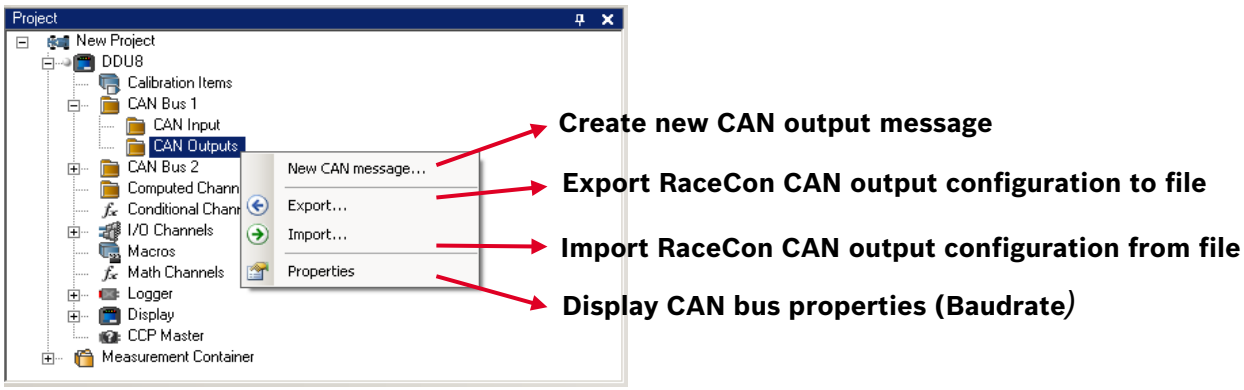
If a measurement channel belongs to more than one source (e.g. DDU 8 and ECU MS 5.1), the ‘Solve Label Ambiguity’ window opens.



7. Assign the ambiguous channels to the desired source.
8. Click ‘Finish’.

9.3 CAN output

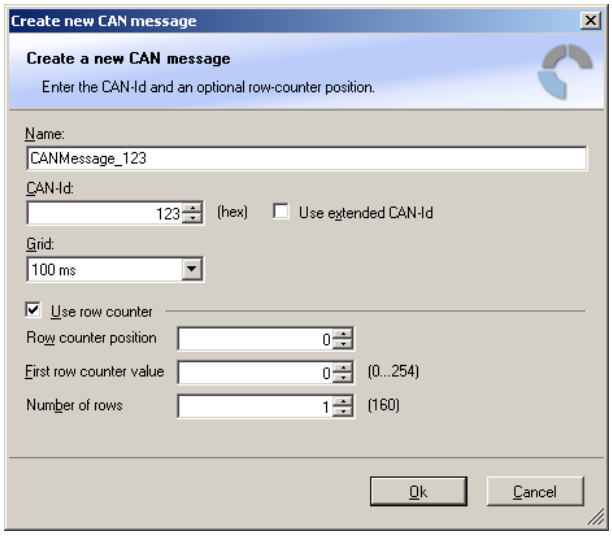
9.3.1 Output configuration



9.3.2 Create new CAN output message channel

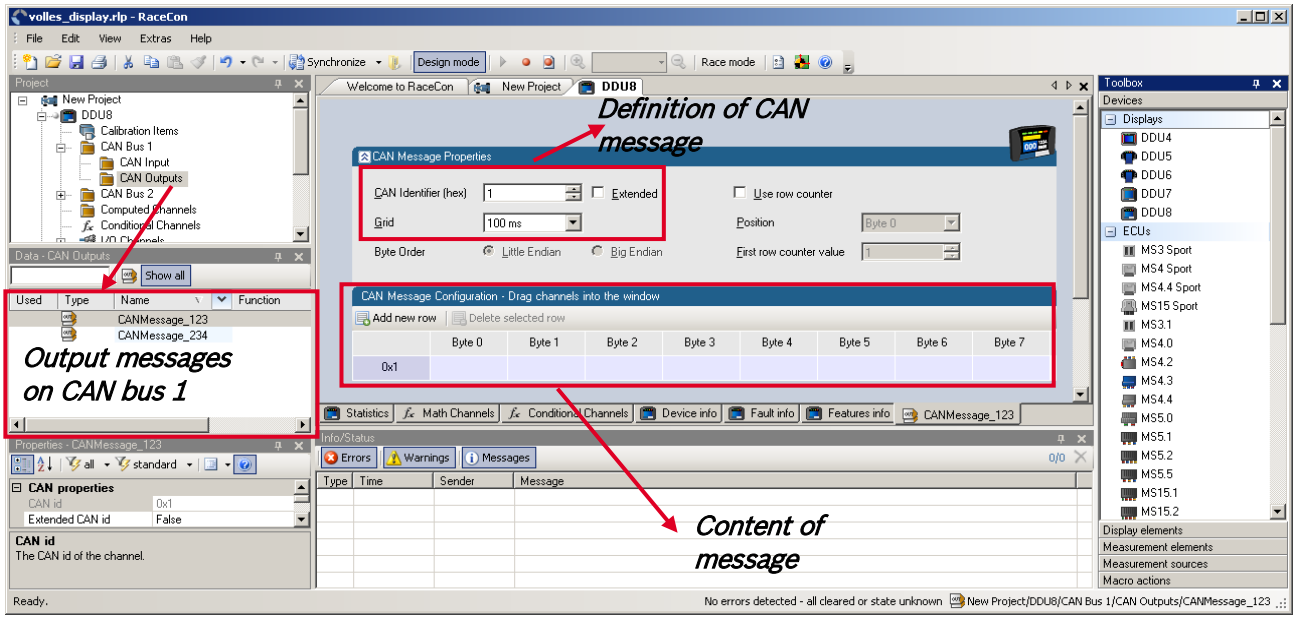
1. Right-click on CAN Output of desired bus (CAN1 or CAN2).
2. Select ‘New CAN Message’ from menu.

The ‘Create new CAN message’ window opens.

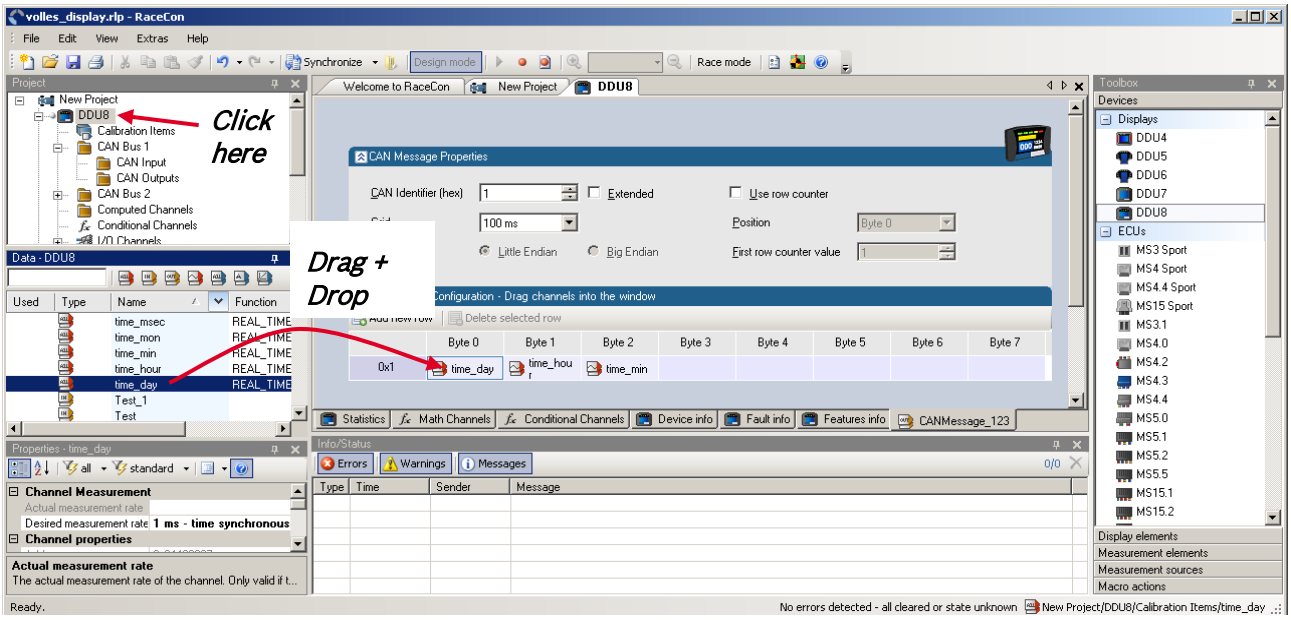


3. Enter name of message, CAN-Id and Grid (output interval).
4. Optionally, specify a row counter (multiplexer).
5. Click ‘OK’ when done.

A CAN message configuration window opens in the Main Area.

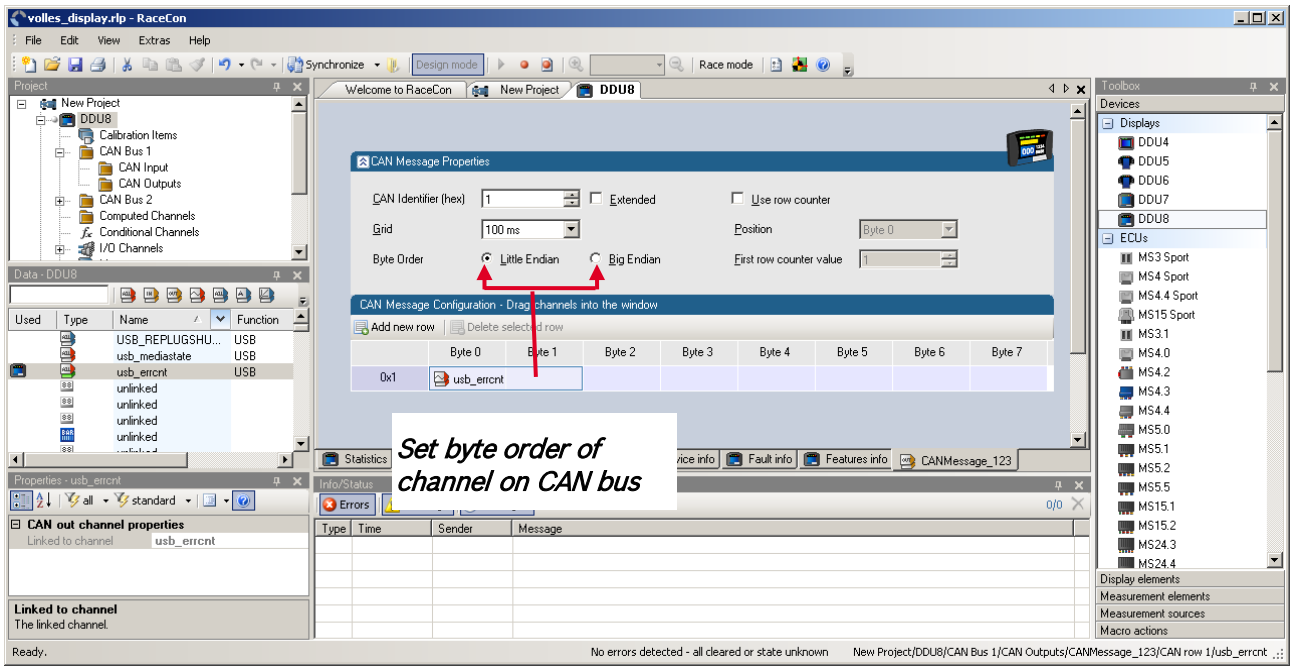


6. Click on ‘DDU 8’ in the DDU 8 Project Tree to display all labels.
7. Select the desired measurement channel and drop it on message’s bytes.



The measurement channel is assigned to the CAN message.

9.3.3 Set up of word length, byte order and quantization



Word length and quantization of channel are fixed.

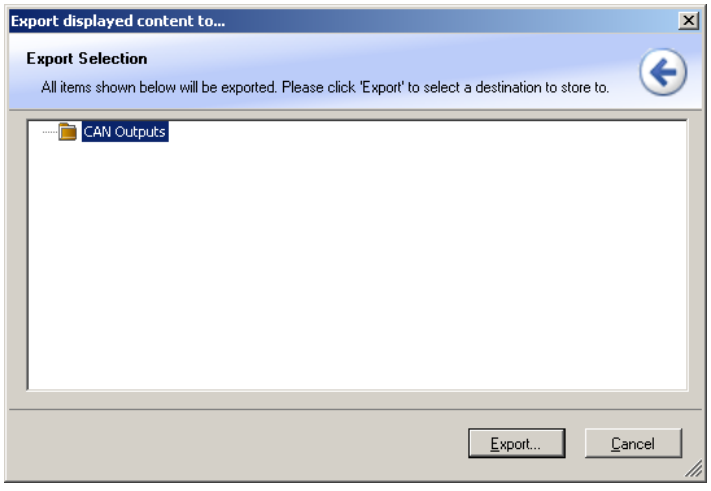
Byte Order can only be changed if a channel allocates more than one byte.

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.



4. Click ‘OK’ when done.

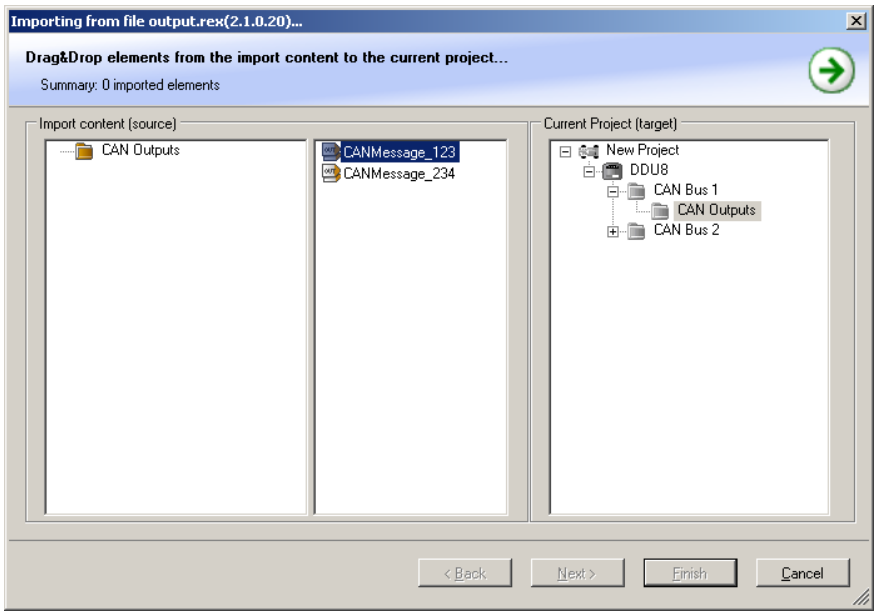
9.3.5 Import RaceCon CAN configuration

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

A file browser opens.

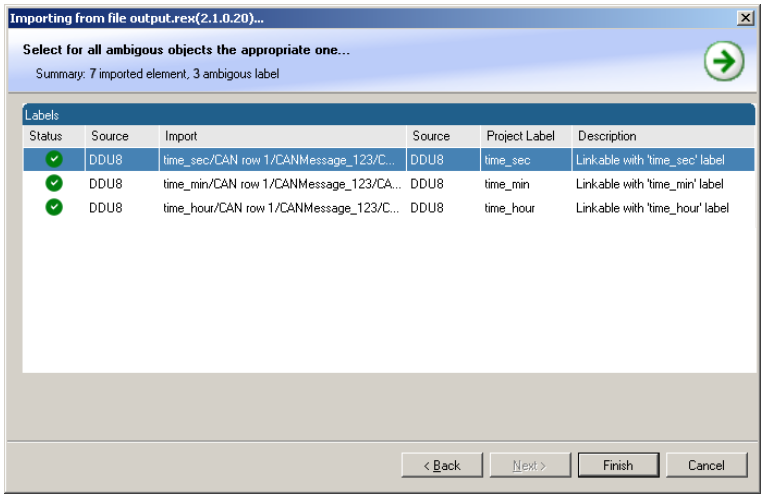
3. Select the input file and click ‘OK’.

An ‘Import Selection’ window opens.



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.



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

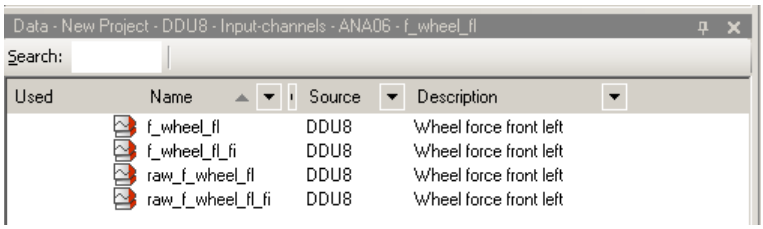
4 PWM outputs

- 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.



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

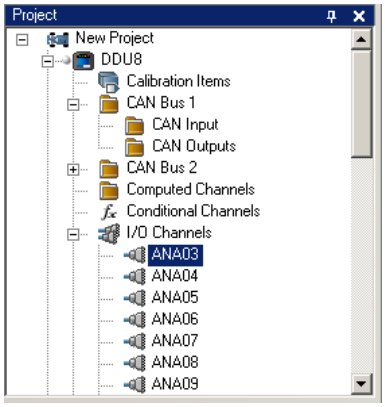
Filtered channels are routed through digital low pass filters:

- 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

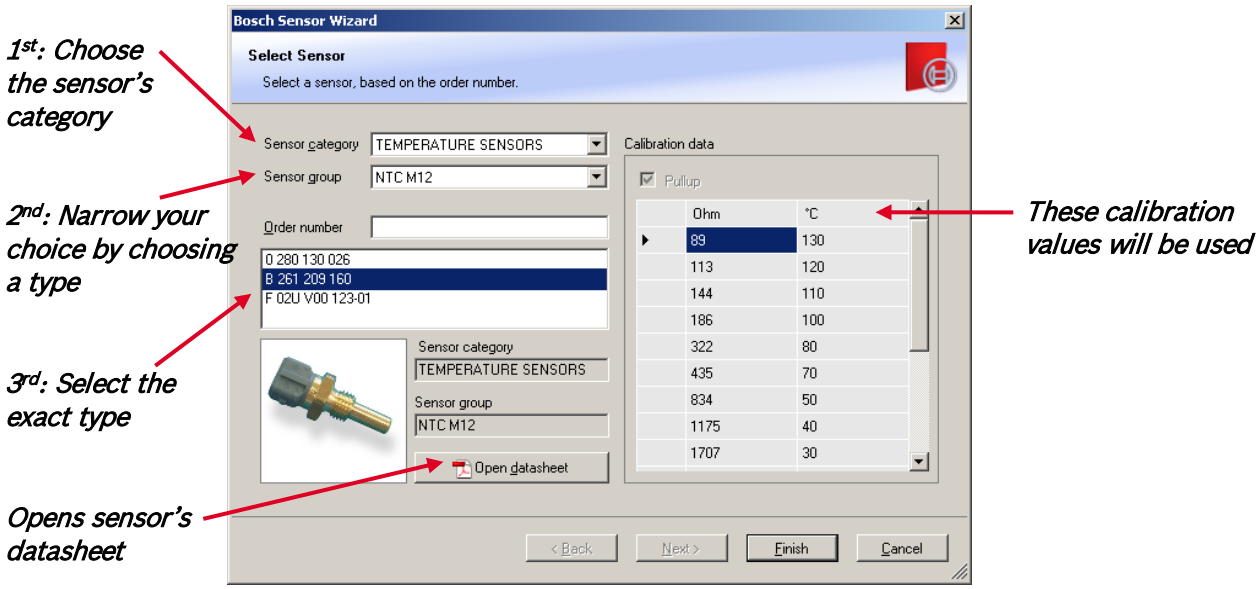
10.3 Configuring inputs

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.

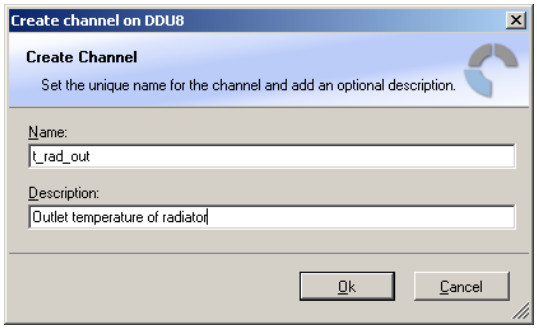


3. Drag the ‘Bosch Sensor Wizard’ from the Toolbox and drop it on the desired analog input channel in the DDU 8 Project Tree.
The ‘Bosch Sensor Wizard’ opens.



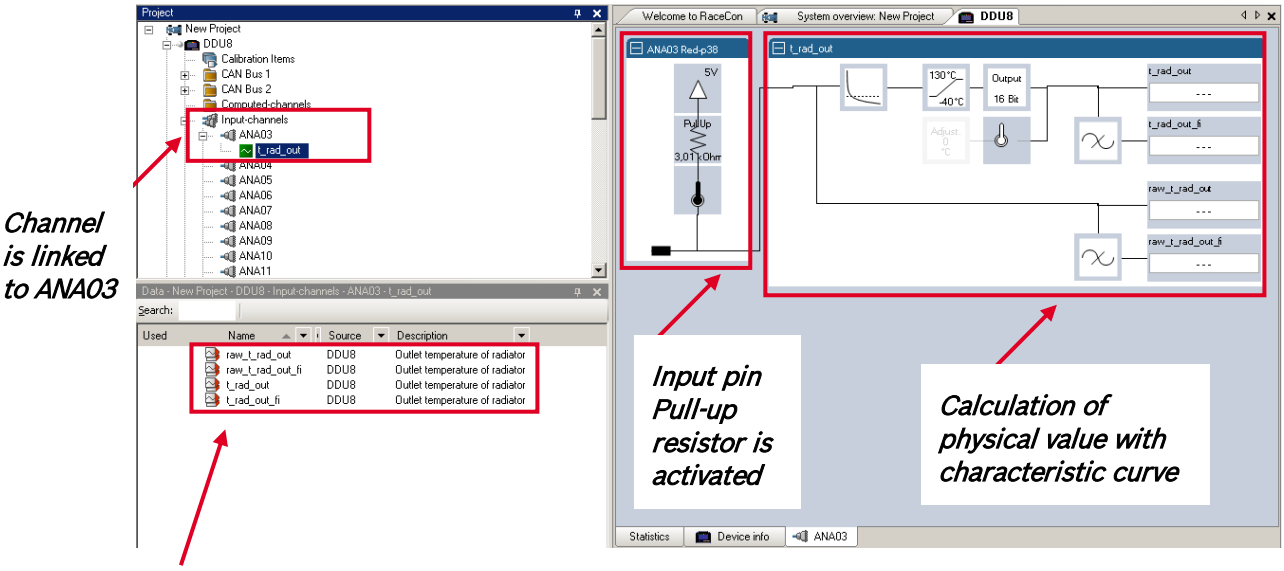
4. Click ‘Finish’ when done.

5. The ‘Create channel on DDU 8’ window opens.
6. Enter channel name and description.



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:

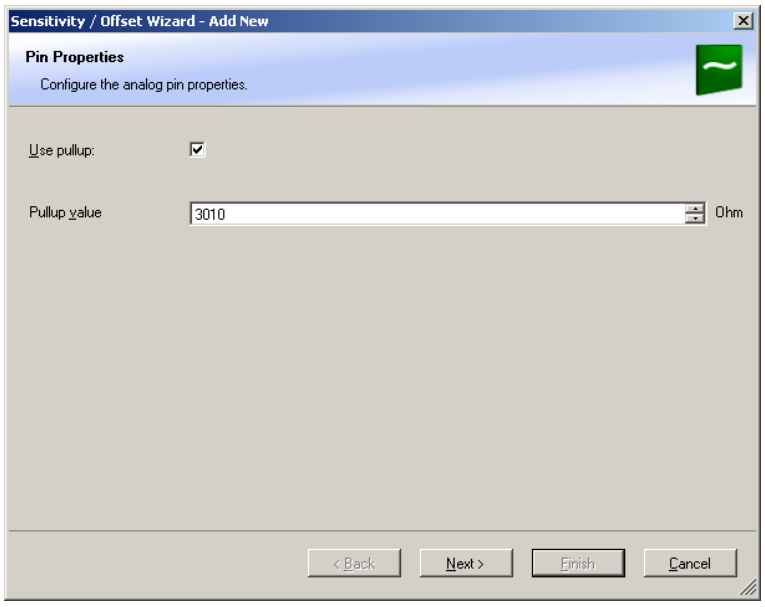
Output Signal					
Zero g (T_A = 25°C, V_{DD} = 5.0 V)(4)	V_{OFF}	2.25	2.5	2.75	V
Zero g (V_{DD} = 5.0 V)	V_{OFF}	2.0	2.5	3.0	V
Sensitivity (T_A = 25°C, V_{DD} = 5.0 V)(5)	S	380	400	420	mV/g
Sensitivity (V_{DD} = 5.0 V)	S	370	400	430.1	mV/g
Bandwidth Response	f_{-3dB}	42.5	50	57.5	Hz
Nonlinearity	NL_{OUT}	–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.

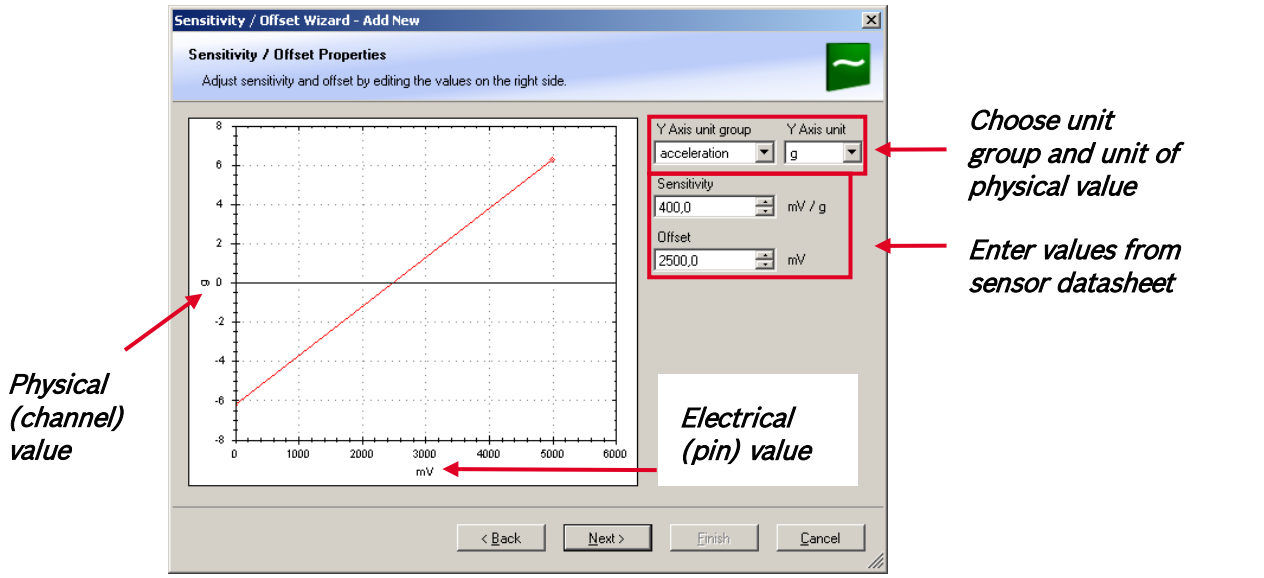
The internal DDU 8 pullup-resistor is used to get a 5 V signal at the analog channel of the DDU 8. It allows you to use a push-button.

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.



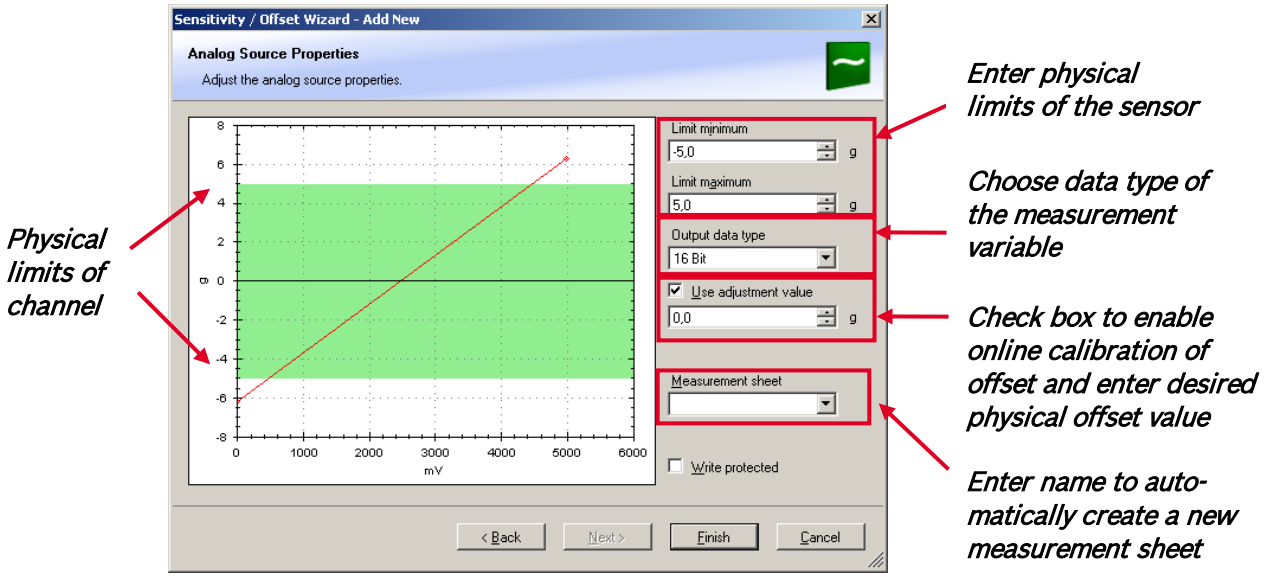
5. Click ‘Next’ when done.

The second part of the ‘Sensitivity/Offset Wizard’ opens.



6. Click ‘Next’ when done.

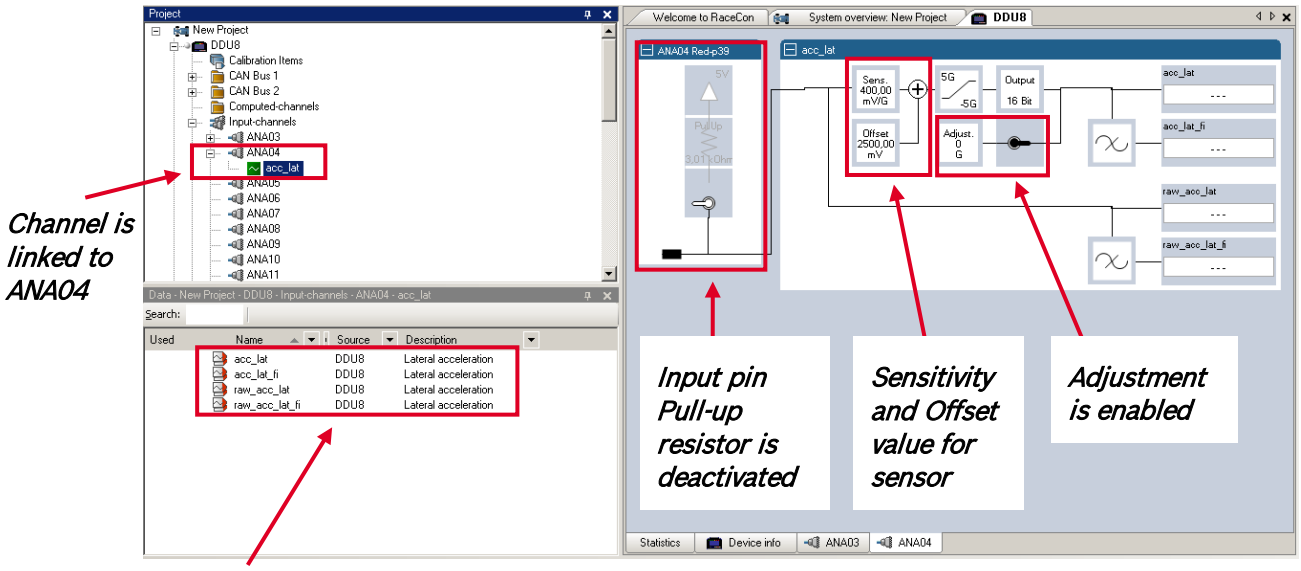
The third part of the ‘Sensitivity/Offset Wizard’ opens.



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

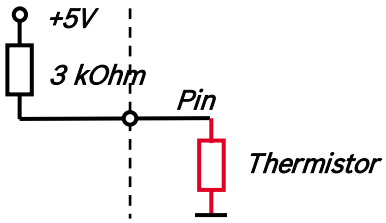
Toper [°C]	RT [Ω]
-40	166 047
-35	119 950
-30	87 600
-25	64 643
-20	48 179
-15	36 250
-10	27 523
-5	21 078

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

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

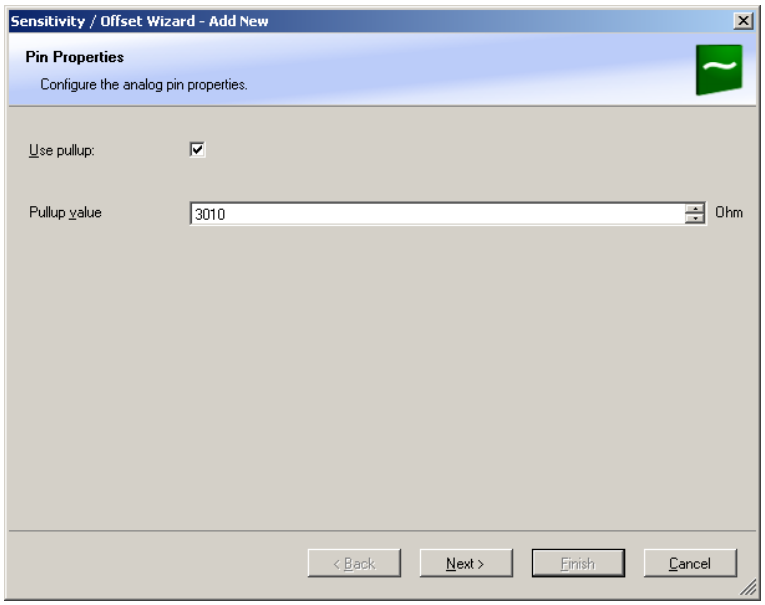
- The sensor has a nonlinear behavior
- Use characteristic curve for linearization
- Input voltage is the ratio between pull-up resistor and thermistor



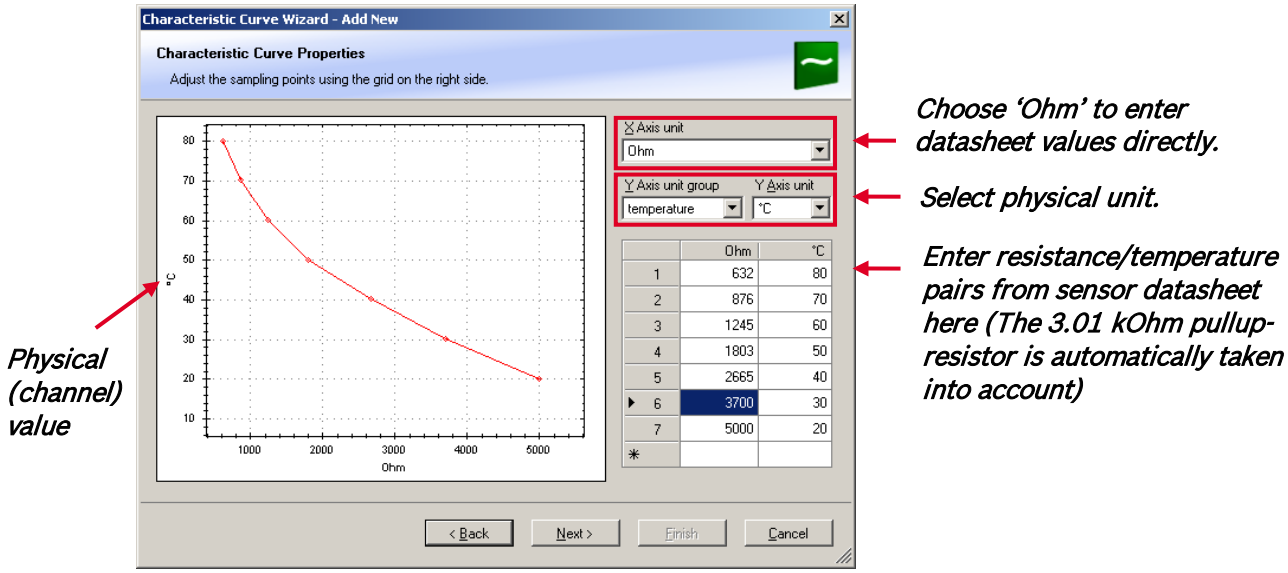
1. Click on ‘Measurement Sources’ in the Toolbox.
2. Expand the list of ‘I/O Channels’ by clicking on ‘+’ in the DDU 8 Project Tree.
3. Drag the ‘Characteristic Curve’ analog signal source from the Toolbox and drop it on the desired analog input channel in the DDU 8 Project Tree.
A ‘Characteristic Curve 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.

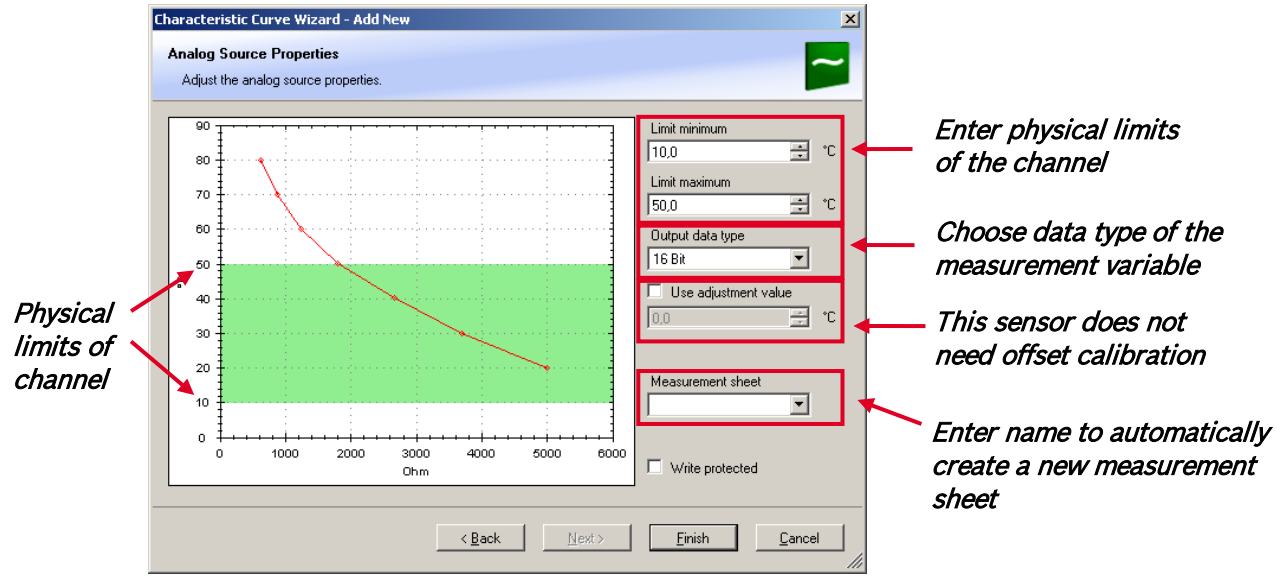
The fixed value of the internal DDU 8 pullup-resistor is 3010 Ohm. If using an additional external pullup-resistor, set up the overall resistance.



5. Click ‘Next’ when done.
The second part of the ‘Sensitivity/Offset Wizard’ opens.

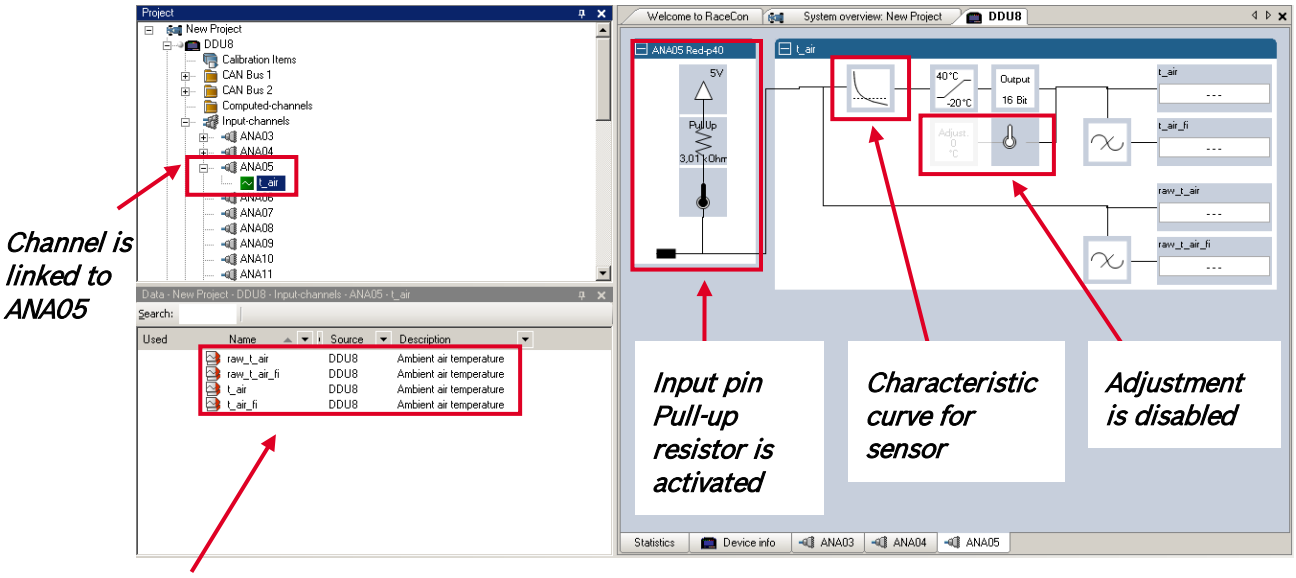


6. Click ‘Next’ when done.
The third part of the ‘Characteristic Curve Wizard’opens.



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.



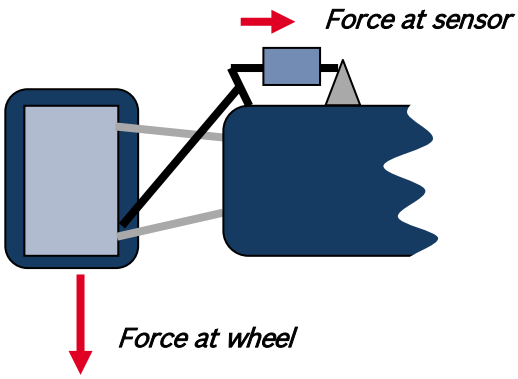
Available measurements for channel:

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

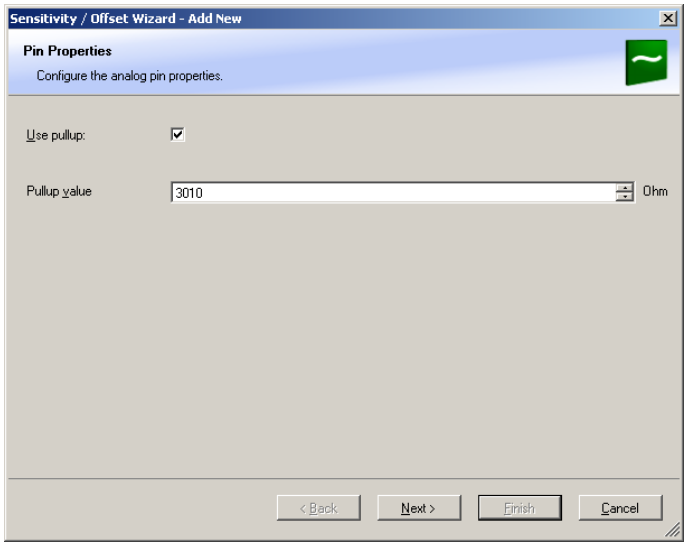
- Physical property ‘wheel force’ not directly measureable
- Load transfer through suspension kinematics
- Physical value at sensor position defined by vehicle
- Curve definition by online adjustment at vehicle



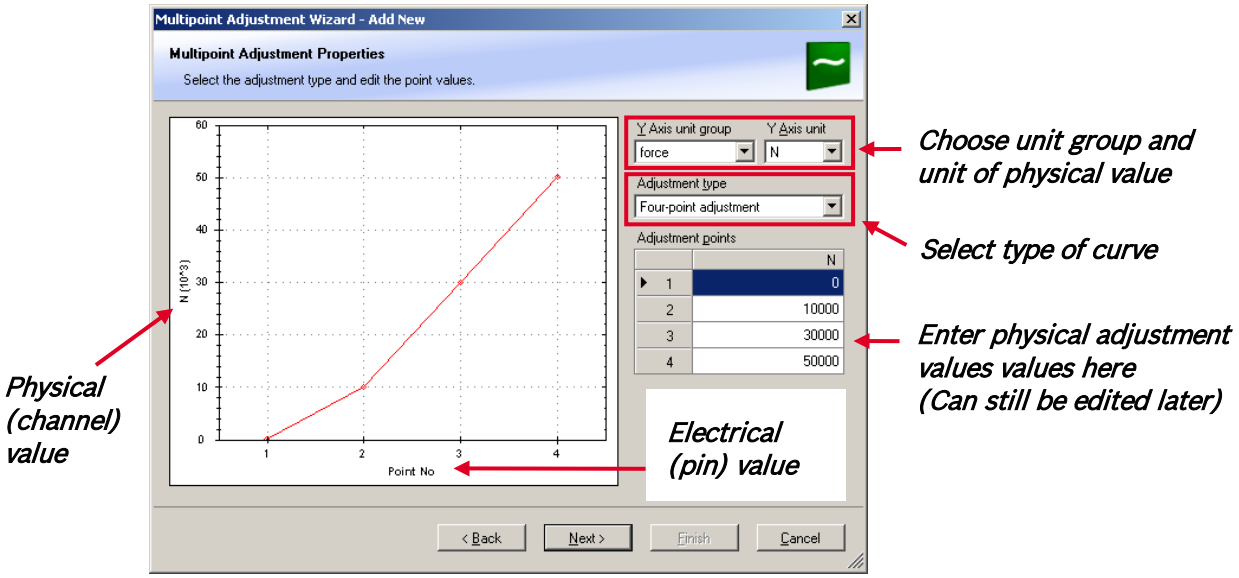
1. Click on ‘Measurement Sources’ in the Toolbox.
2. Expand the list of ‘I/O Channels’ by clicking on ‘+’ in the DDU 8 Project Tree.
3. Drag the ‘Multipoint Adjustment’ analog signal source from the Toolbox and drop it on the desired analog input channel in the DDU 8 Project Tree.
A ‘Multipoint Adjustment 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.

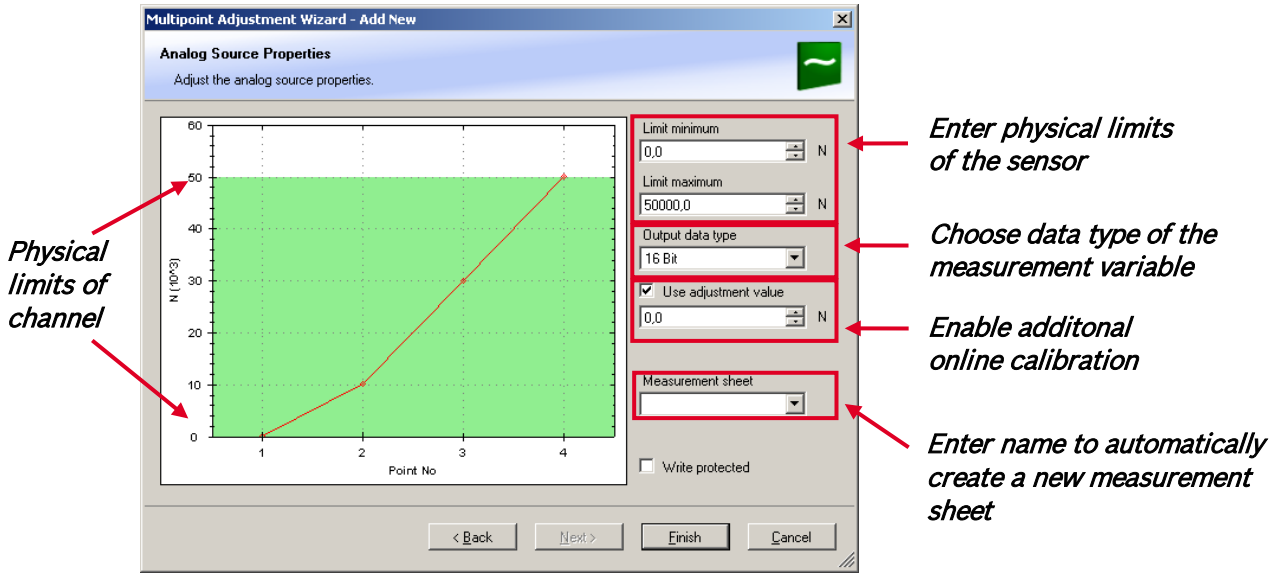
The fixed value of the internal DDU 8 pullup-resistor is 3010 ohm. If using an additional external pullup-resistor, set up the overall resistance.



5. Click ‘Next’ when done.
The second part of the ‘Multipoint Adjustment Wizard’ opens.



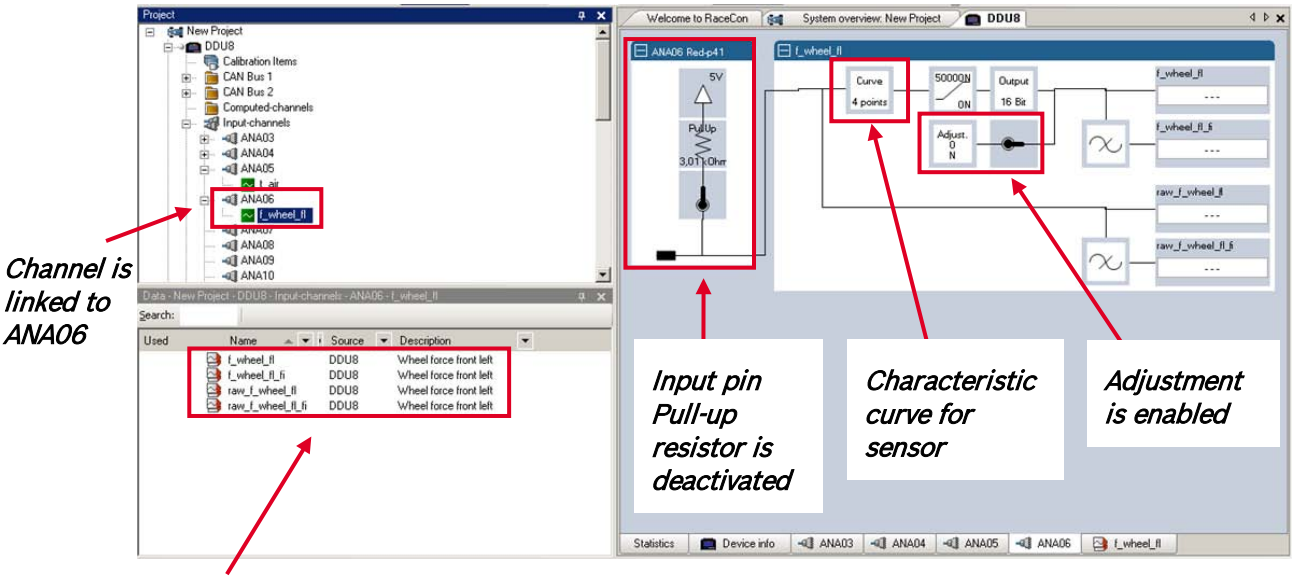
6. Click ‘Next’ when done.
The third part of the ‘Multipoint Adjustment Wizard’ opens.



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.



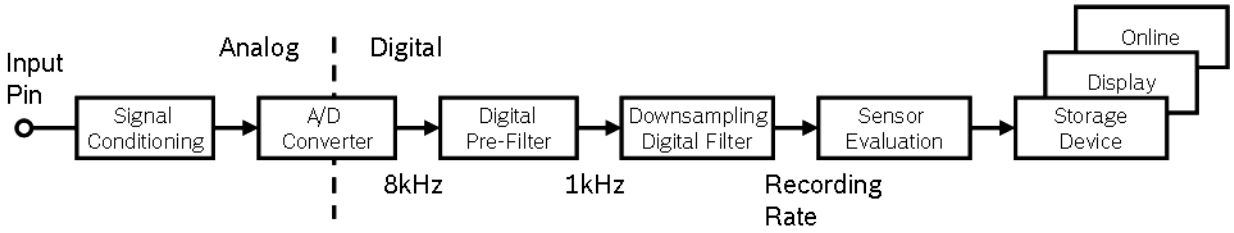
Available measurements for channel:

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

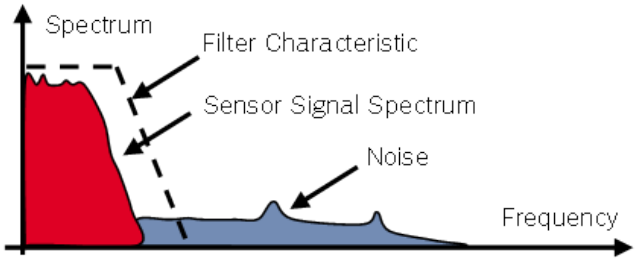
Online definition of the curve is covered in the chapter ‘11.3 Online calibration of measurement channels’ of this manual.

10.3.5 Digital filter details

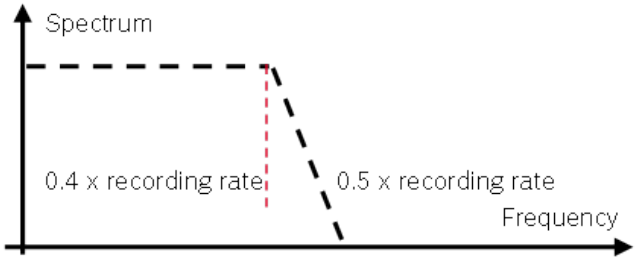
DDU 8 uses A/D converter oversampling and digital filtering to recording rate.



Digital filters eliminate 'out-of-band' noise



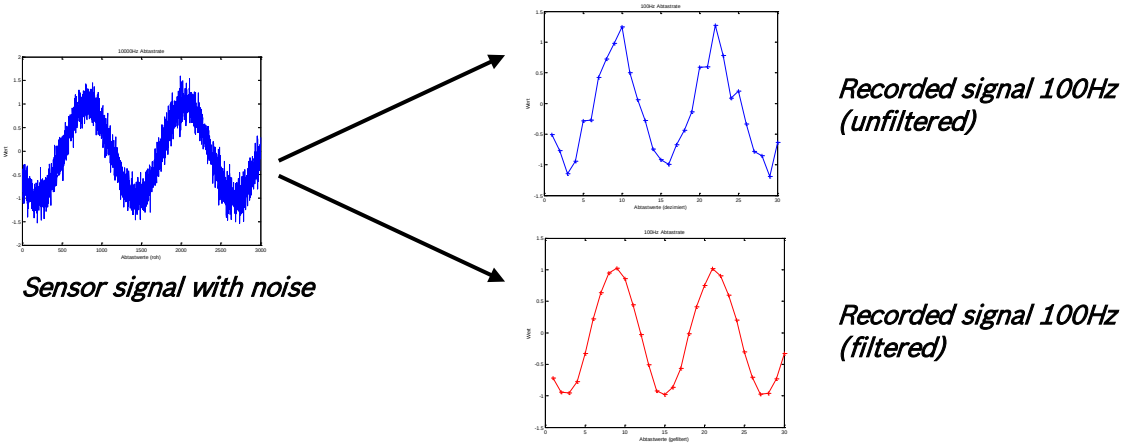
Cut-off frequency automatically adjusted to recording rate



Example:

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

Linear phase – no signal distortion



Latency compensation – no filter delay in recorded data

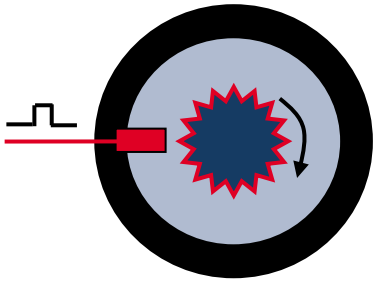
- Filtering is (smart) averaging over several samples
- Filtered signal is delayed with respect to real time signal
- DDU 8 filters have constant, frequency independent delay
- Delay (e.g. 22 samples at 10ms) is corrected during recording
- No delay filtered vs. unfiltered in recorded data
- Correction 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

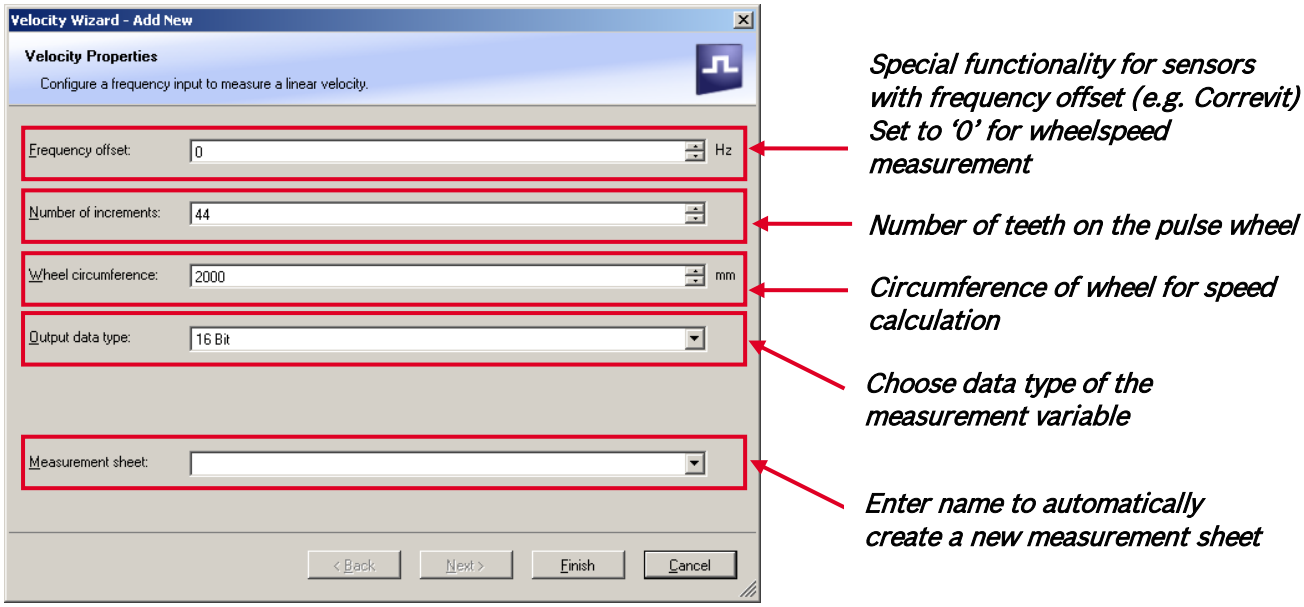
This function requires the installation of Software Upgrade 2.

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

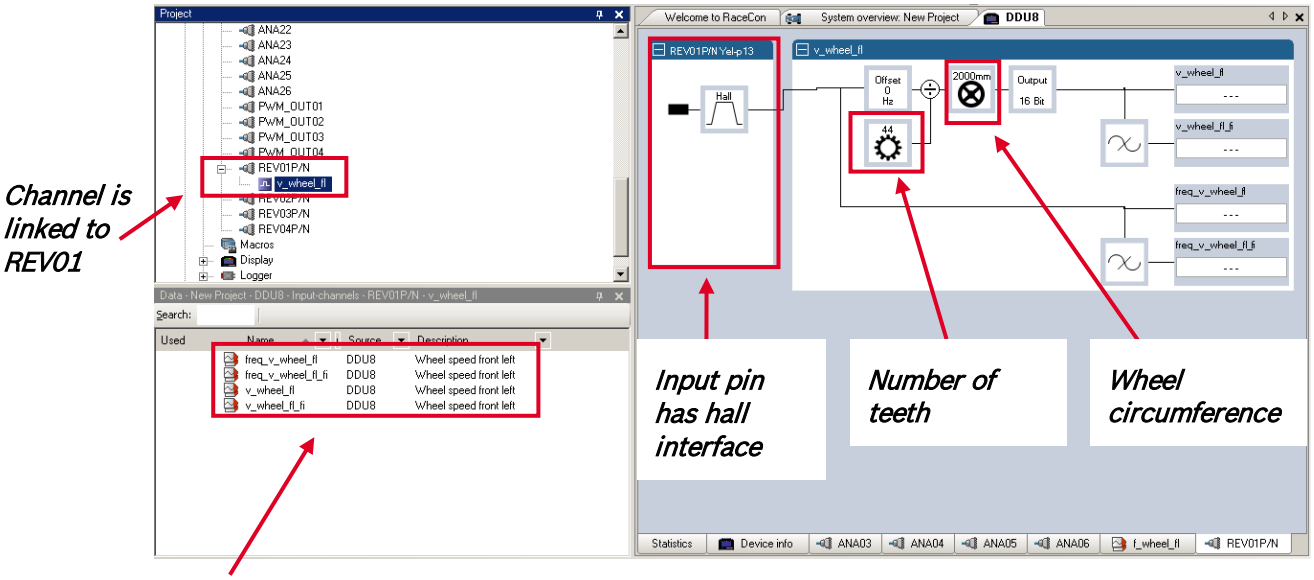


1. Click on ‘Measurement Sources’ in the Toolbox.
2. Expand the list of ‘I/O Channels’ by clicking on ‘+’ in the DDU 8 Project Tree.
3. Drag the ‘Velocity’ digital signal source from the Toolbox and drop it on the desired ‘REV’ input channel in the DDU 8 Project Tree.
The ‘Velocity Wizard’ opens.



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

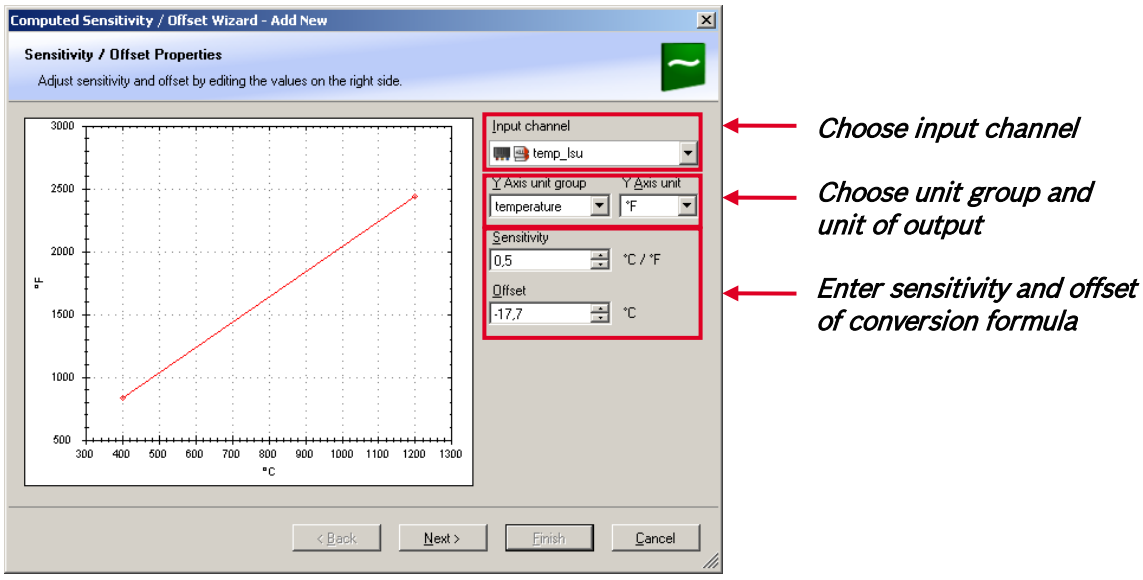
Computed sources receive data from a measurement channel rather than an input pin.

- 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

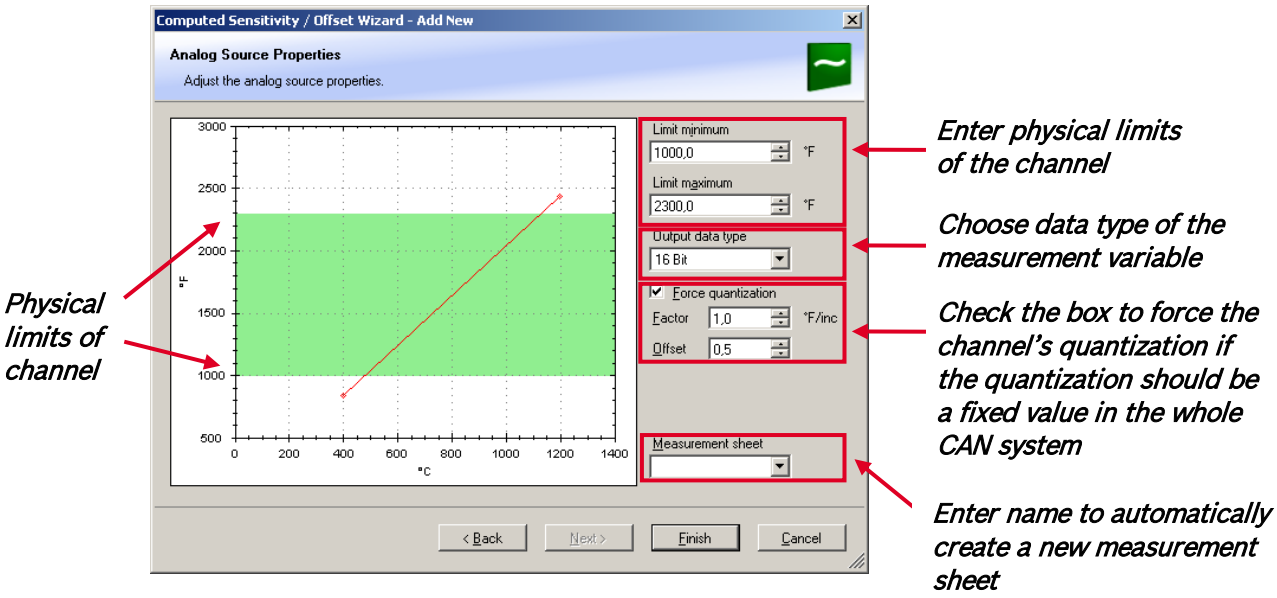
1. Click ‘Measurement Sources’ in the Toolbox.

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’.

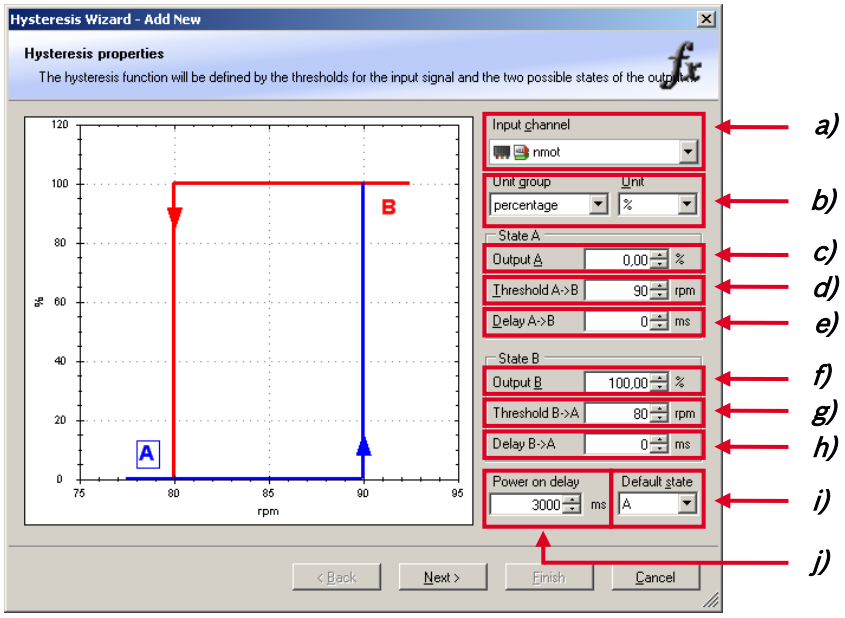
4. Click ‘Finish’ when done.
5. Enter channel name and description.
6. Click ‘OK’ when done.

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).

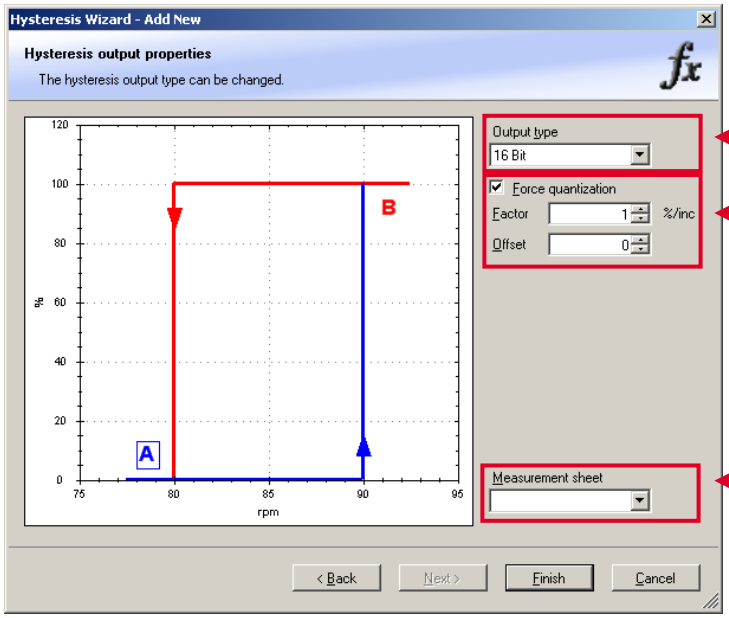
g) Enter threshold value when state changes from B to A.

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.

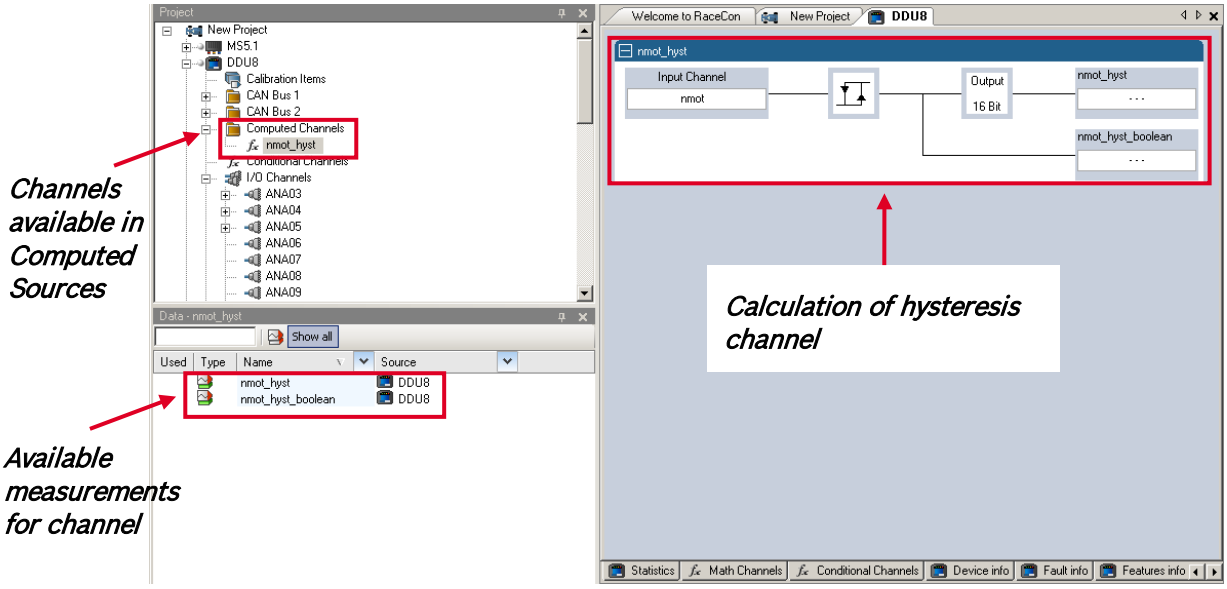


Choose data type of the measurement variable

Check the box to force the channel’s quantization if the quantization should be a fixed value in the whole CAN system

Enter name to automatically 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.



Channels available in Computed Sources

Available measurements for channel

Calculation of hysteresis channel

10.5.1 Special functionality: Vehicle speed

This functionality allows:

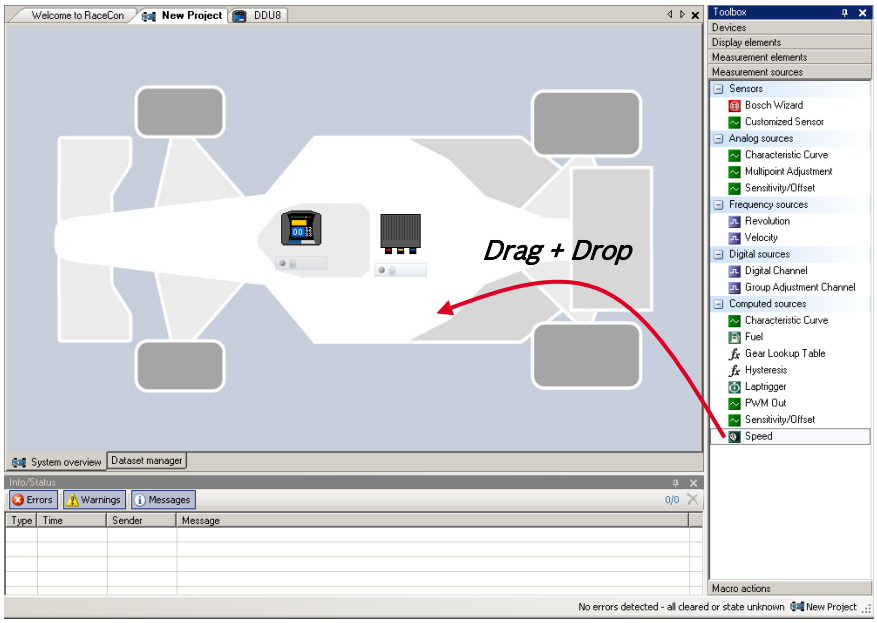
- high performance vehicle owners to measure wheel spin under acceleration and wheel slip/lock under braking.
- calculating vehicle ‘speed over ground’.

Vehicle speed calculation function

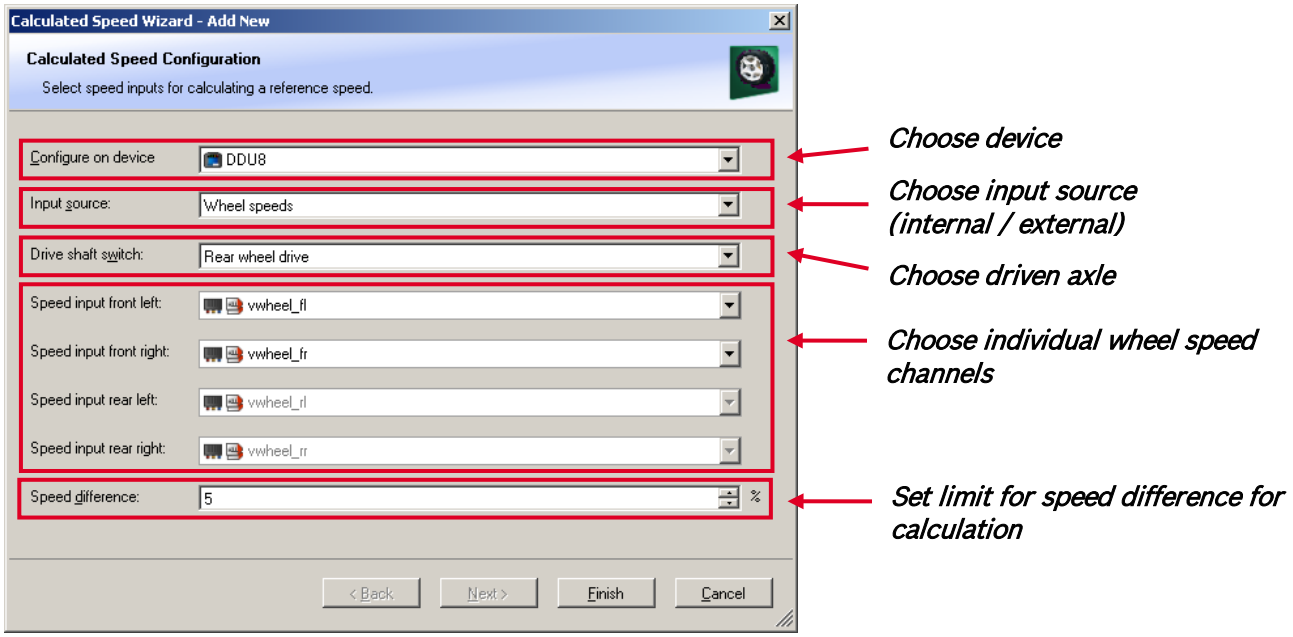
- Calculating vehicle speed of 2 wheel drive: (Wheel speeds of non-driven axle as input)
  Calculated speed is average of both speeds if speed difference between wheels < limit.
  Calculated speed is maximum of both speeds if speed difference between wheels > limit.
- Calculating vehicle speed of 4 wheel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

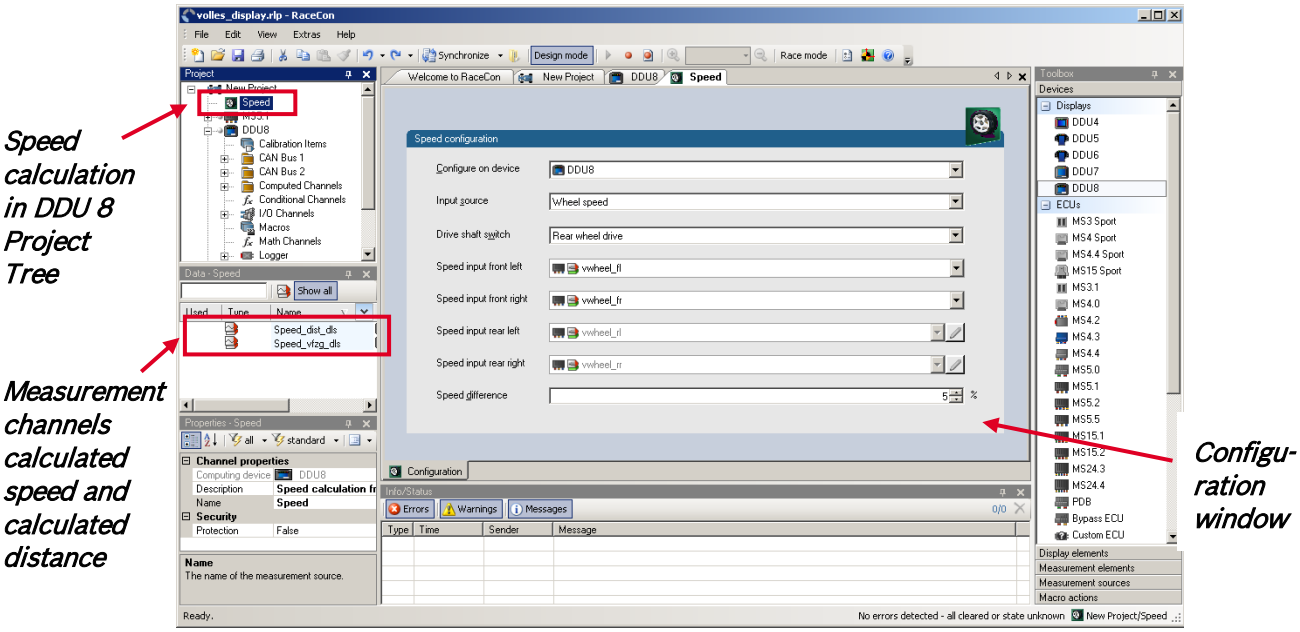
1. Click on tab ‘System Overview’.
2. Click on ‘Measurement Sources’ in the Toolbox.
3. Drag the ‘Speed’ computed source from the Toolbox and drop it on ‘Computed Channels’ in the DDU 8 Project Tree. Do not drop it on ‘DDU 8’!



A ‘Calculated Speed Wizard’ opens.



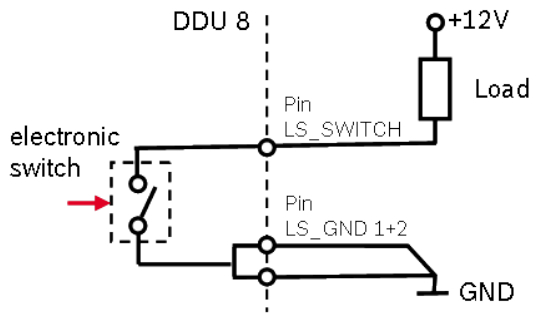
4. Click ‘Finish’ when done.
The speed calculation is inserted into the DDU 8 Project Tree.



10.6 Configuring PWM outputs

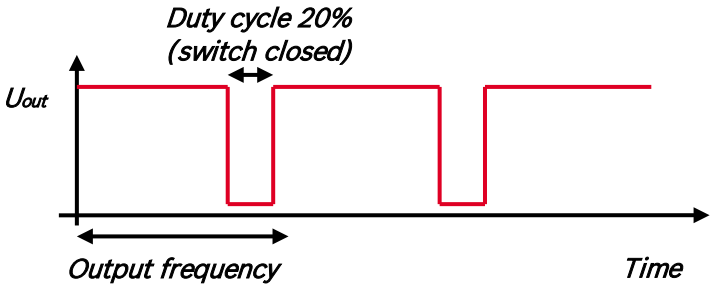
PWM

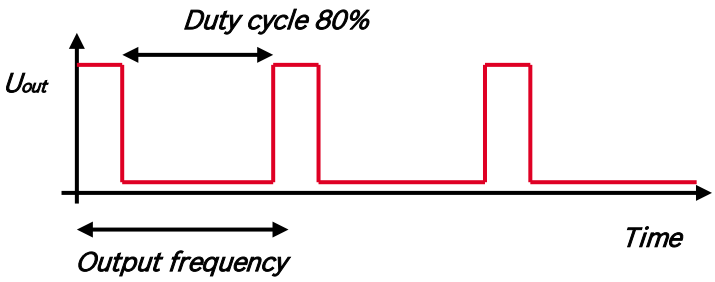
- Pulse Width Modulation
- Output frequency is constant
- ‘On time’ (duty cycle) controlled by input channel



DDU 8 has 4 PWM outputs

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

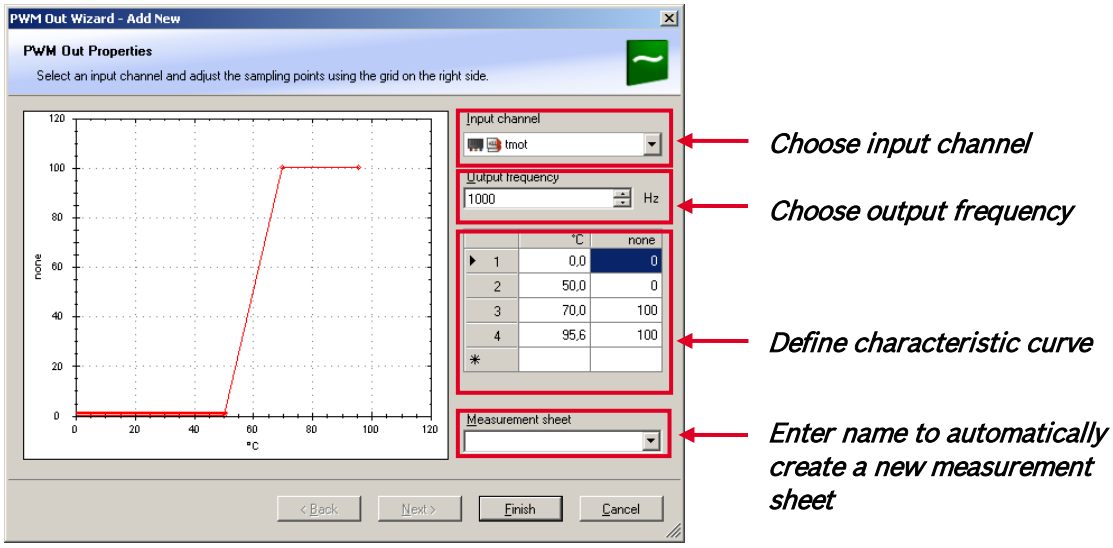




10.6.1 Configuring a PWM output

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.



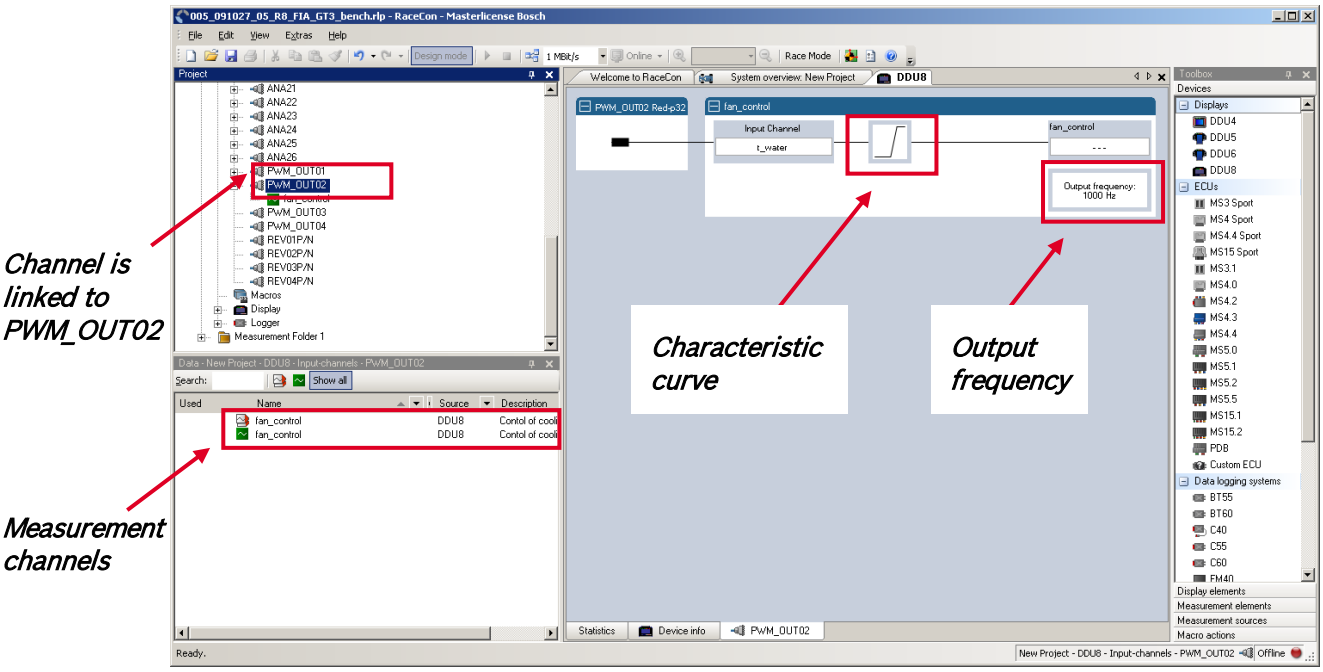
Note: Working with automatically created measurement sheets is explained in chapter ‘11.2 Setting up an online measurement’.

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_ls_out_01_OL	PWM output 1 error open load
pwm_err_ls_out_01_OT	PWM output 1 error over temperature
pwm_err_ls_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

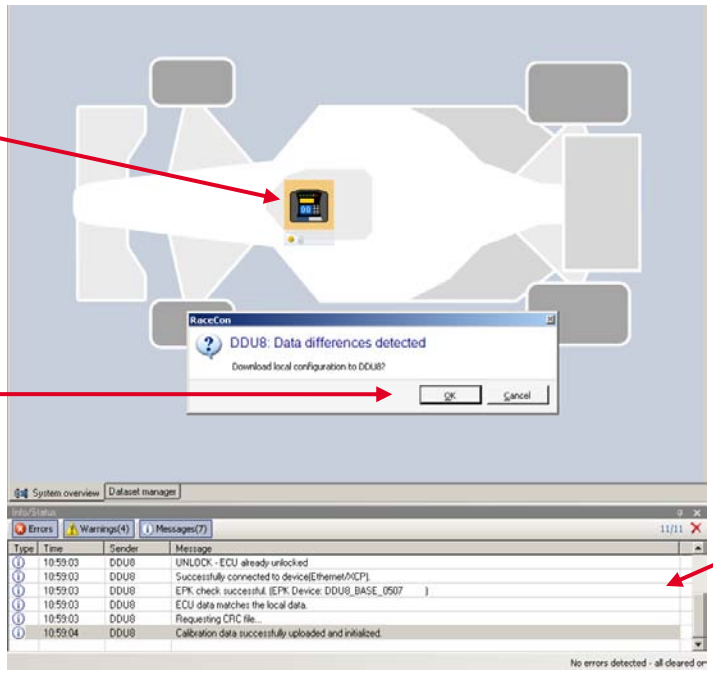
11.1 Achieving an online connection

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

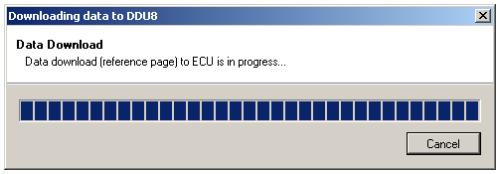
Click ‘OK’ to download RaceCon configuration to device



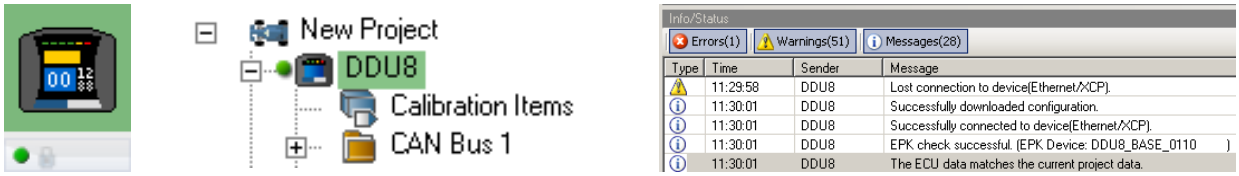
Status message window

11.1.2 Going online

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



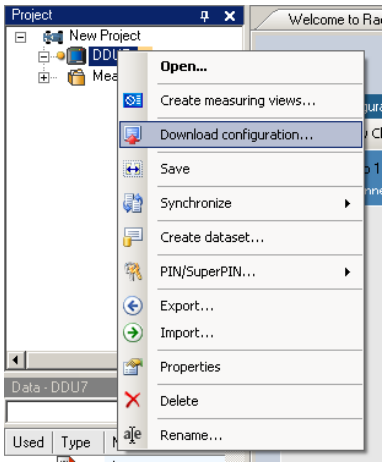
A green dot and background at the device in the project view and the DDU 8 Project Tree indicate a successful download and system consistency.



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’.

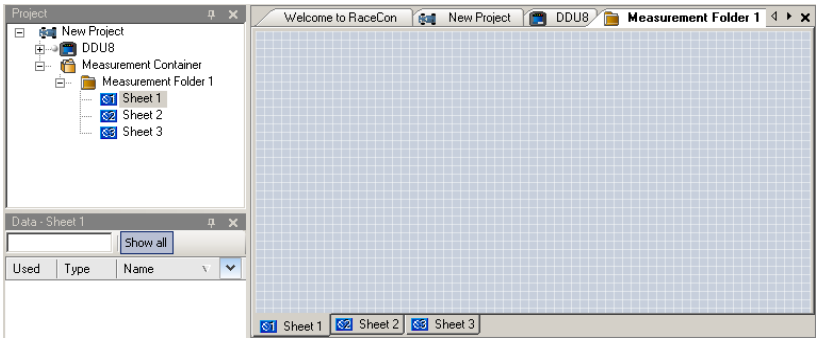


The configuration download starts.

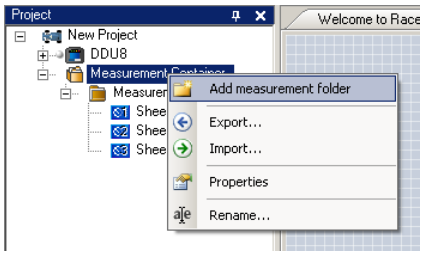
A Green dot and background indicate a successful download.

11.2 Setting up an online measurement

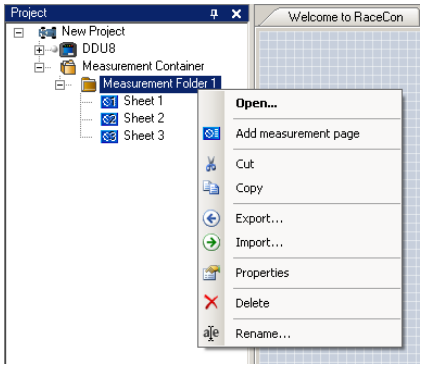
DDU 8 supports online measurement of sensor values and diagnostic variables.
Expand ‘Measurement Container’ and ‘Measurement Folder 1’ in the Project Tree and double-click on ‘Sheet1’. ‘Sheet 1’ is opened in the Main Area.



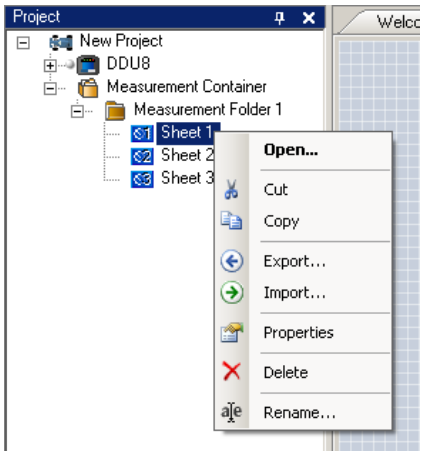
From the context menu of the project, new measurement pages can be created.



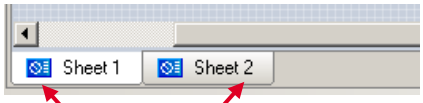
From the context menu of a measurement page, the folder can be renamed and deleted. It also allows the creation of measurement pages.



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



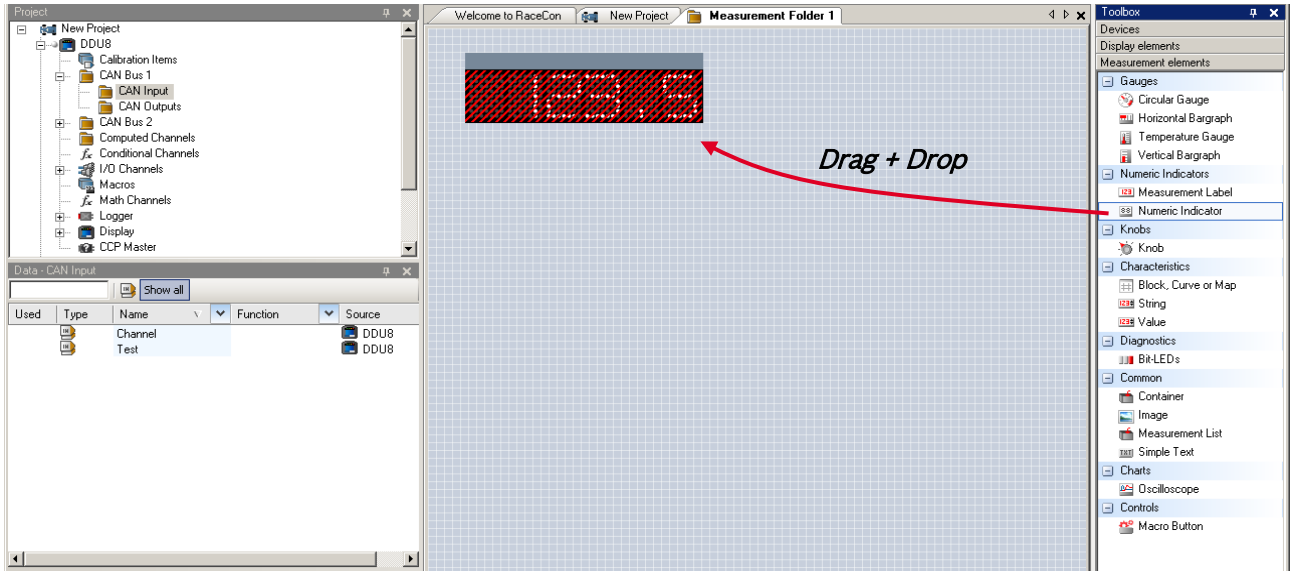
To change between different pages, click on the tabs on the bottom of the Main Project Area.



Tabs to switch between sheets

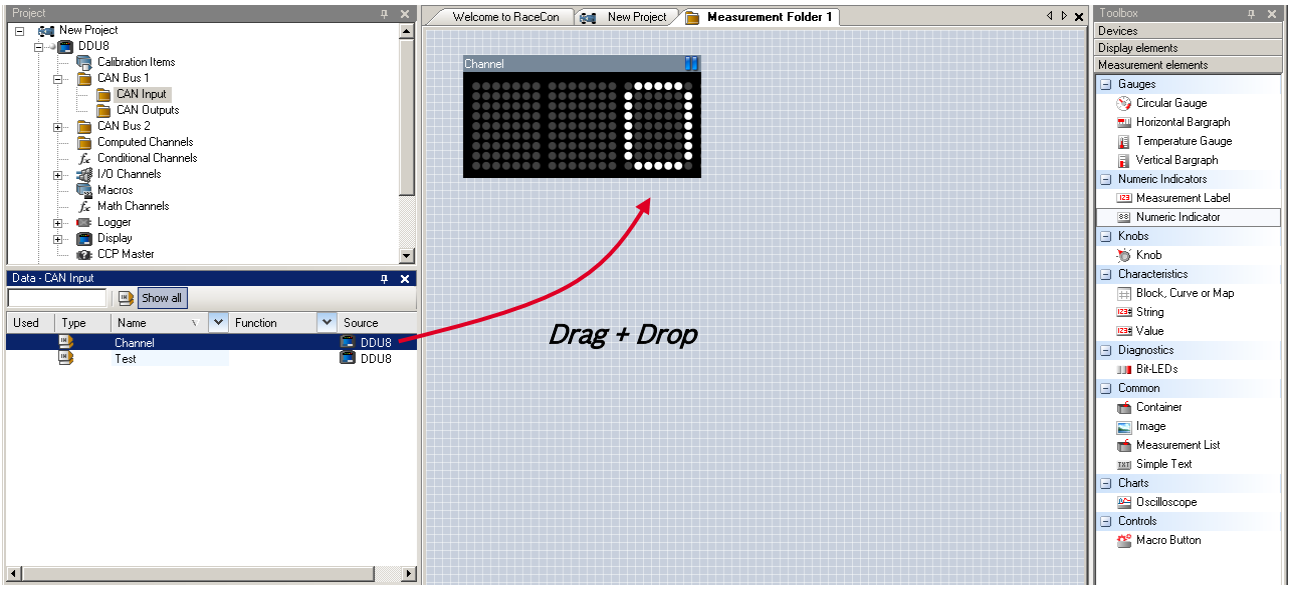
To add an element to a measurement sheet, do following steps:

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

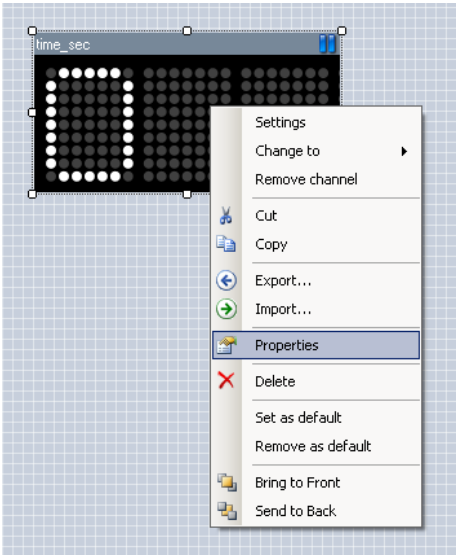


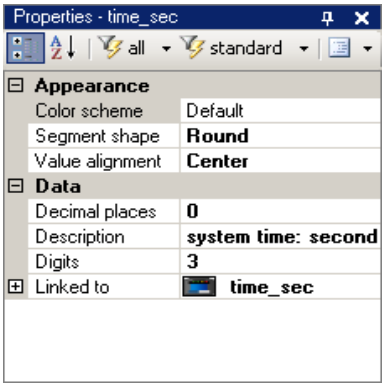
2. Click on ‘DDU 8’ in the Project Tree to display all measurement channels.

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



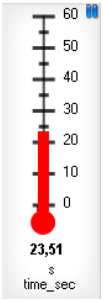
The measurement element’s appearance can be changed using the Properties Menu.



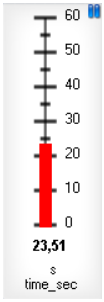


RaceCon offers different types of measurement elements:

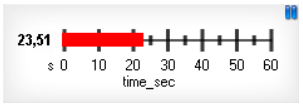
Circular gauge



Temperature gauge

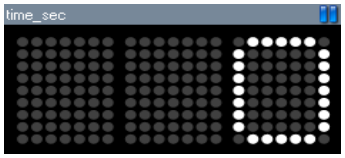


Vertical Bar graph style

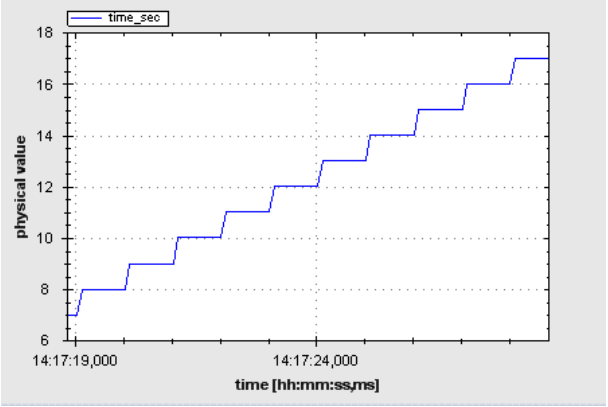


Horizontal Bar graph style

Measurement label



Numeric indicator



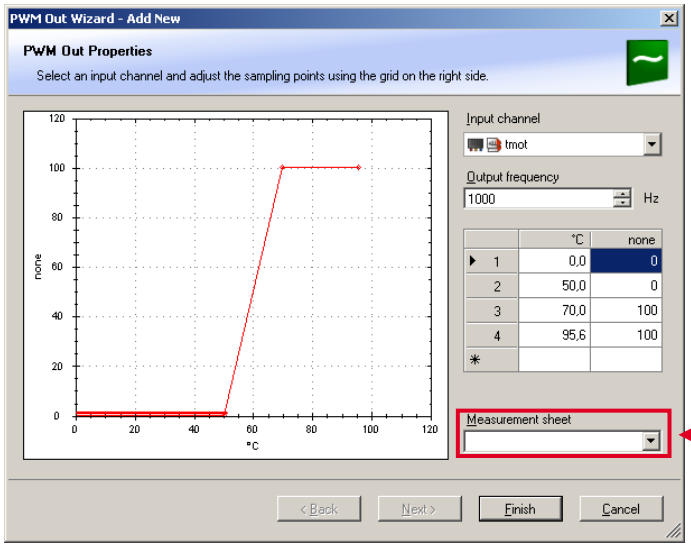
Oscilloscope (Chart)

11.2.1 Automatic creation of measurement sheets

RaceCon can create measurement sheets automatically.

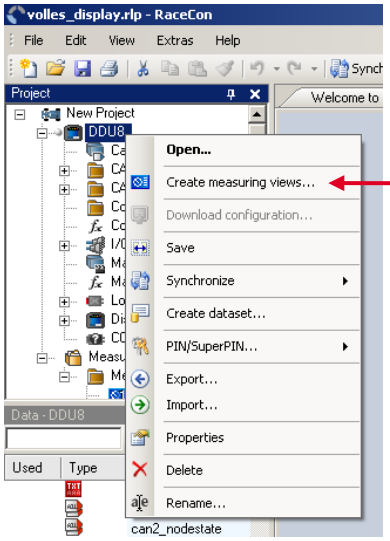
You can create and use measurement sheets with the DDU 8 as well as with all other devices connected to RaceCon.

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.



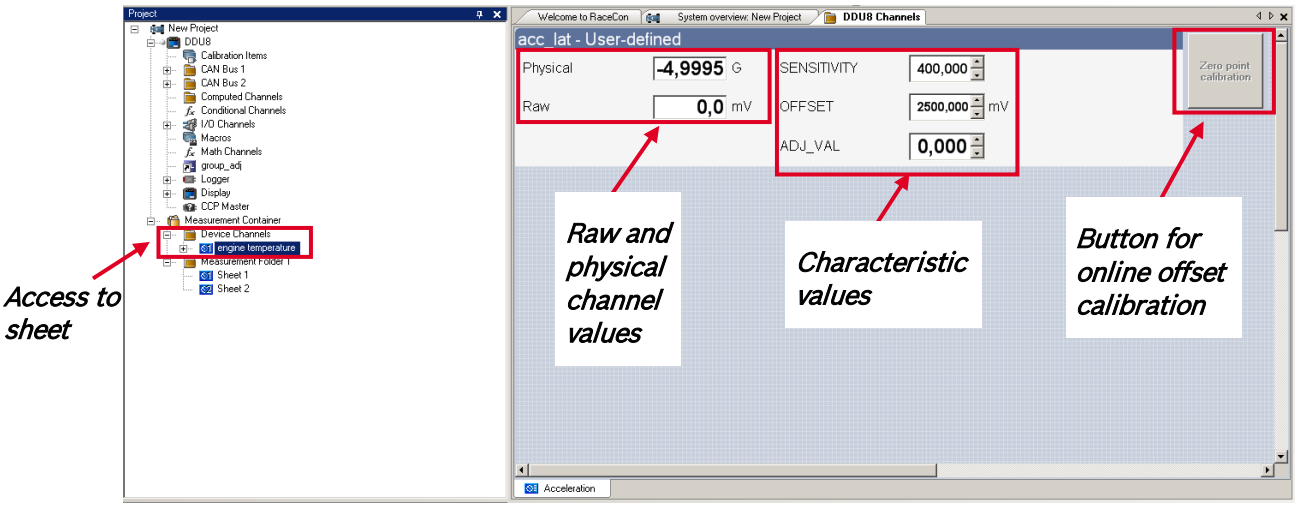
Select existing sheet from list or enter name of new sheet

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



Click to create measurement sheets

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.

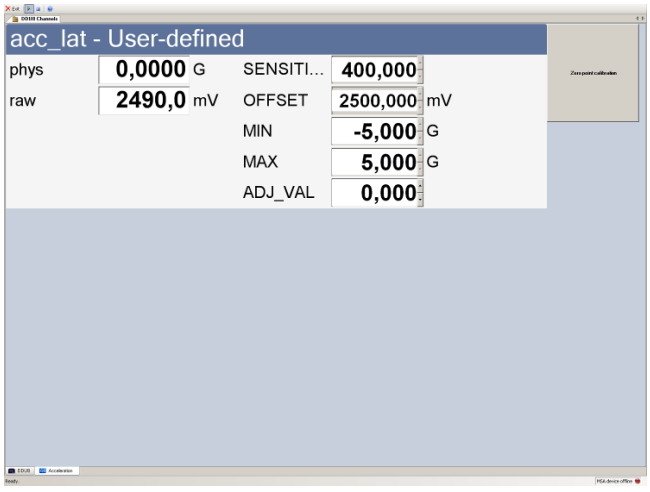


11.2.2 Using the measurement sheets

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.

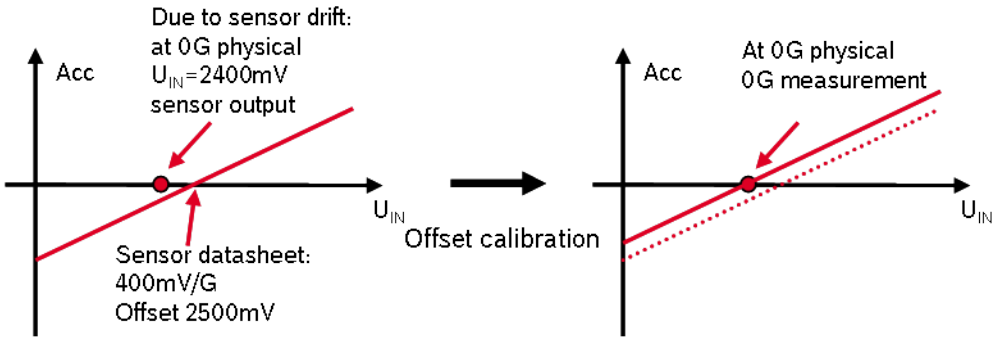
2. Switch between different sheets using the tabs at the bottom of the page or the keyboard shortcuts associated with the sheets.

3. Press the ‘Esc’ key to return to ‘Design Mode’.



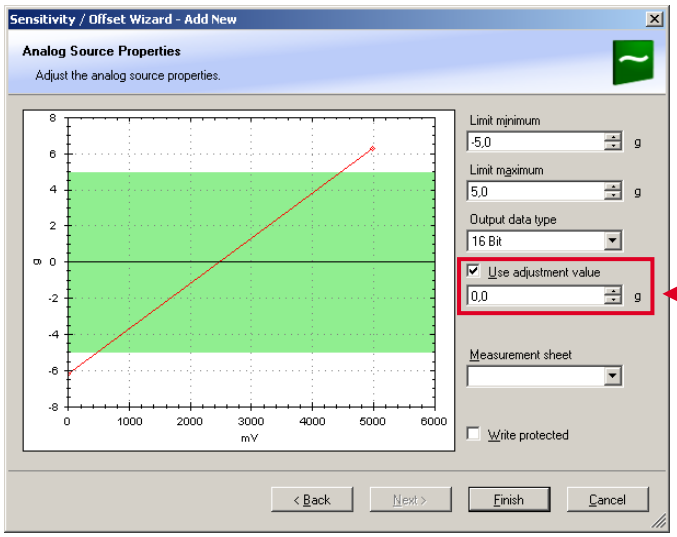
11.3 Online calibration of measurement channels

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



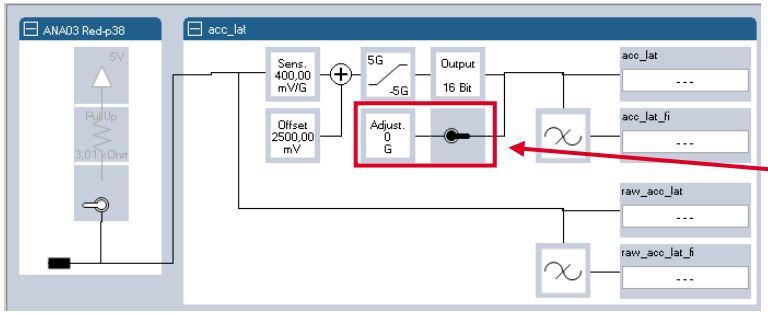
11.3.1 Enable online offset calibration for measurement channel

During creation of the measurement channel



Check box to enable online offset calibration and enter desired physical target value

In the channel view

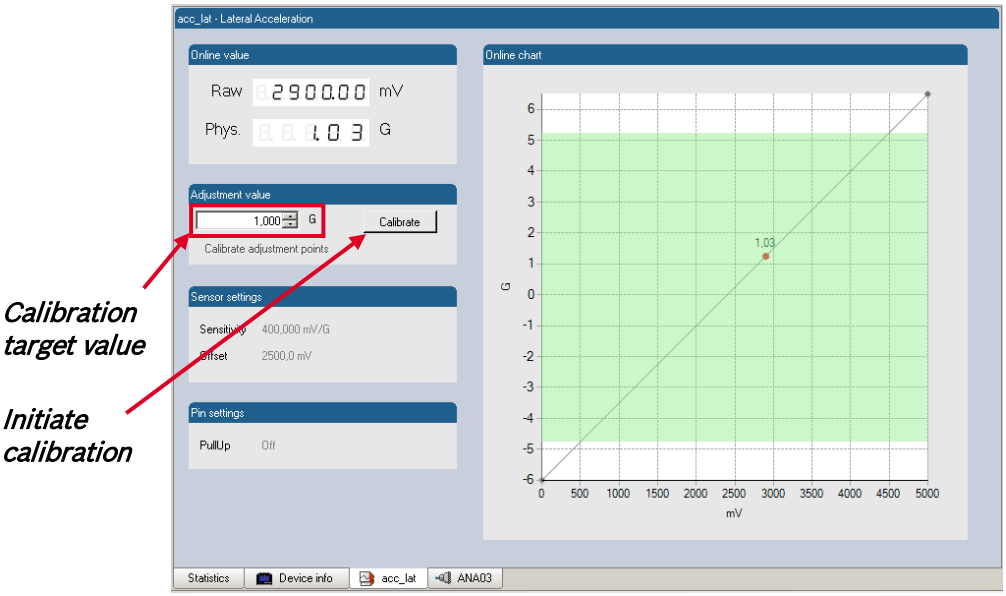


Activate switch to enable online calibration

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.

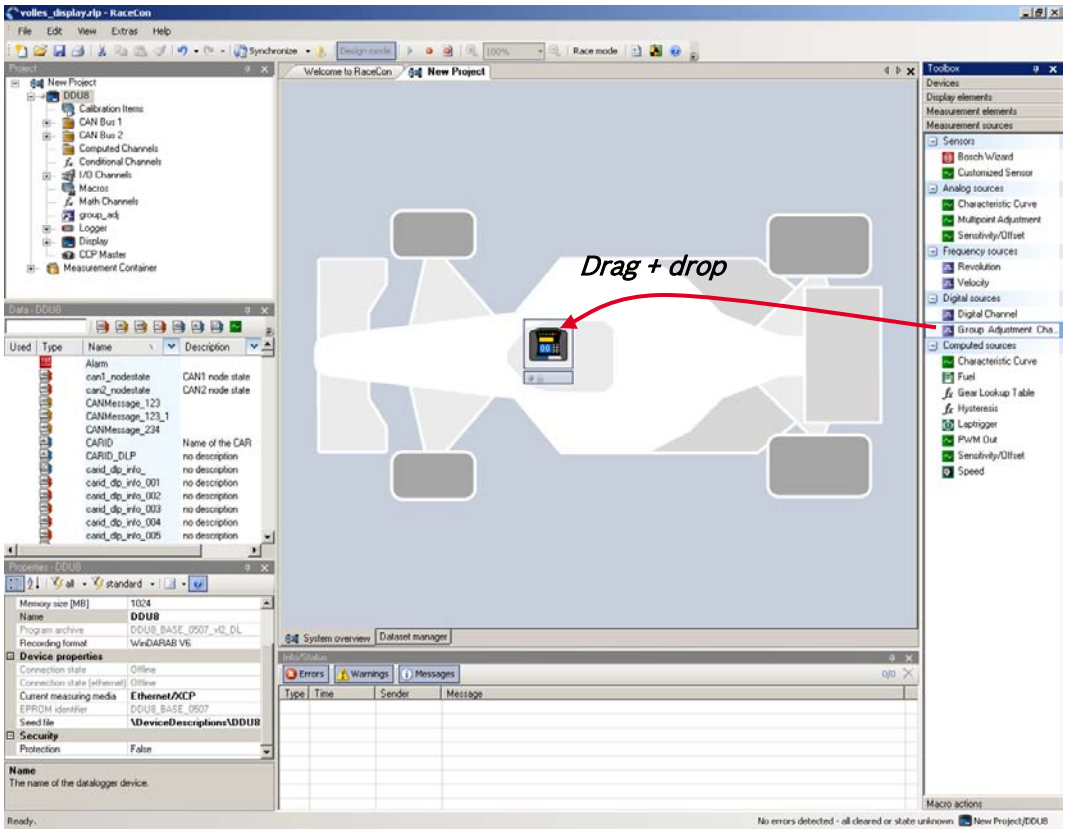
11.4.1 Configuration of group adjustment

Group adjustment consists of two components:

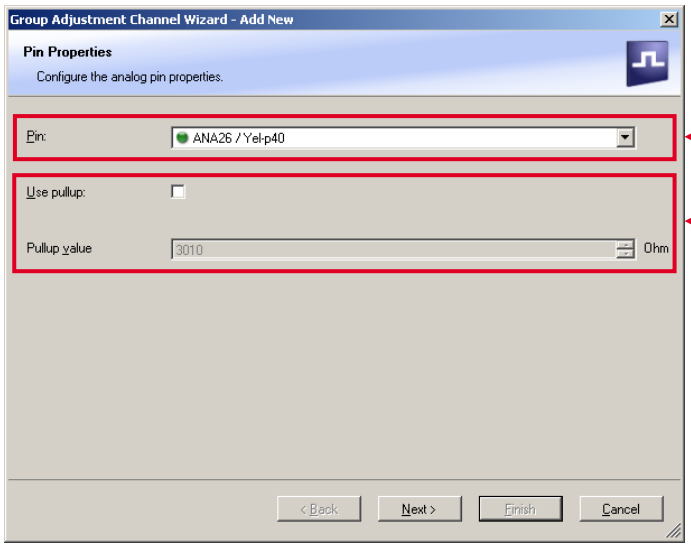
- An input channel which triggers the adjustment event
- A group of input channels linked to the group adjustment event

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.

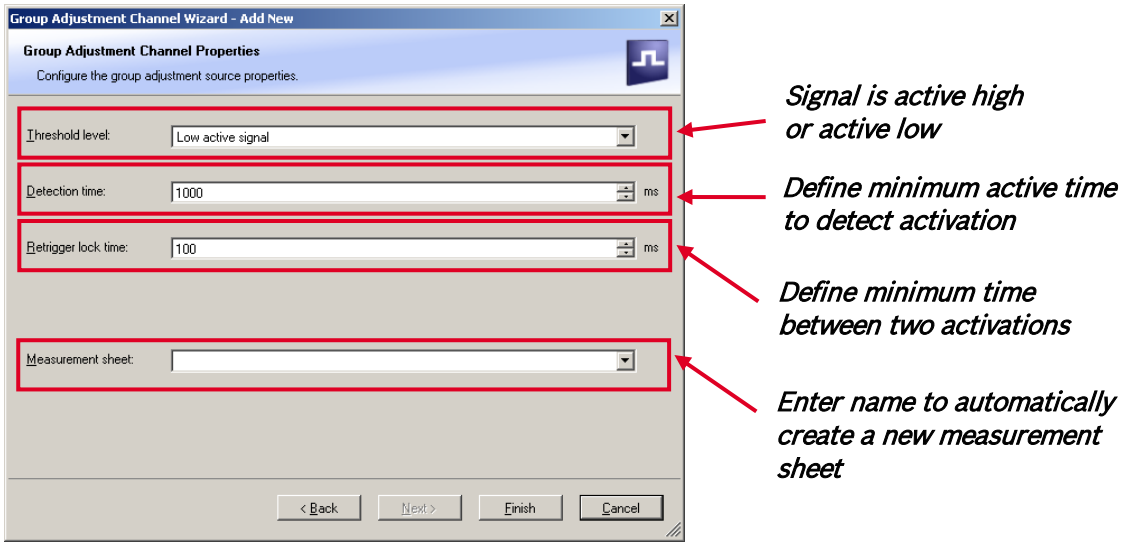


Select the pin to which the sensor shall be connected

Check the box to activate the internal DDU 8 pullup-resistor and set the resistor value

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.



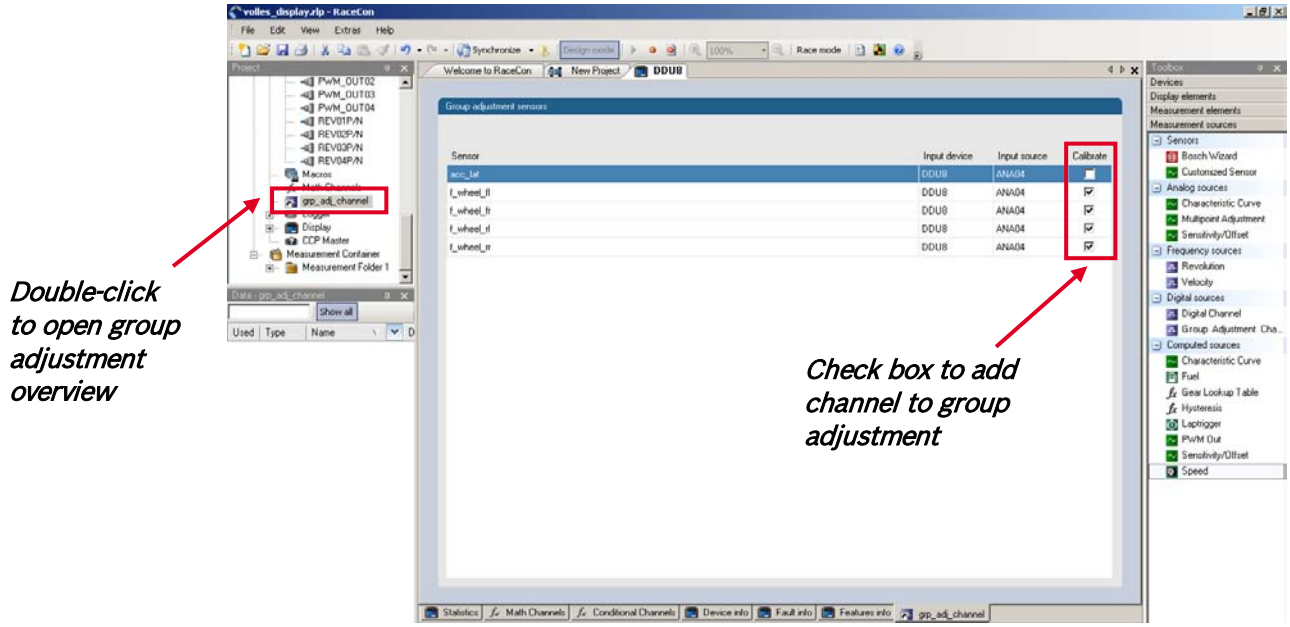
Note: Working with automatically created measurement sheets is explained in chapter ‘11.2 Setting up an online measurement’.

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.

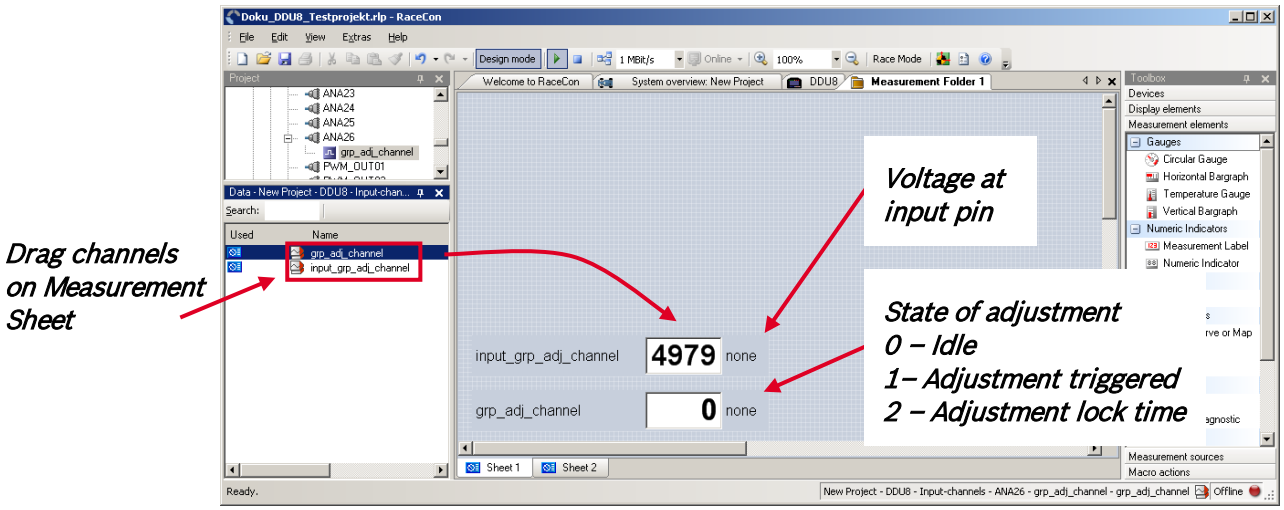
2. To add measurement channel(s) to the group adjustement event, check the ‘Calibrate’ box of the desired channel(s).



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.

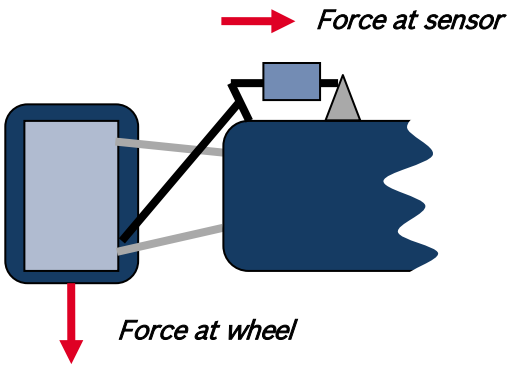


Hint: A display alarm can be linked to the trigger channel to indicate that the trigger has been detected.

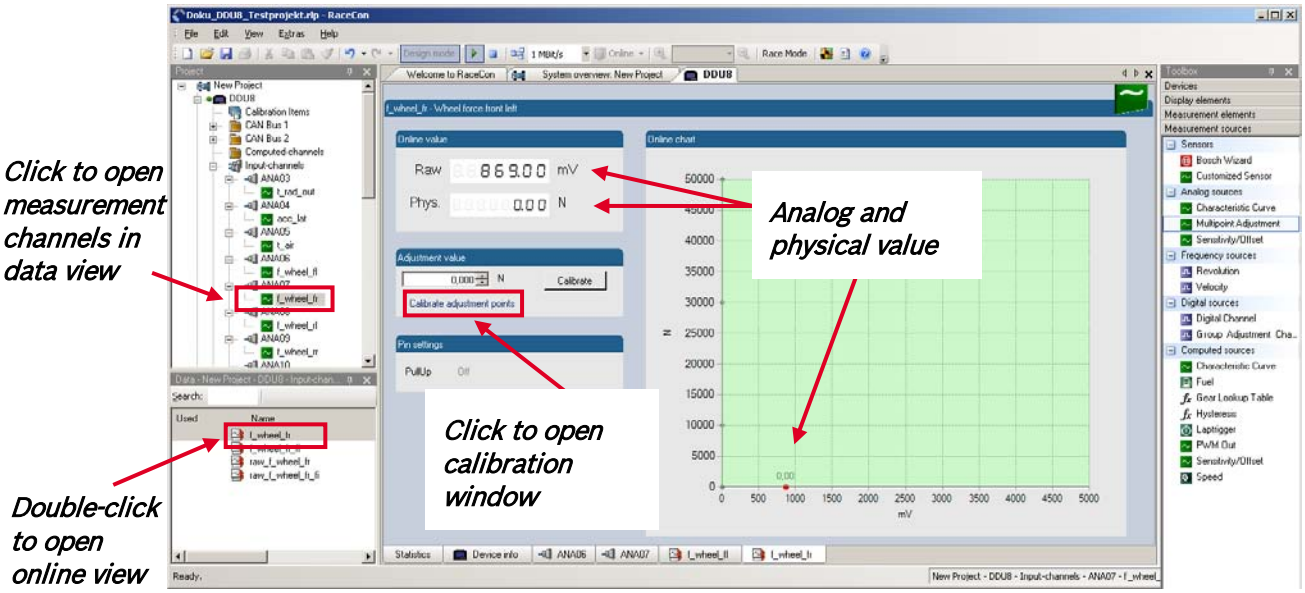
11.5 Online calibration of multipoint adjustment channels

Example: measurement of wheel force

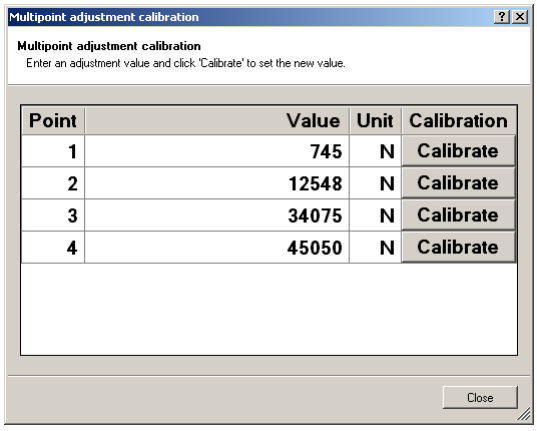
- Physical property ‘wheel force’ not directly measureable
- Load transfer through suspension kinematics
- Physical value at sensor position defined by vehicle
- Curve definition by online adjustment at vehicle



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.

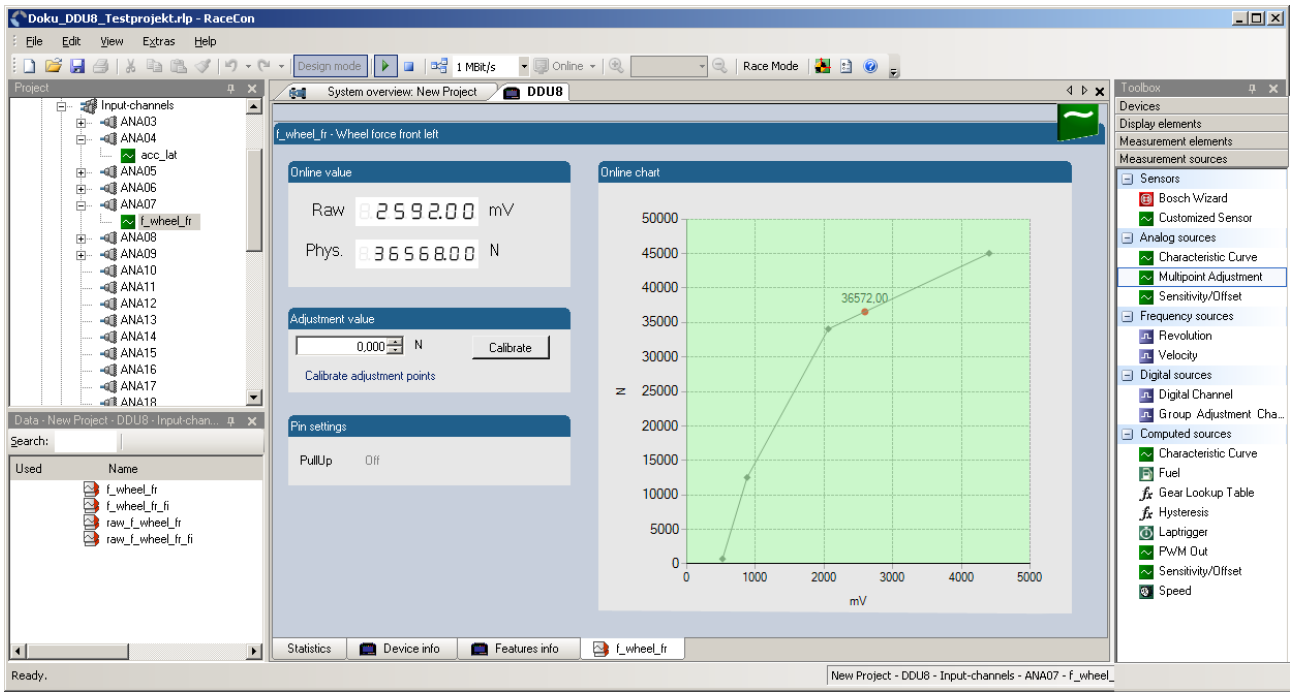


5. Click on ‘Calibrate adjustment points’ to open calibration window.

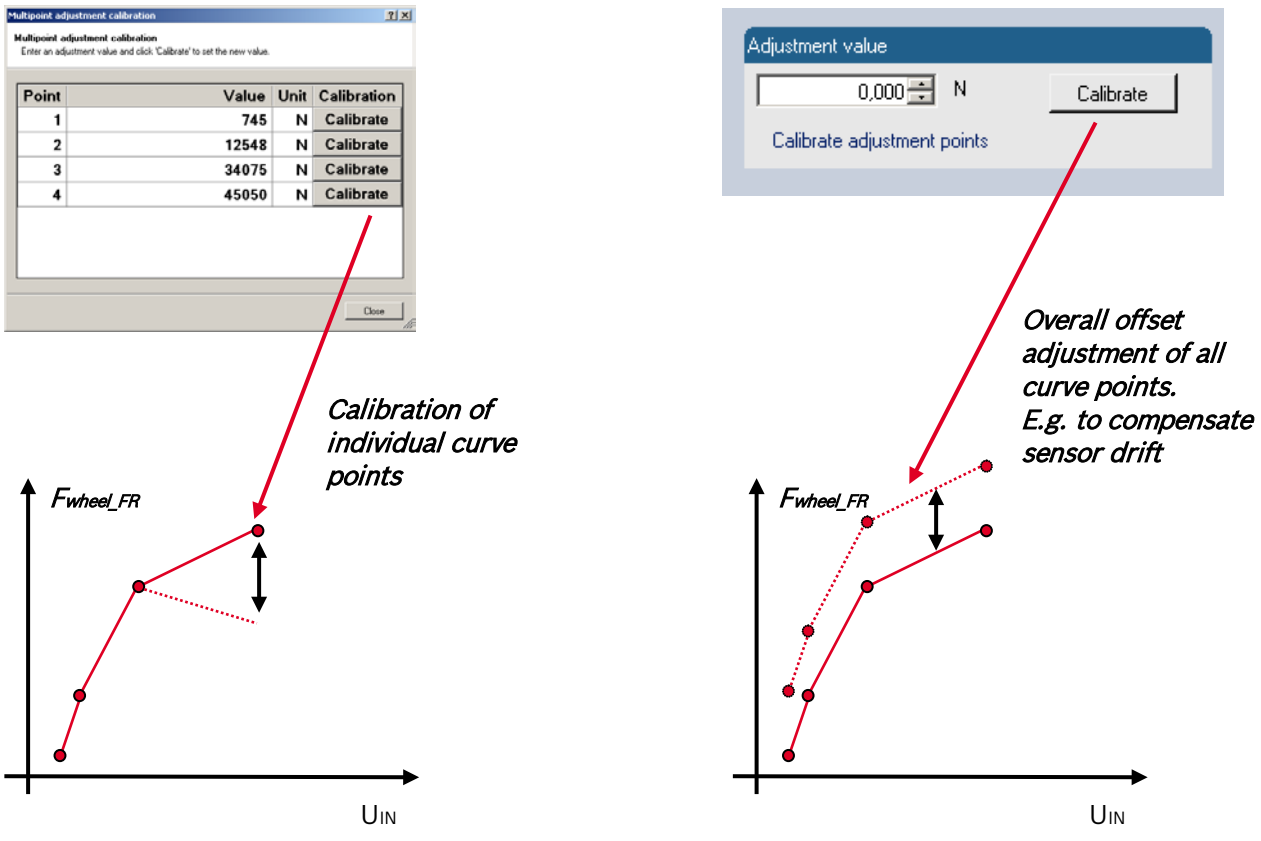


6. Apply the desired physical condition to the sensor (e.g. by applying a force on the wheel).
7. Enter the physical value in the value column of the desired calibration point (e.g. 745 N).
8. Press the ‘Calibrate’ button of the desired calibration point.
9. Repeat for all curve points.
10. Click ‘Close’ 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

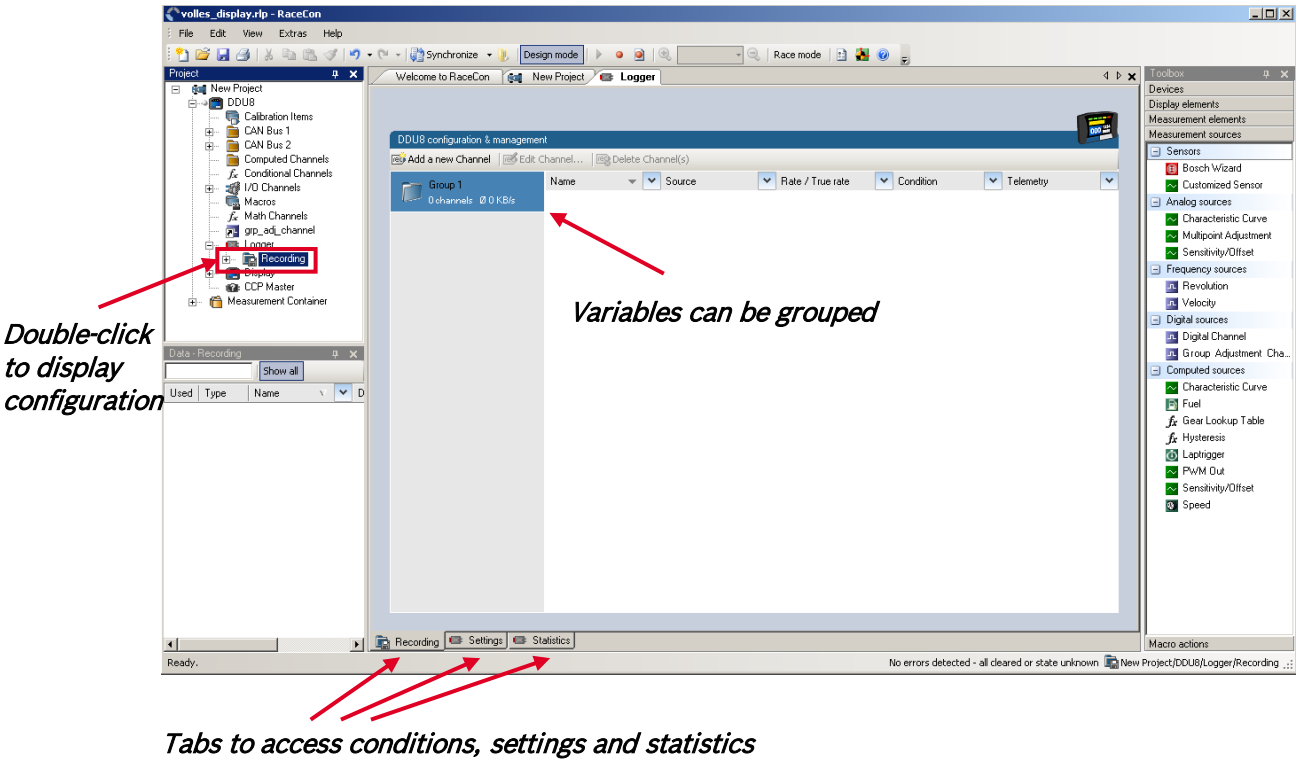
Burst telemetry

- 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.

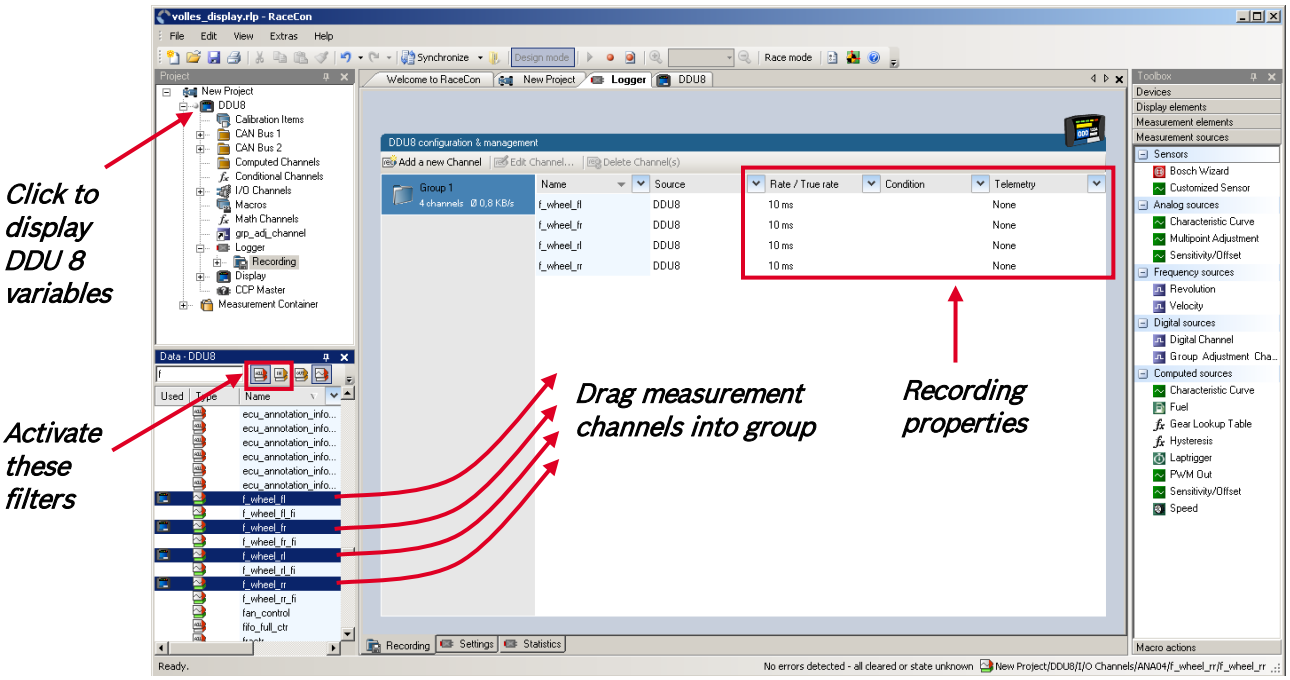
The recording configuration is displayed in the Main Area.



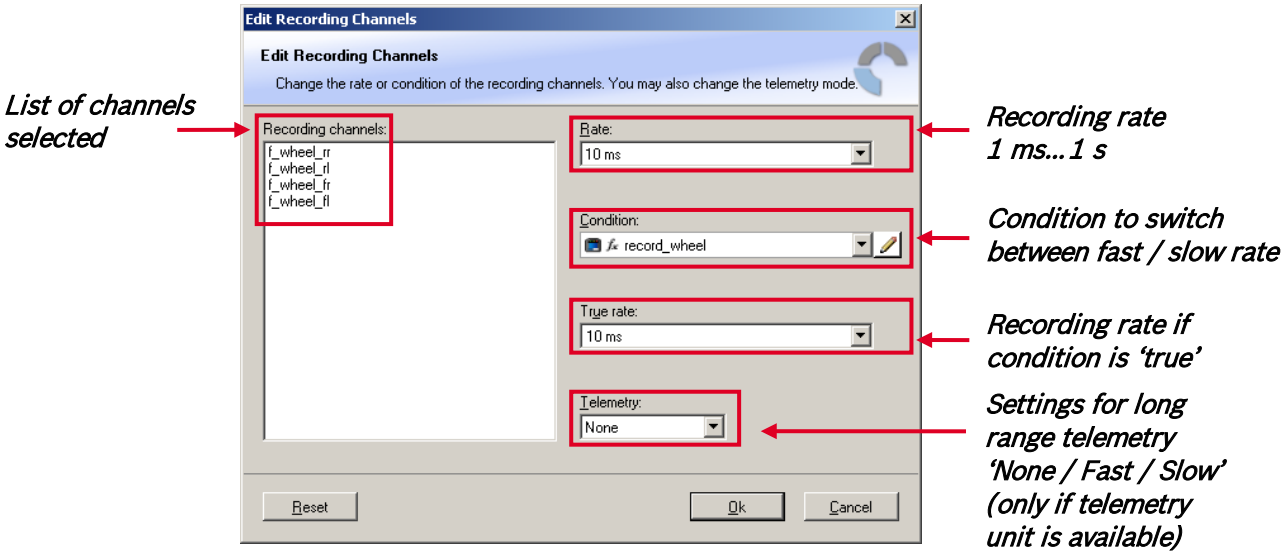
3. To add measurement channels to a recording, click ‘DDU 8’ in the DDU 8 Project Tree.

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.



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).

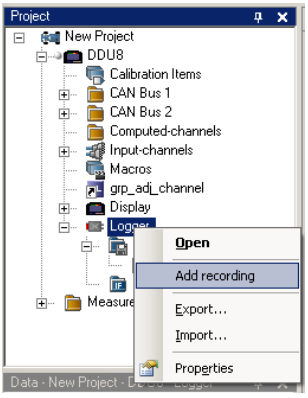
Transmission Scheme

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.

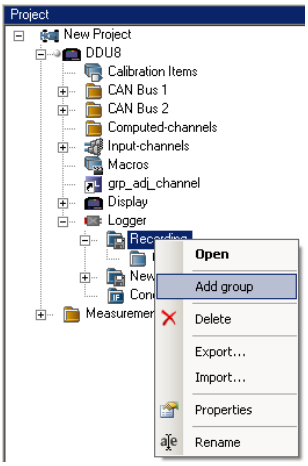
To add a recording, select ‘Add Recording’ from the context menu of the Logger in the DDU 8 Project Tree.



12.2.2 Adding a recording group

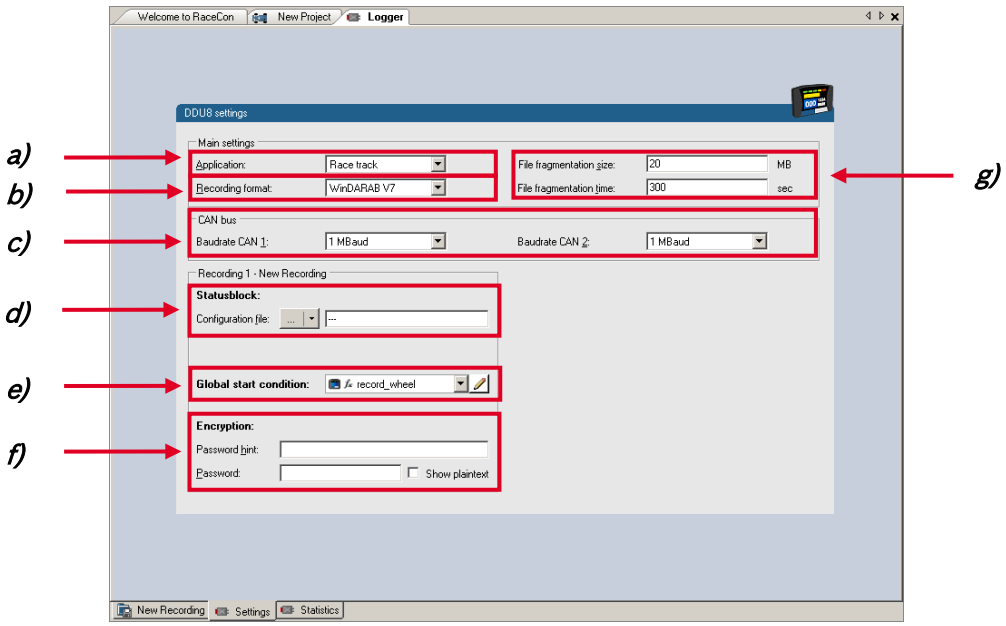
Recording channels can be grouped.

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:

- 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)

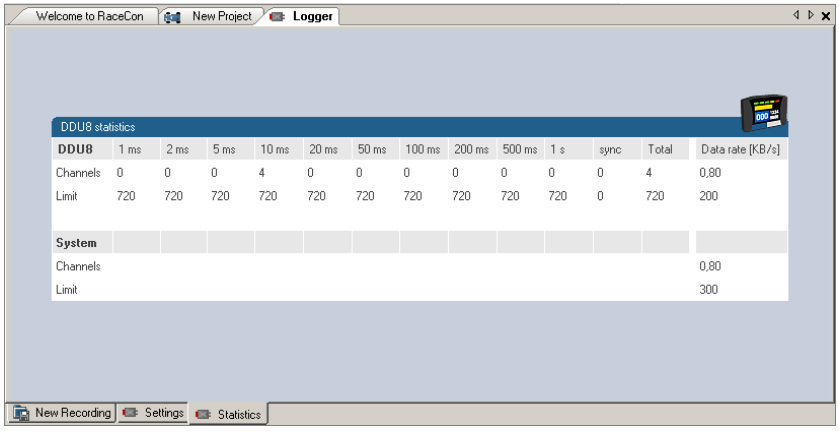
g) Setting for automatic fragmentation. Do not change!

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.



12.2.5 Recording diagnosis

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

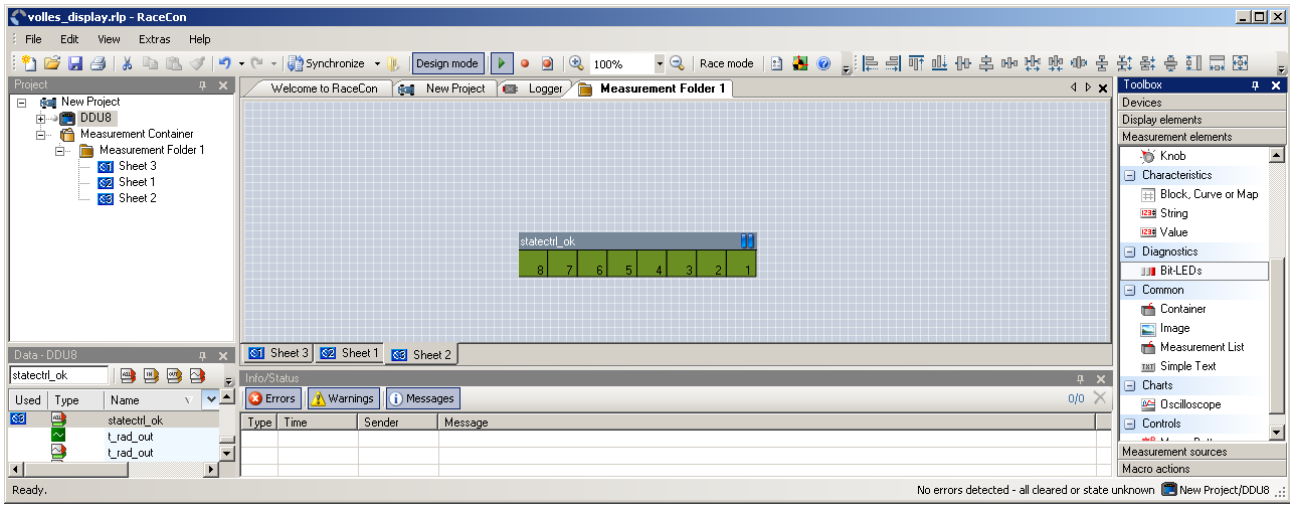
Bit	Value	Name
0	1	RECORD
1	2	DATAOK
2	4	BLKOK
3	8	-
4	16	-
5	32	-
6	64	STARTED
7	128	-

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.



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.

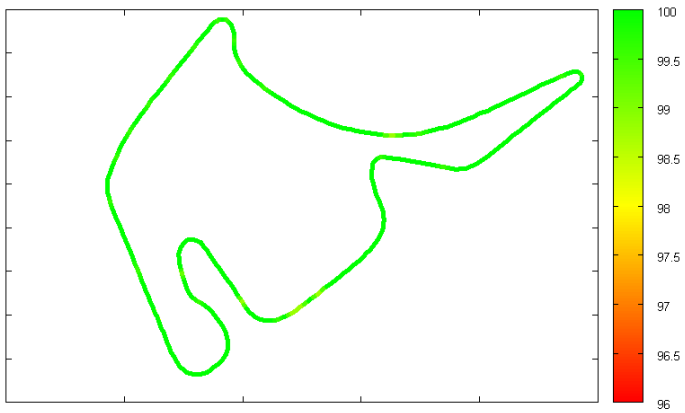
- Measurement correctly initialized, but recording threshold(s) not reached: 254
- Measurement correctly initialized, DDU 8 is recording data: 255
- Values less than 254 indicate an error state
- ‘statectrl_ok’ can be linked to an alarm on the display. See chapter ‘8.2.3 ‘Alarm’ display element’ for details.

12.3 Configuration of online telemetry

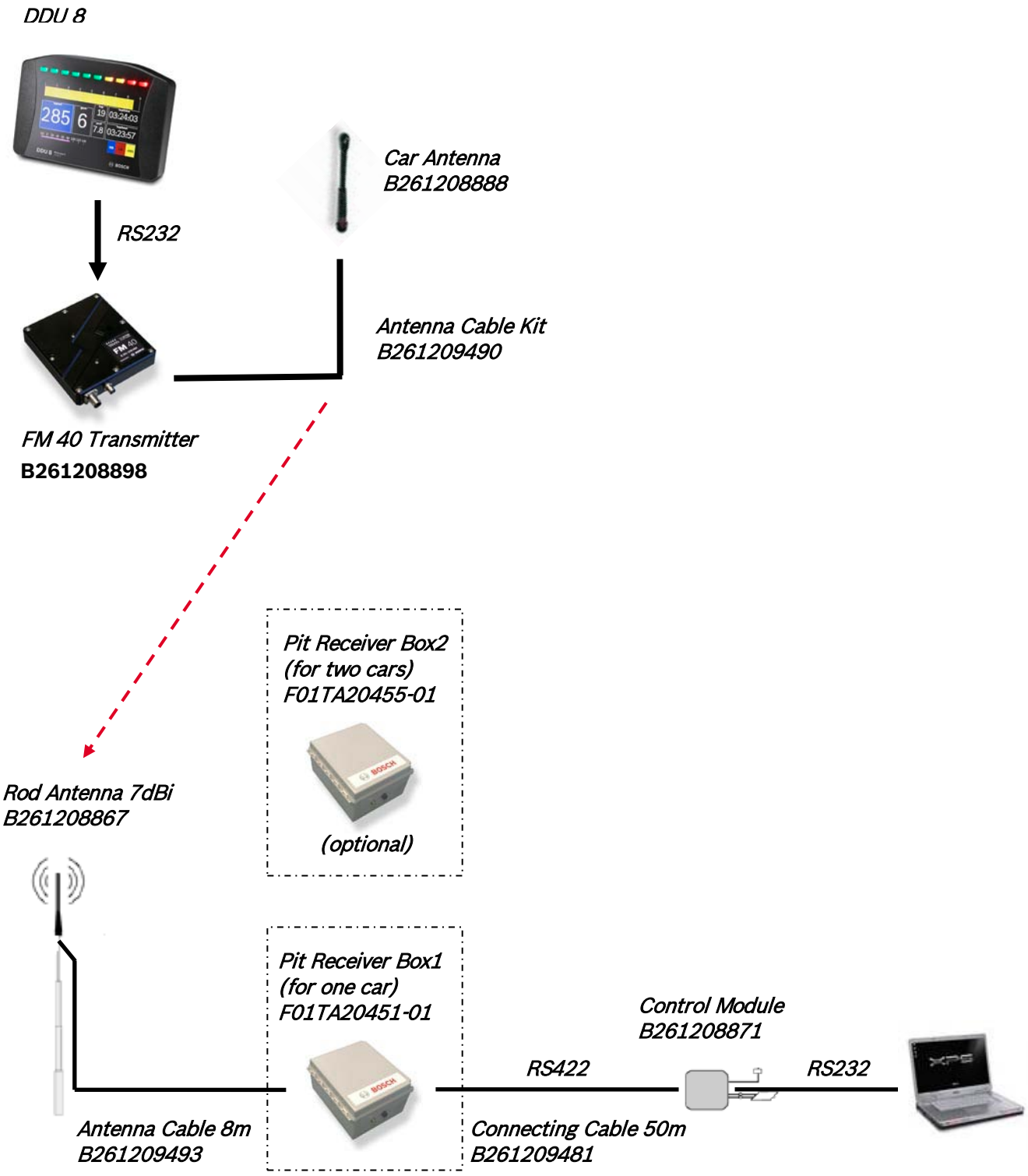
12.3.1 Long range telemetry system FM 40

- 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

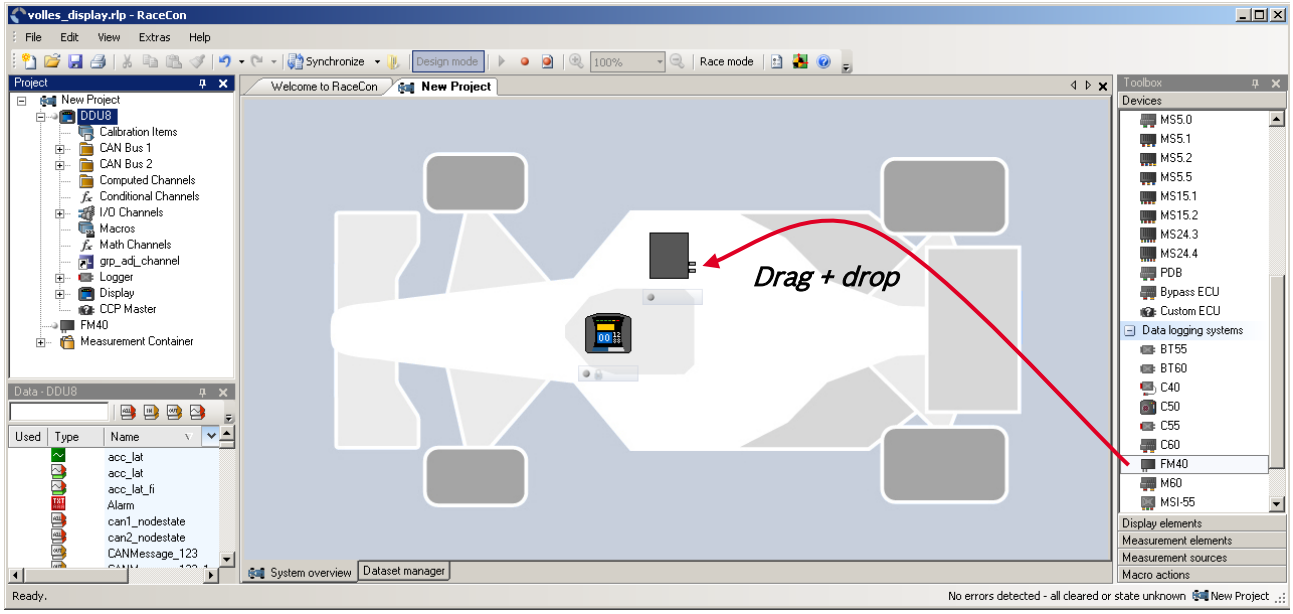


12.3.2 Hardware setup

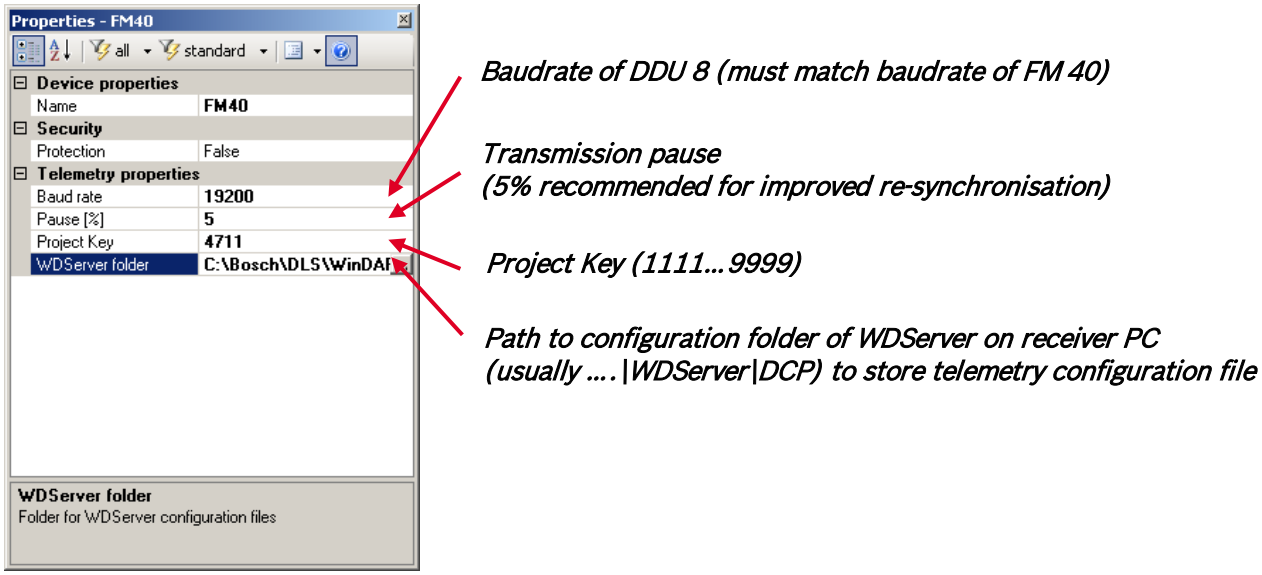


12.3.3 Software setup

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.

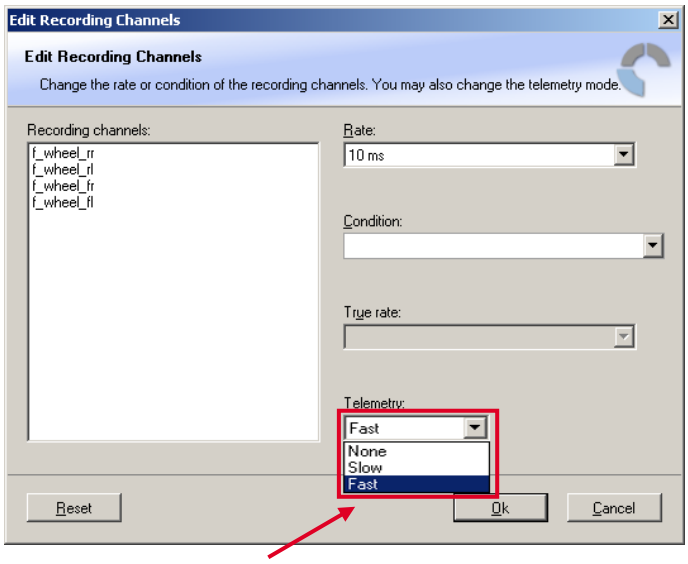
The recording configuration is displayed in the Main Area.

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’.



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

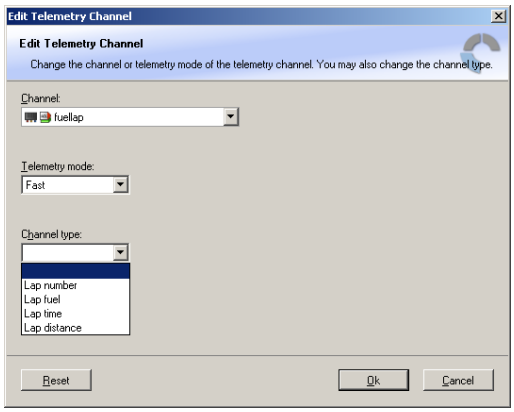
The FM 40 allows the transmission of special information such as running distance of current lap, lap number of current lap and lap time, fuel consumption of last lap completed. You have to assign the channel type to the telemetry channel so that it is recognized accurately by RaceCon.
Channel's names 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.

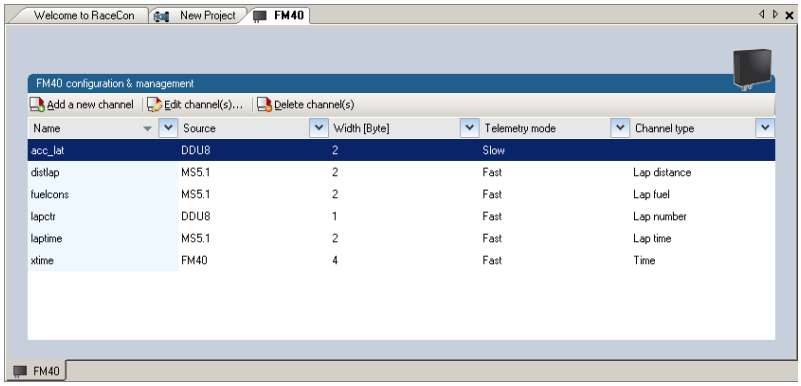


4. Choose the channel type. The table below shows the function of the available channel types.

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.

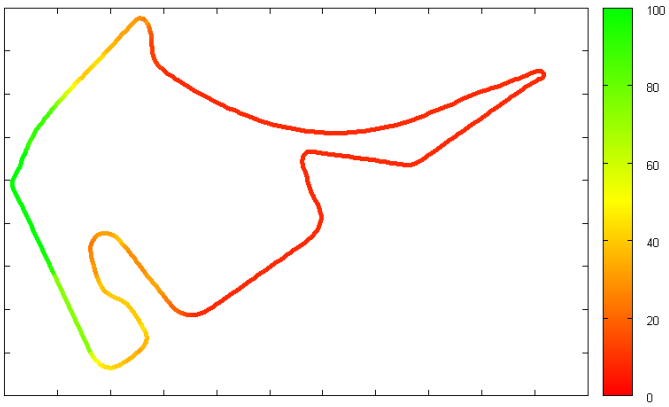


12.4 Configuration of burst telemetry

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

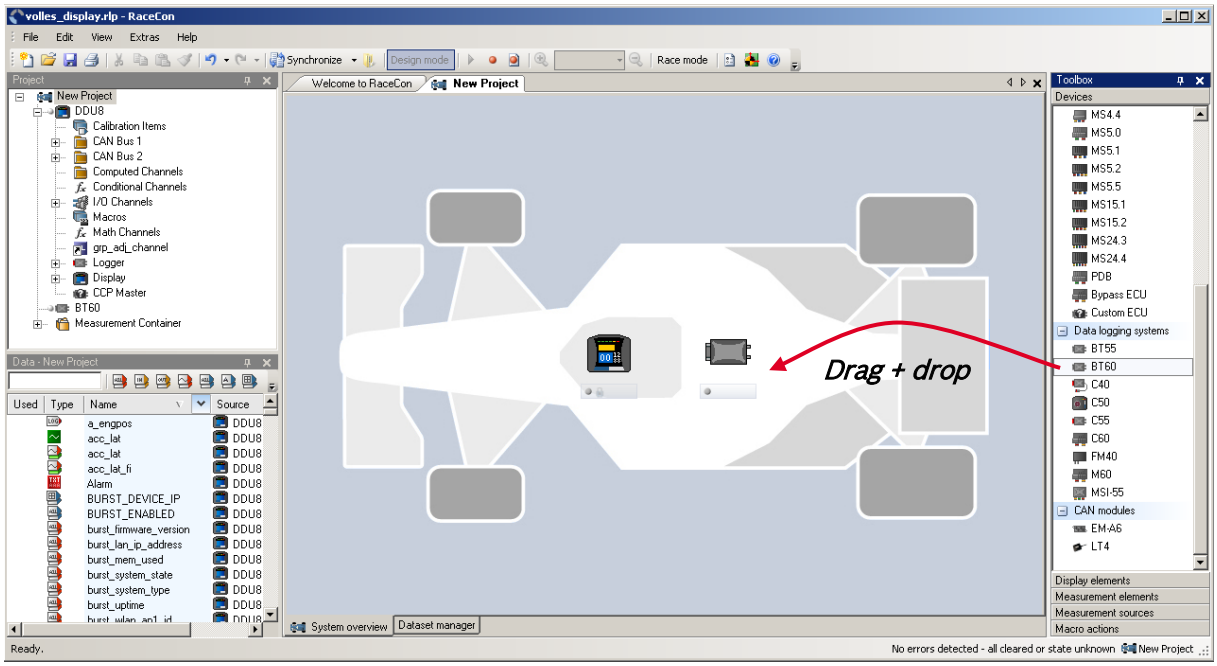


12.4.2 Hardware setup

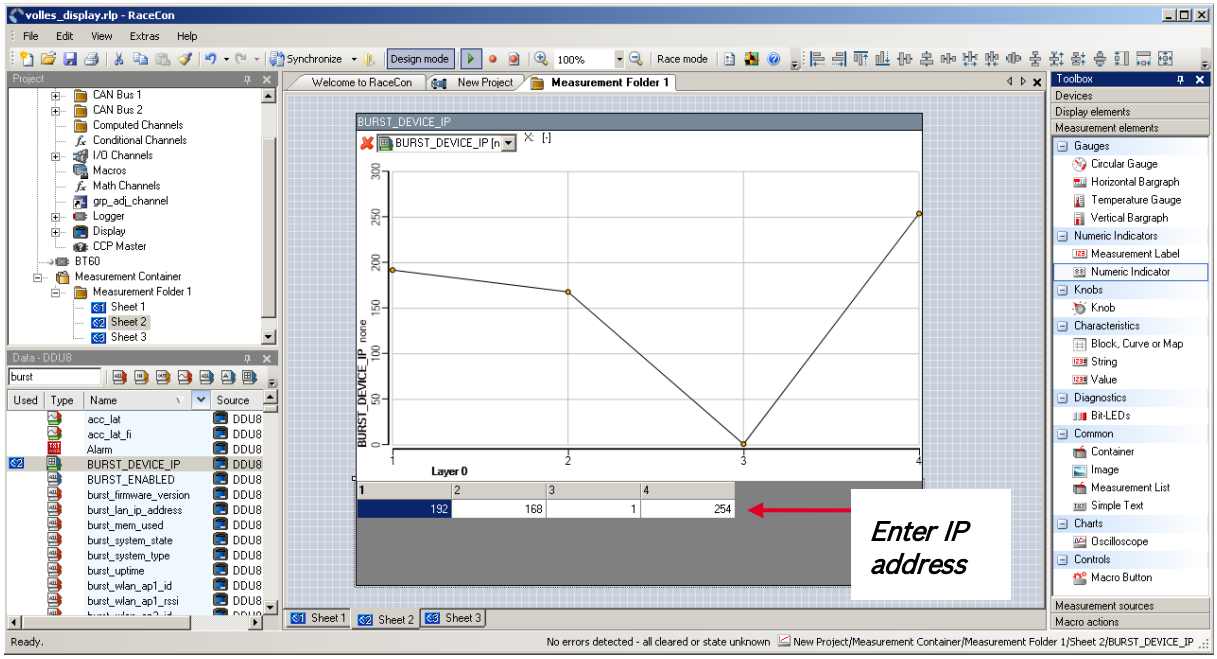
12.4.3 Software setup

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.

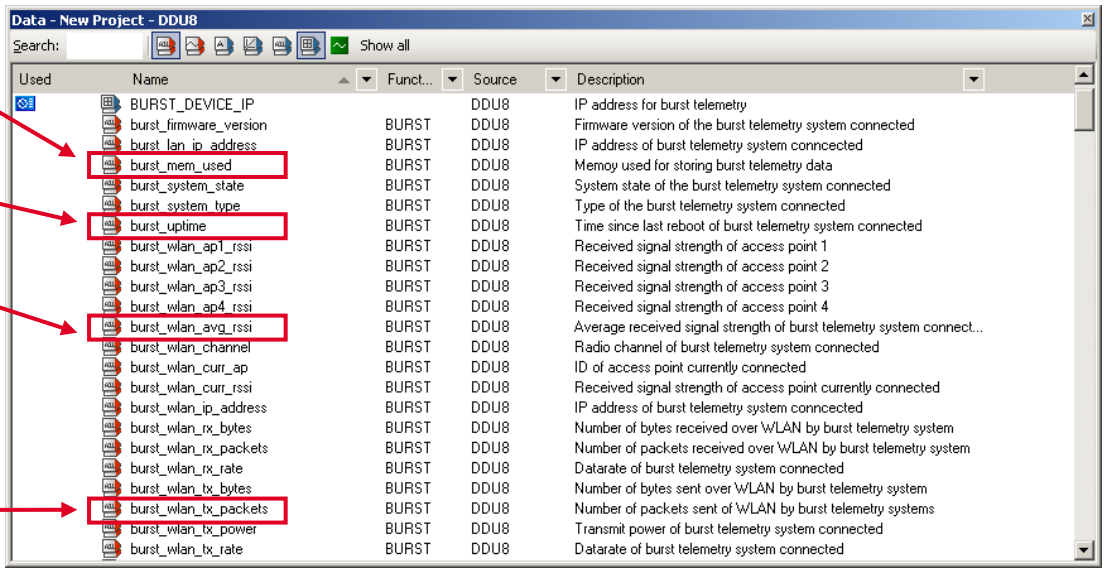
To display a channel, drag a channel from Data Area to the measurement sheet.

Data ready for transmission

DDU 8 connected to BT60

Signal quality of radio link:
-55 dBm: good
-70 dBm: fair
-95 dBm: no link

Byte counter for data transmission over radio link



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.

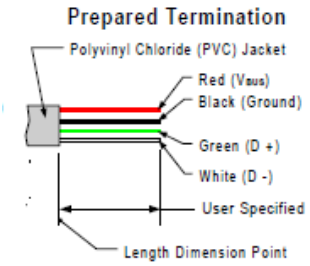
Note: For USB recording, Software Upgrade 1 also has to be enabled.

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.

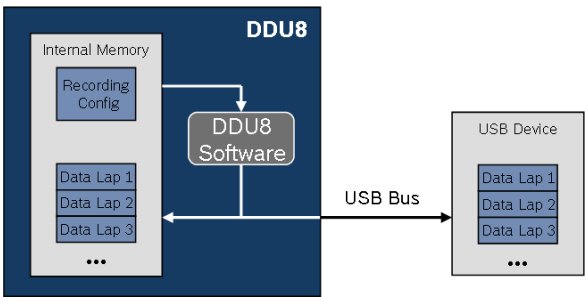
To format the USB device with the Bosch File System (BFS), do the following steps:

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’.

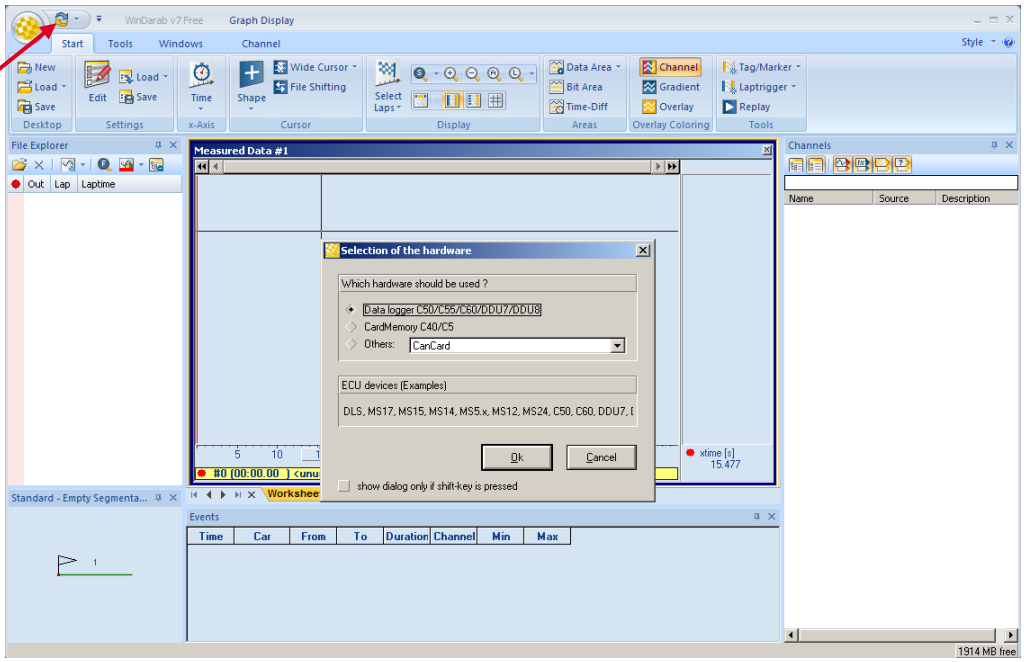
An USB device is recognized by Windows as a ‘storage medium’, but it can only be initialized with RaceCon and read with WinDarab.

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.

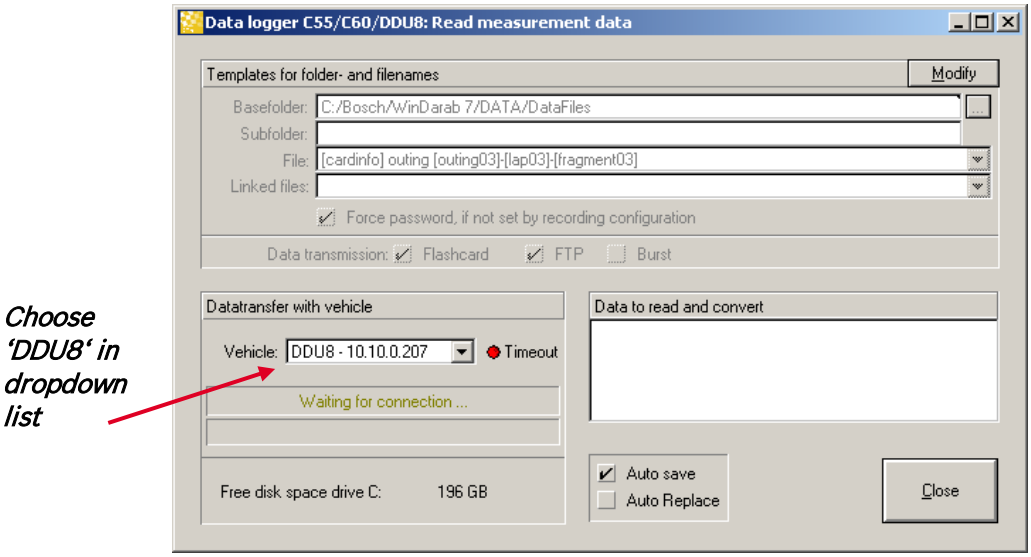


6. Power off the system.
7. Remove USB device from the vehicle.
8. Start the WinDarab software.
9. Click on the ‘Import/Export’ icon.
10. Select ‘Data logger C50/C55/C60/DDU7/DDU8’ and click ‘OK’ when done.

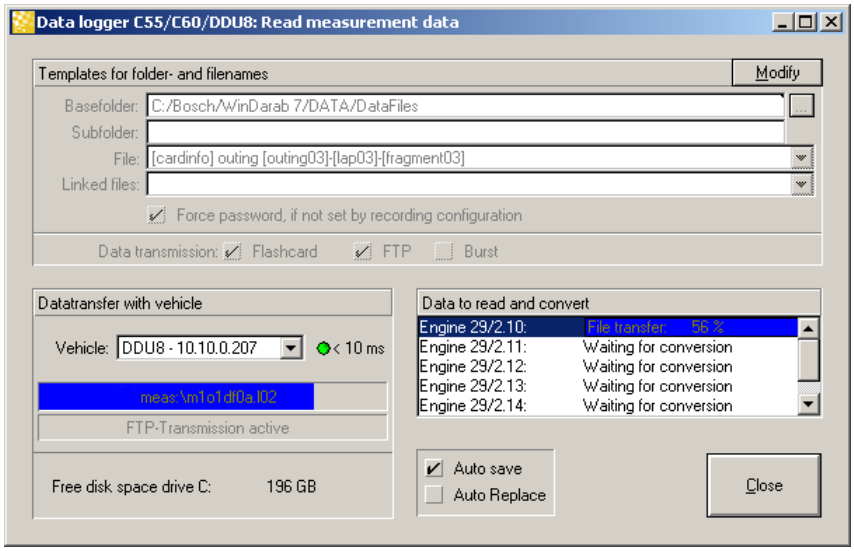


The ‘Read measurement data’ dialog opens.

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.



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



17. Click ‘Close’ when transmission has finished.

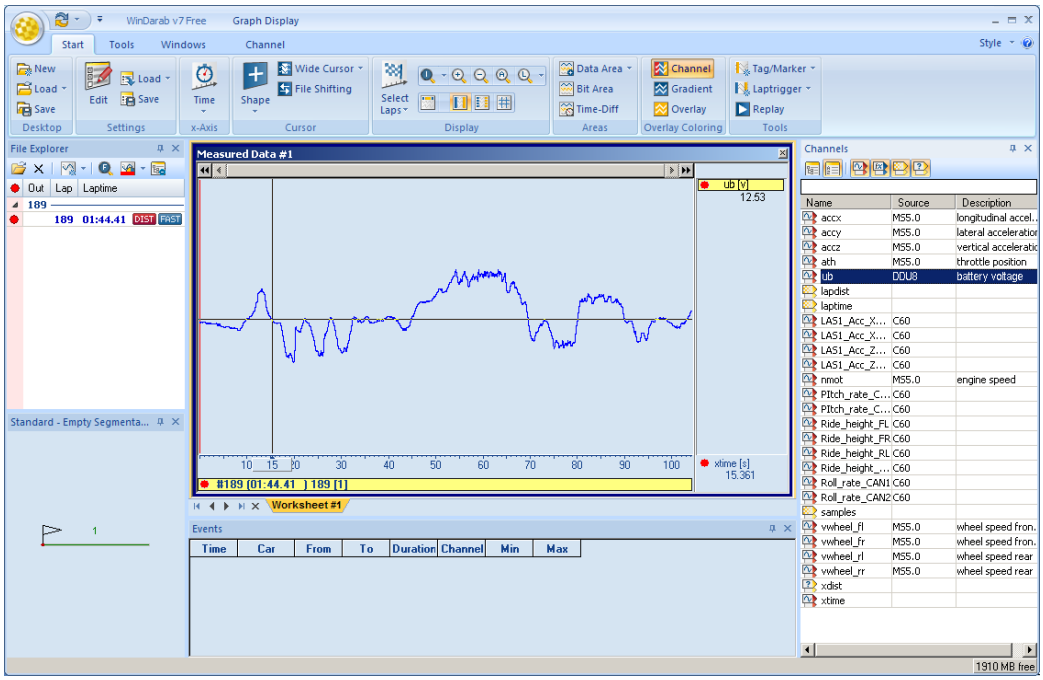
18. Click on the Start button and choose ‘Open measurement file’.

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.



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

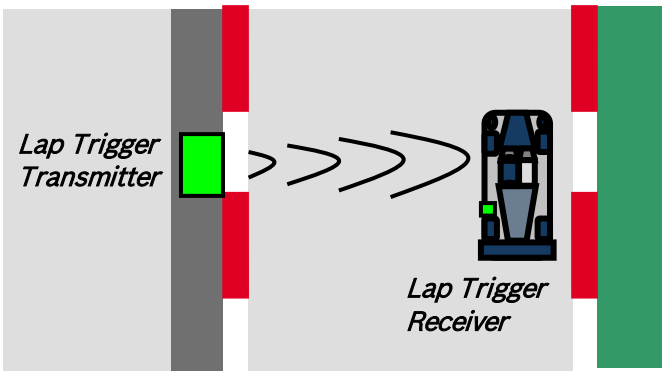
13.1 Lap trigger (timing beacon)

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)

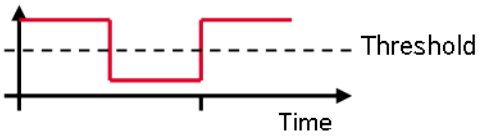
13.1.1 Electrical trigger signal

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

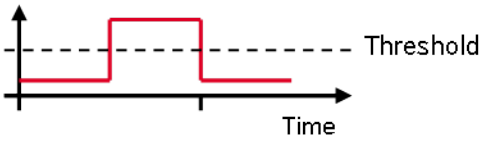
- Analog input
- Digital input
- CAN input

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

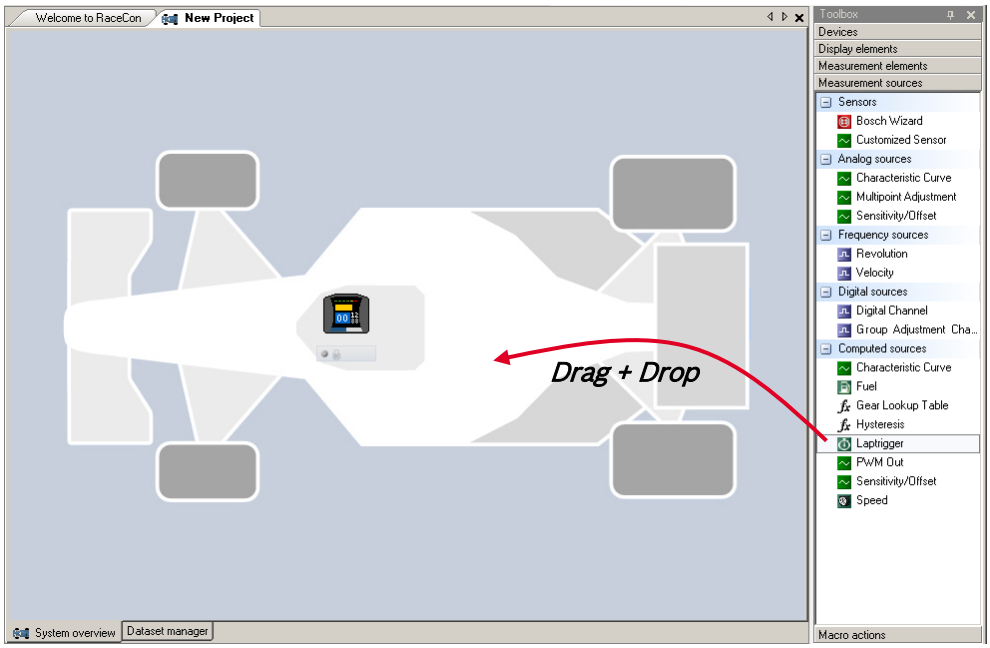
- Minimum vehicle speed for acceptance of trigger prevents false triggers while vehicle is stationary in the pits.
- Time based re-trigger protection prevents false triggers due to signal reflections on main straight.
- Lap distance based retrigger protection prevents false triggers due to track topology.

13.1.4 Forced triggers

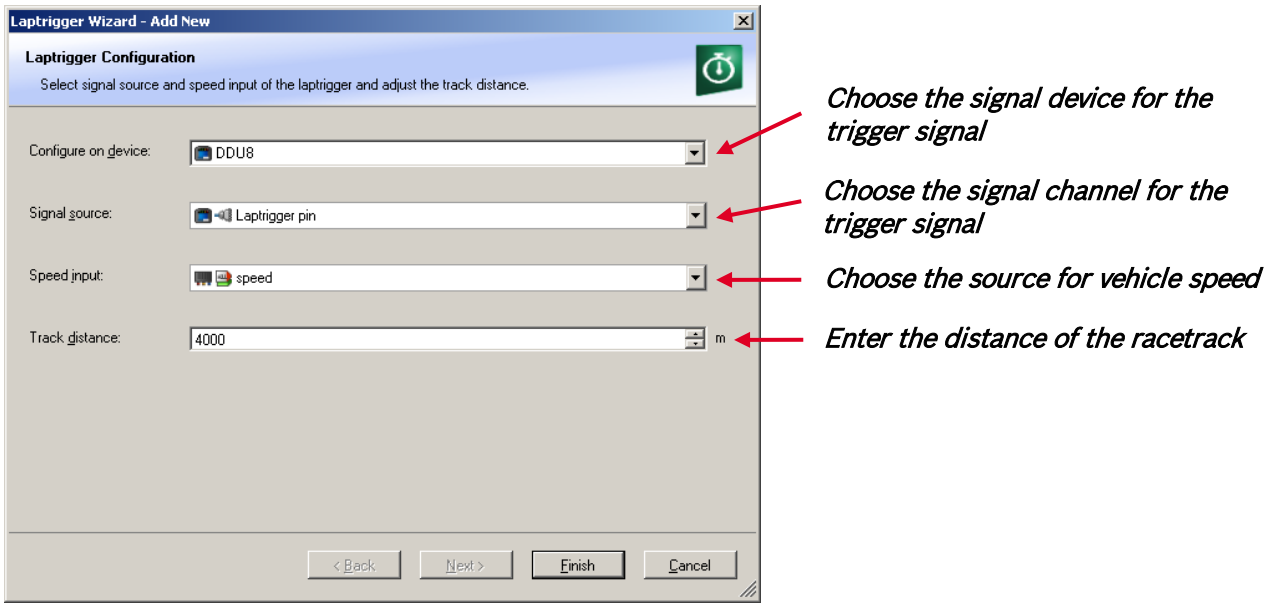
Lap distance based insertion of 'forced trigger'.

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’!



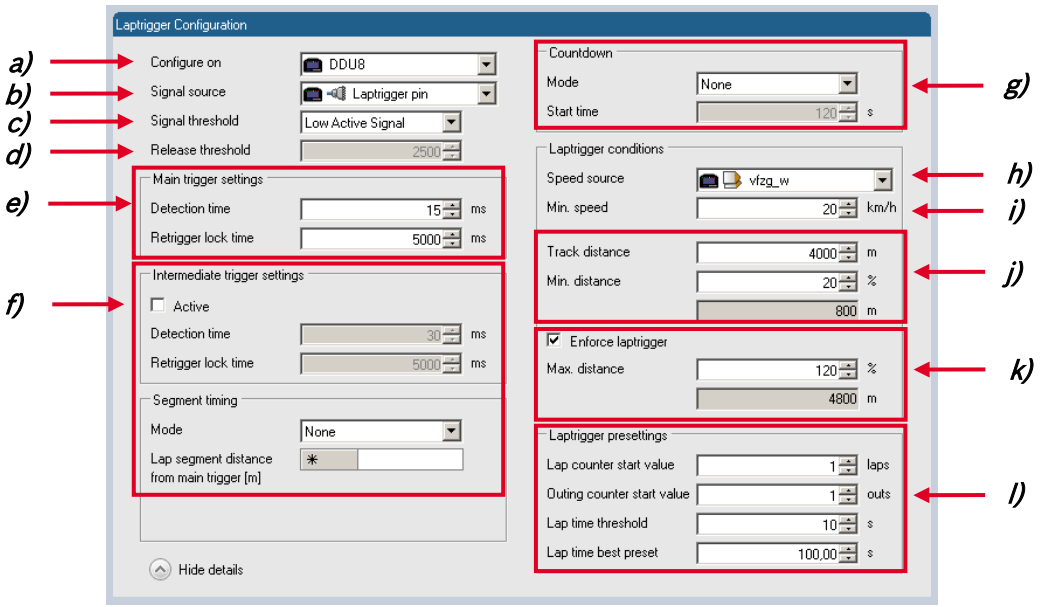
A ‘Laptrigger Wizard’ window opens.



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.



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.

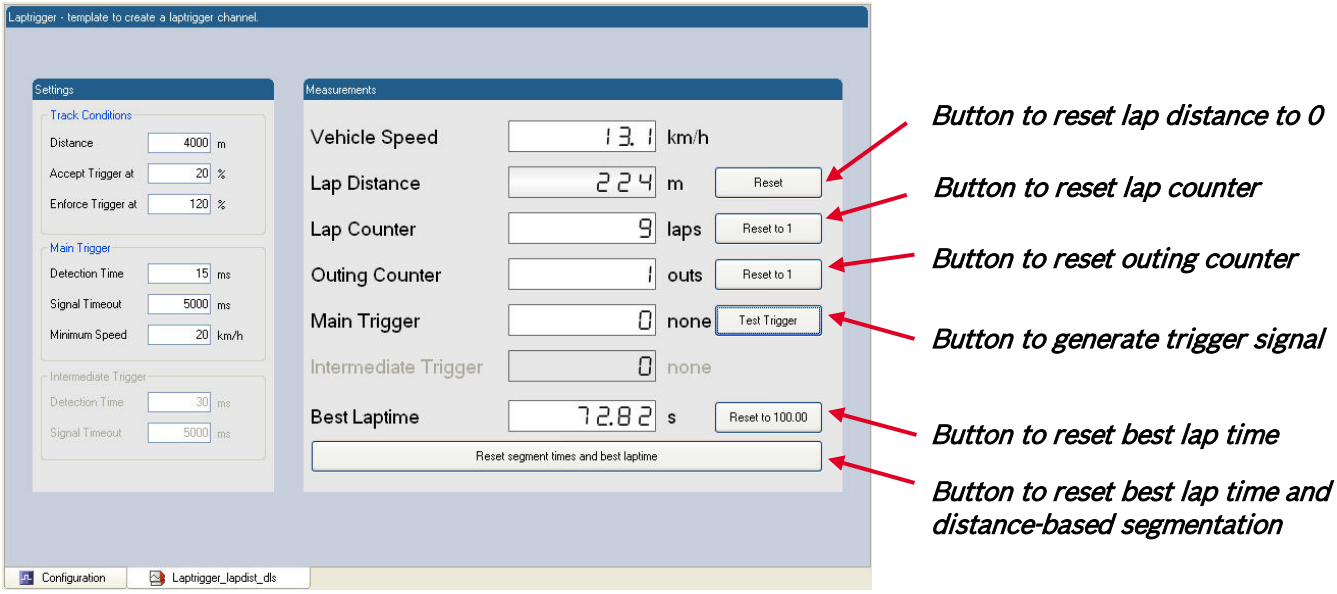
k) Define settings for distance based forced trigger. See chapter ‘13.3.3 Distance based forced trigger’ for details.

l) Define presettings for trigger. See chapter ‘13.1.7 Lap trigger presettings’ for details.

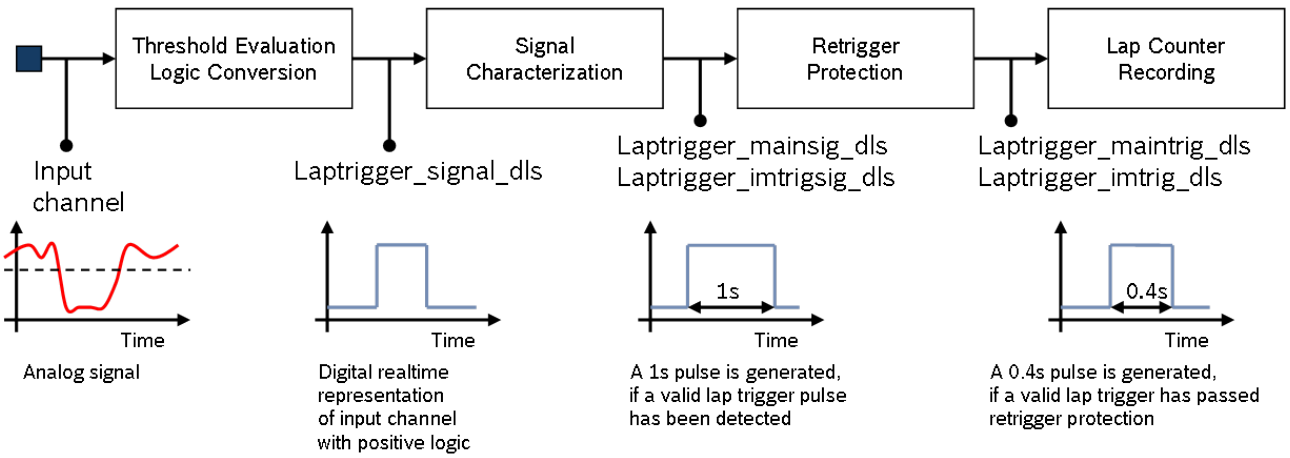
13.1.6 Lap trigger channel diagnosis / counter reset

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.

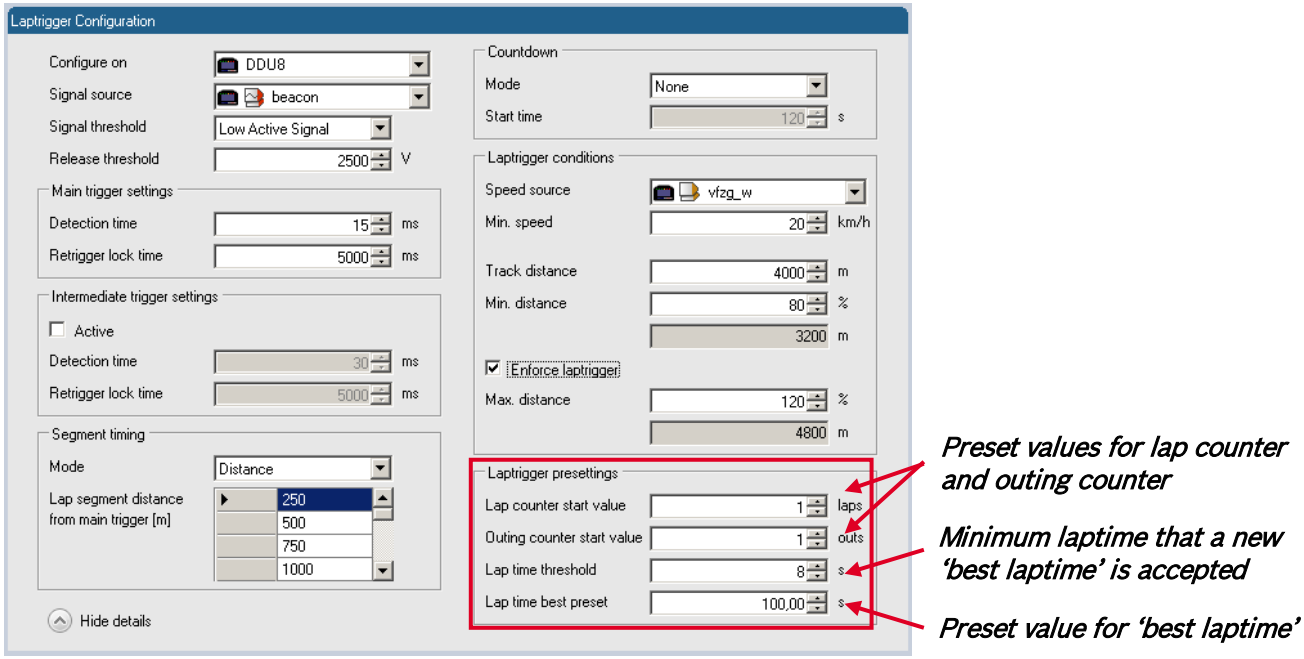


Lap trigger diagnosis scheme

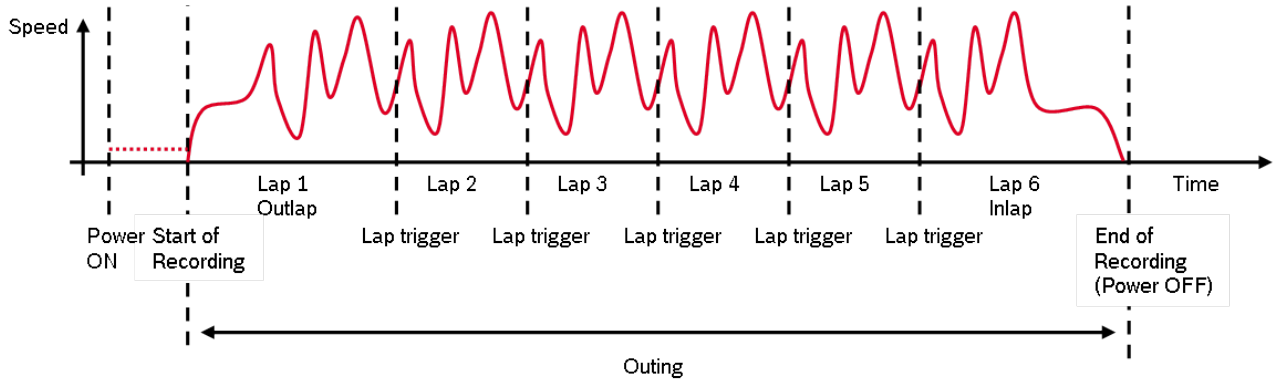


13.1.7 Lap trigger presettings

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



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

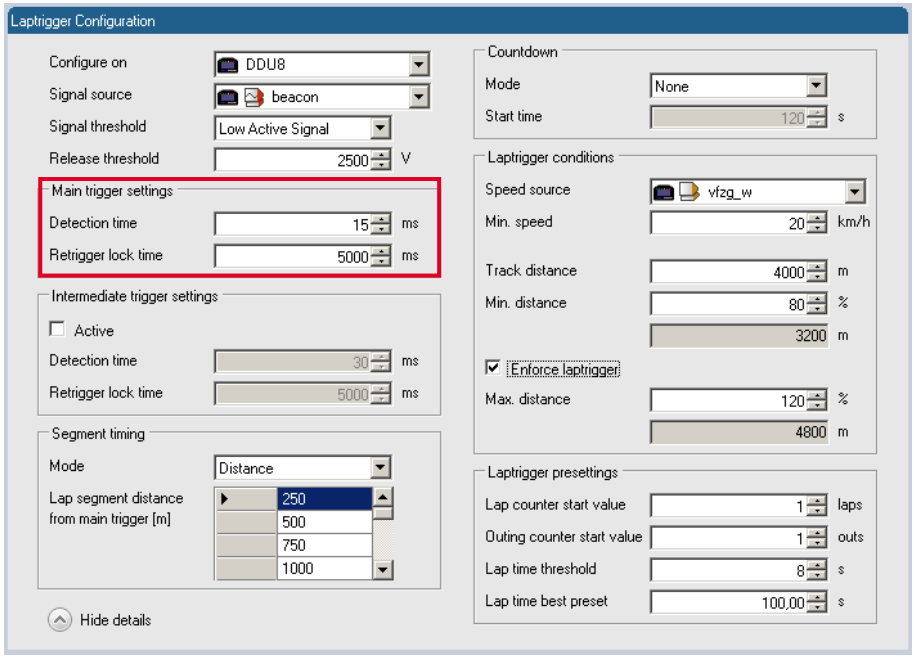
To display lap times use the following channels:

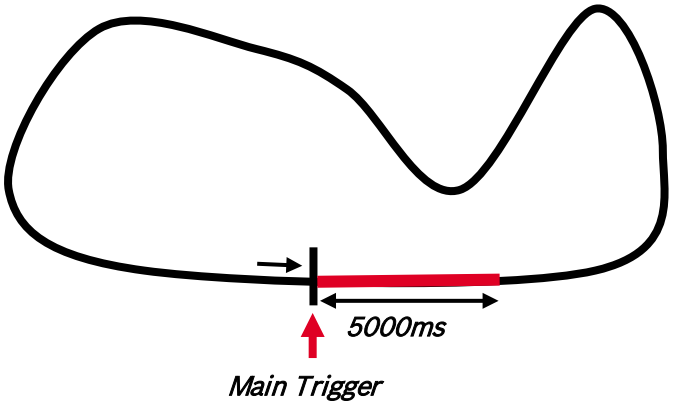
Channel	Function
Laptrigger_lapcurr_dls	Current lap number
Laptrigger_lapctr_dls	Number of completed laps
Laptrigger_laptime_dls	Running laptime
Laptrigger_laptime_best_dls	Laptime of best lap
Laptrigger_laptimeold_dls	Laptime of last lap completed
Laptrigger_laptimeseg_dls	Segment time of last segment

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.

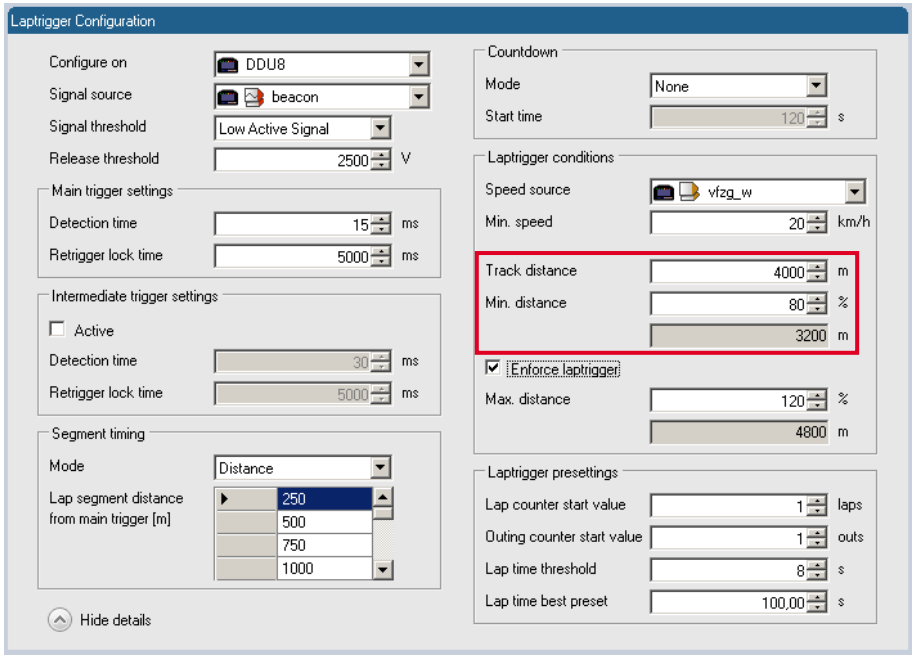


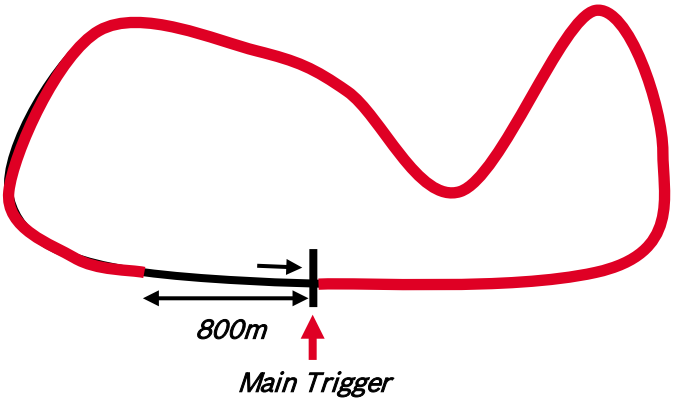


13.3.2 Distance based retrigger protection

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

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

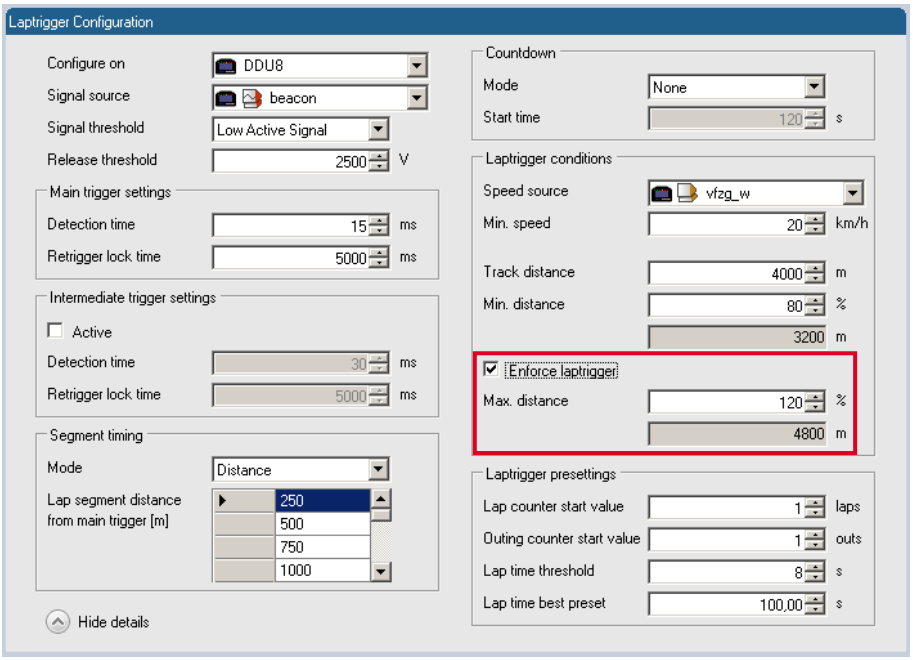


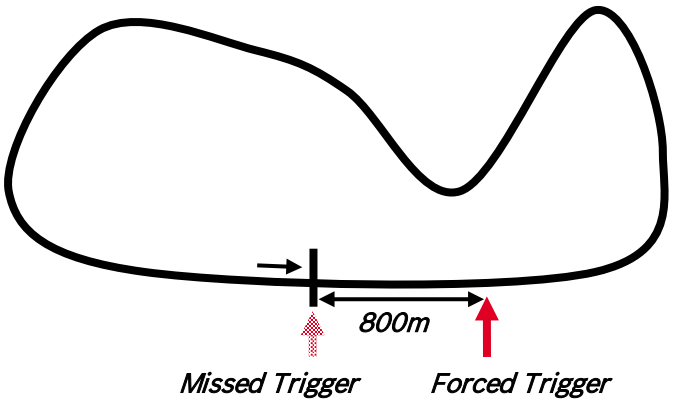


13.3.3 Distance based forced trigger

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.





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

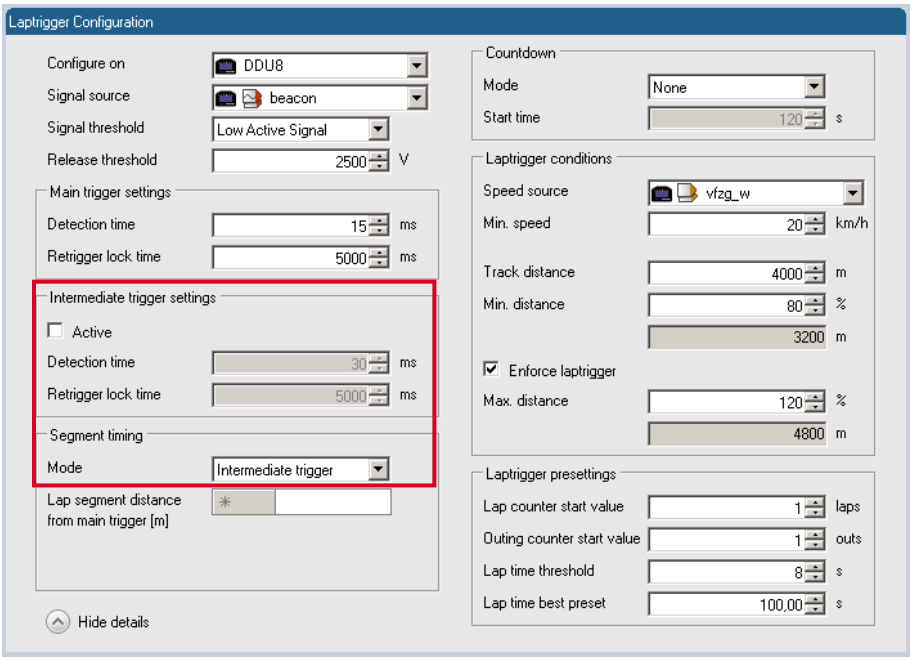
To display segment times use the following channels:

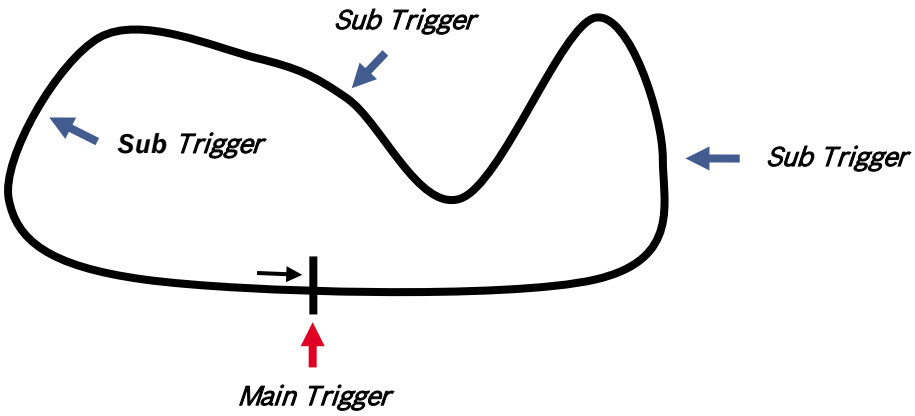
Channel	Function
Laptrigger_lapdiff	Time difference between finished lap and last lap
Laptrigger_lapdiffb	Time difference between finished lap and best lap
Laptrigger_dlast	Difference of lap segment time compared to last lap
Laptrigger_dbest	Difference of lap segment time compared to best lap

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.





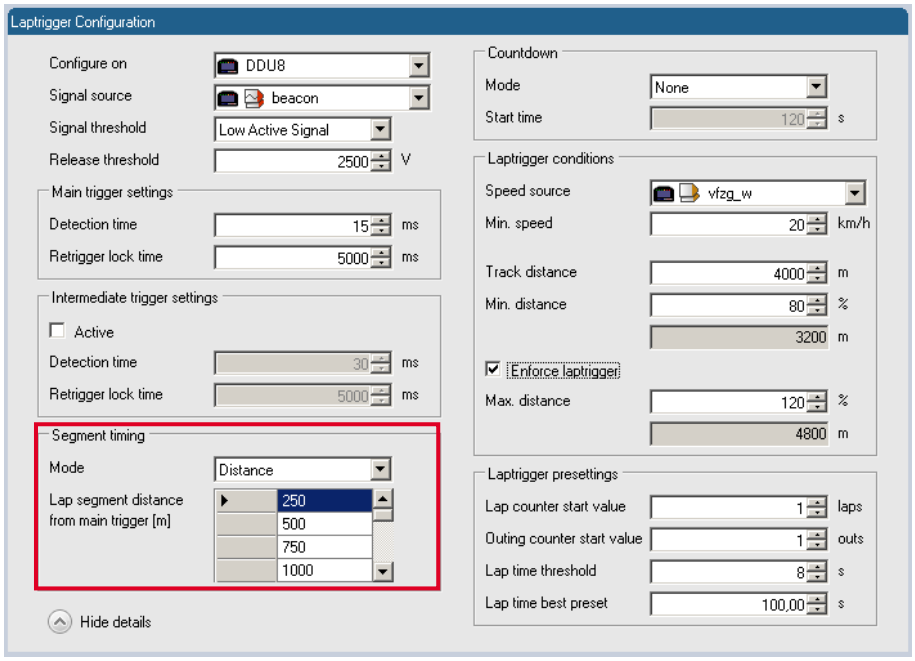
13.4.2 Distance mode

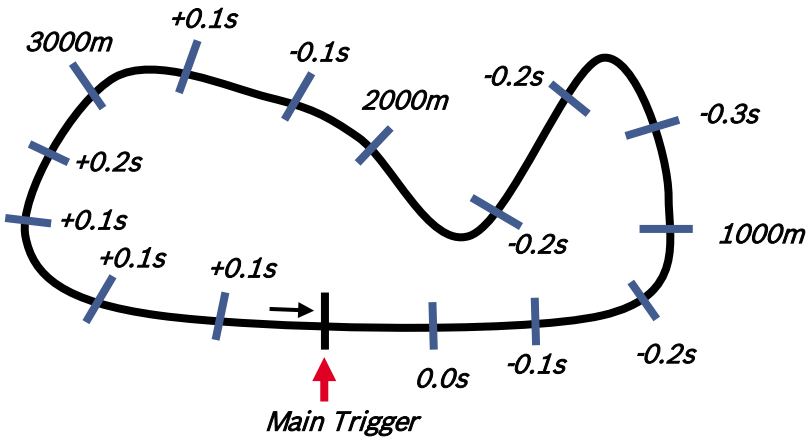
Using main trigger (20 ms pulse) at Start-Finish-Line.

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’.

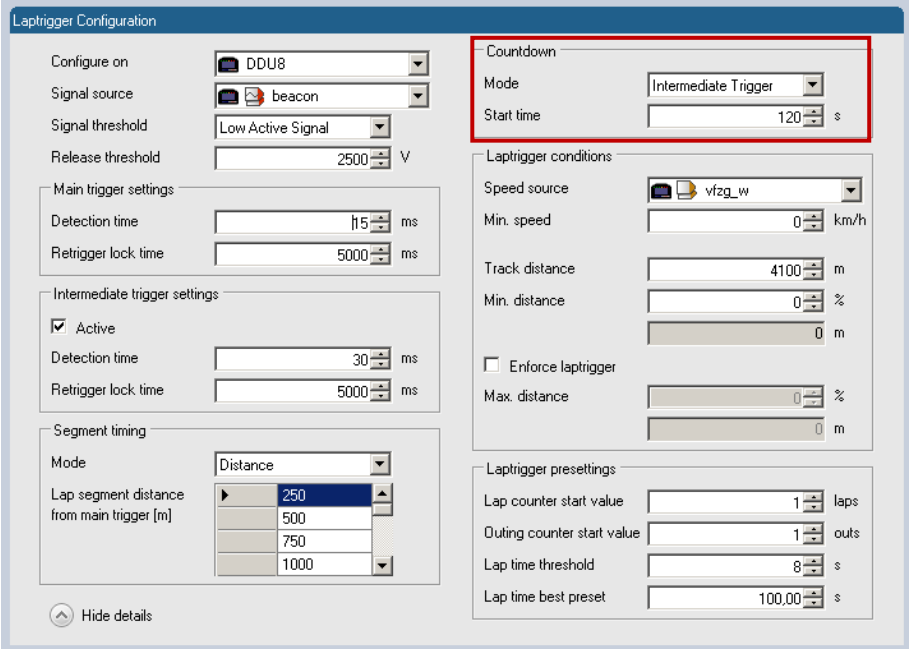




13.5 Countdown timer

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.

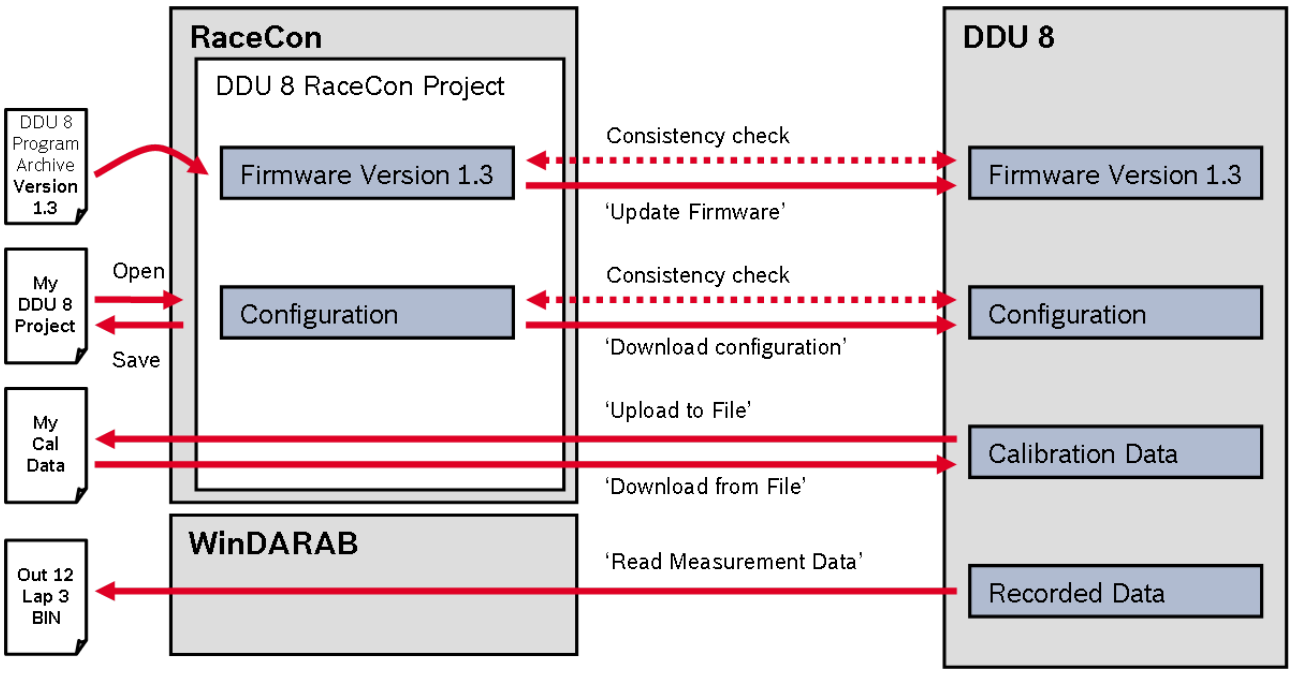


14 Firmware

14.1 Firmware and configuration

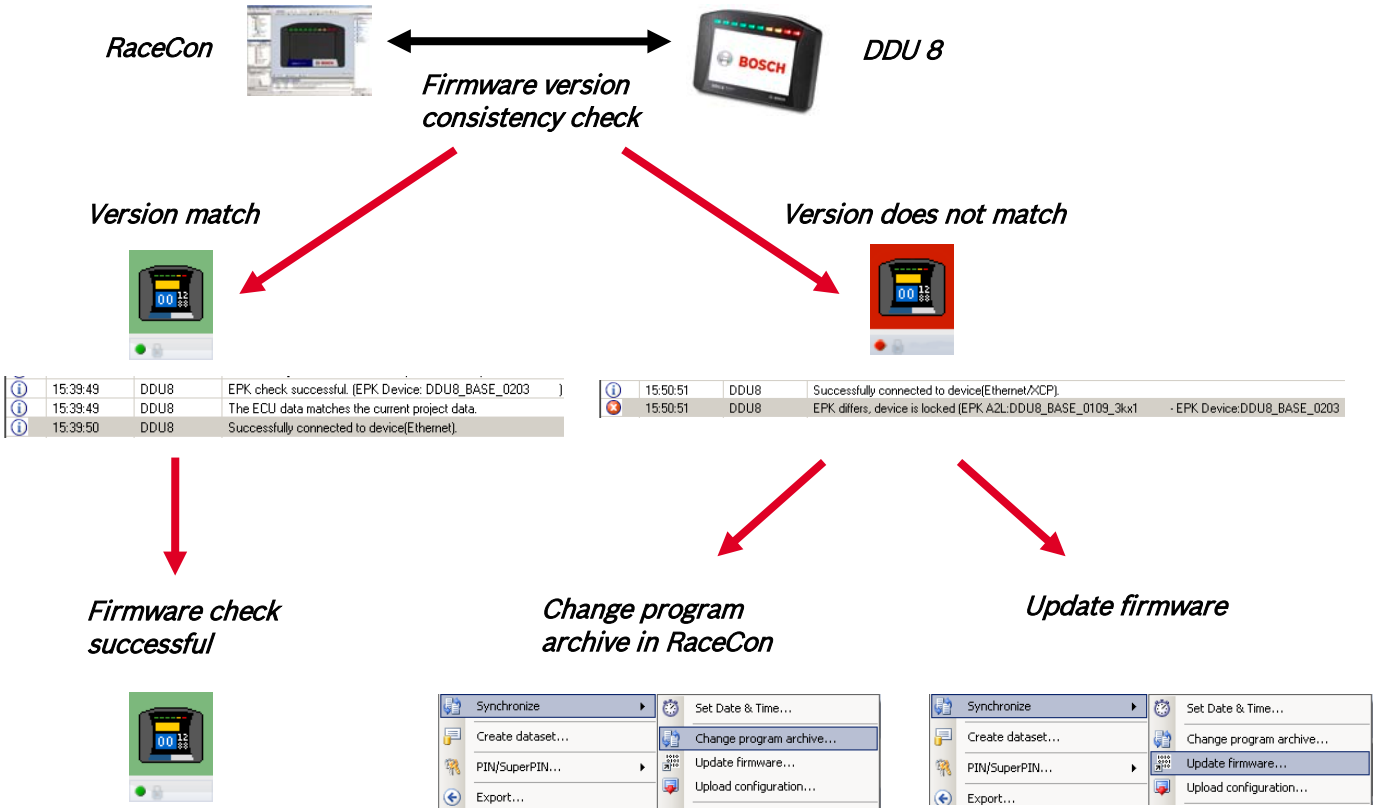
DDU 8 holds 4 types of data:

- 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

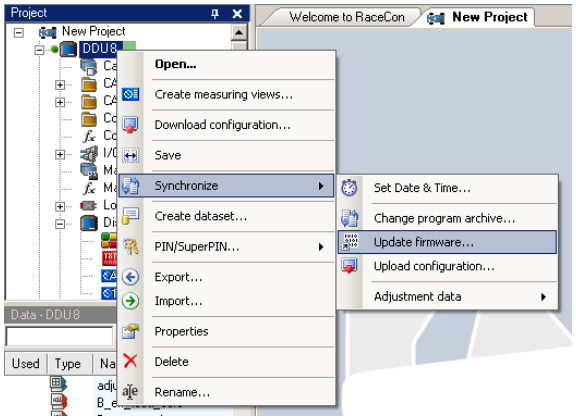
The scheme shows the process during each connection between RaceCon and DDU 8.



14.2.1 Performing the firmware update

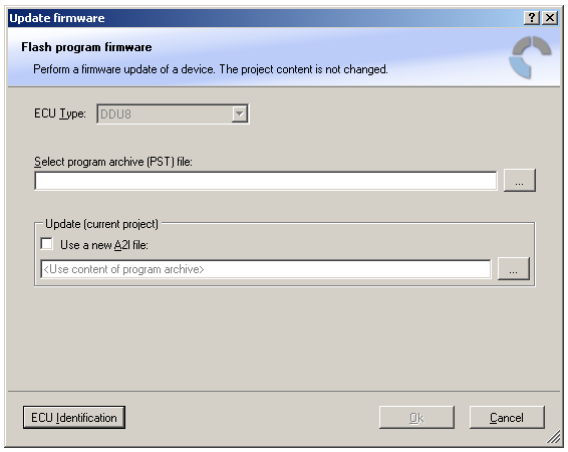
Firmware update is only possible if the DDU 8 is connected to RaceCon.
The configuration of Input channels, CAN I/O, display, recording + telemetry will not be changed.

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

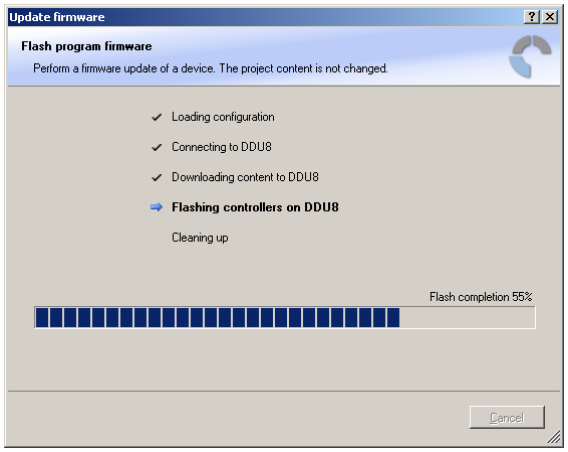


A pop-up menu opens.

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

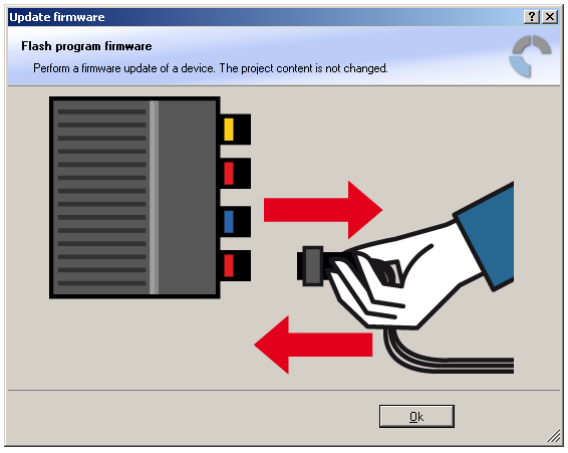


3. Click ‘OK’ when done.
The firmware update starts. The DDU 8 displays the message ‘Updating firmware’.
Do not switch off the car’s ignition or interrupt the power supply of the DDU 8!



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 ?

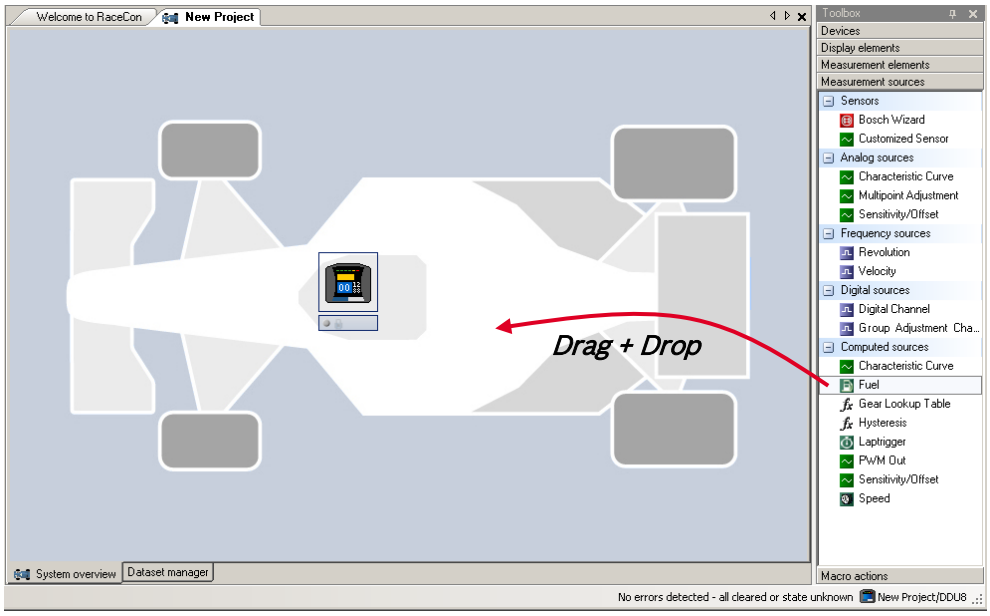
GPS sensor start-up

- 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’.

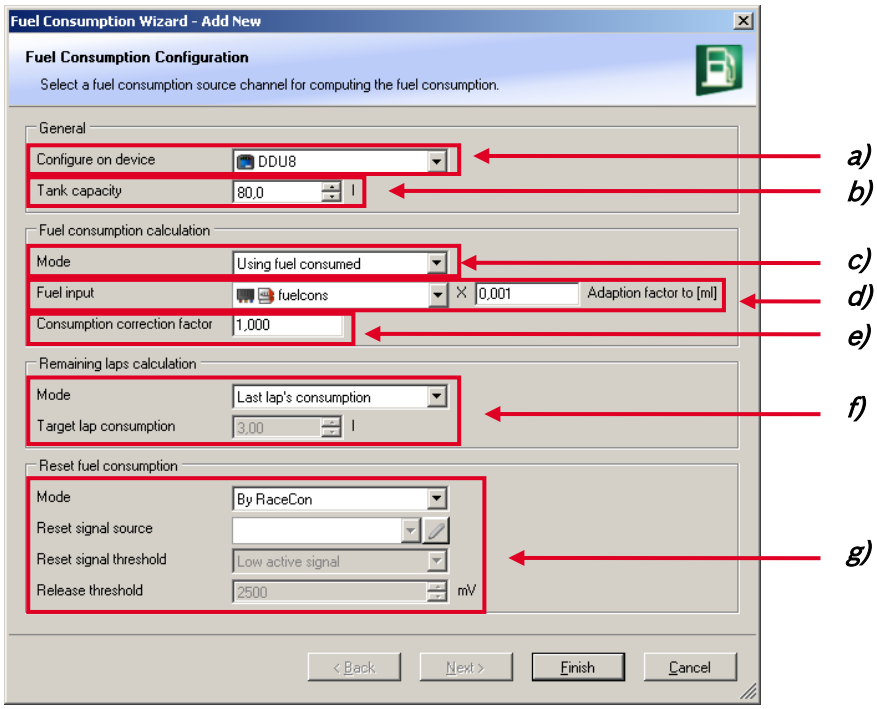
16 Fuel consumption calculation

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.



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:

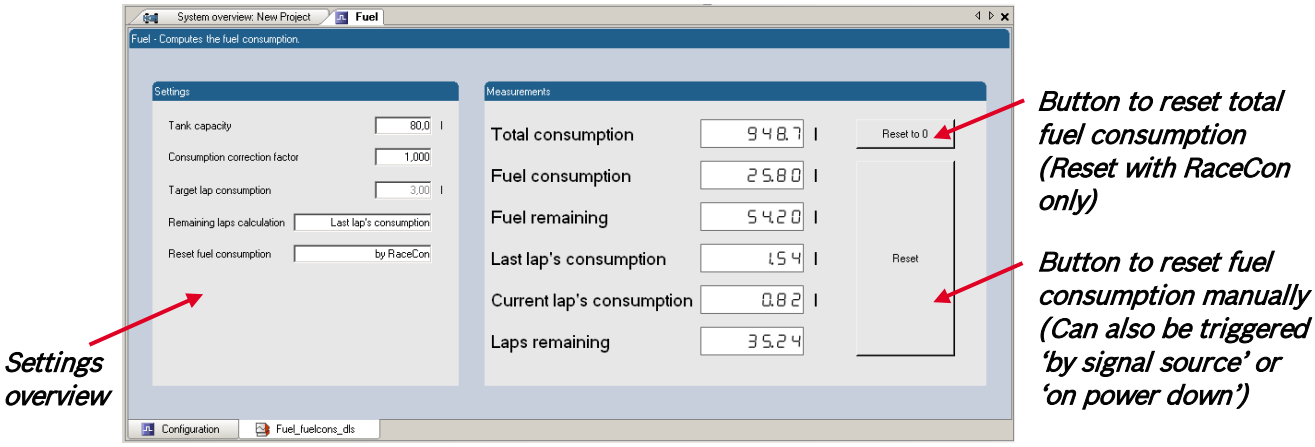
- manually using RaceCon
- On 'power down' (assuming that the tank is filled each time the ignition is turned off)
- By signal source as input channel (e.g. a switch connected to input pin)

3. Press 'Finish' when done.

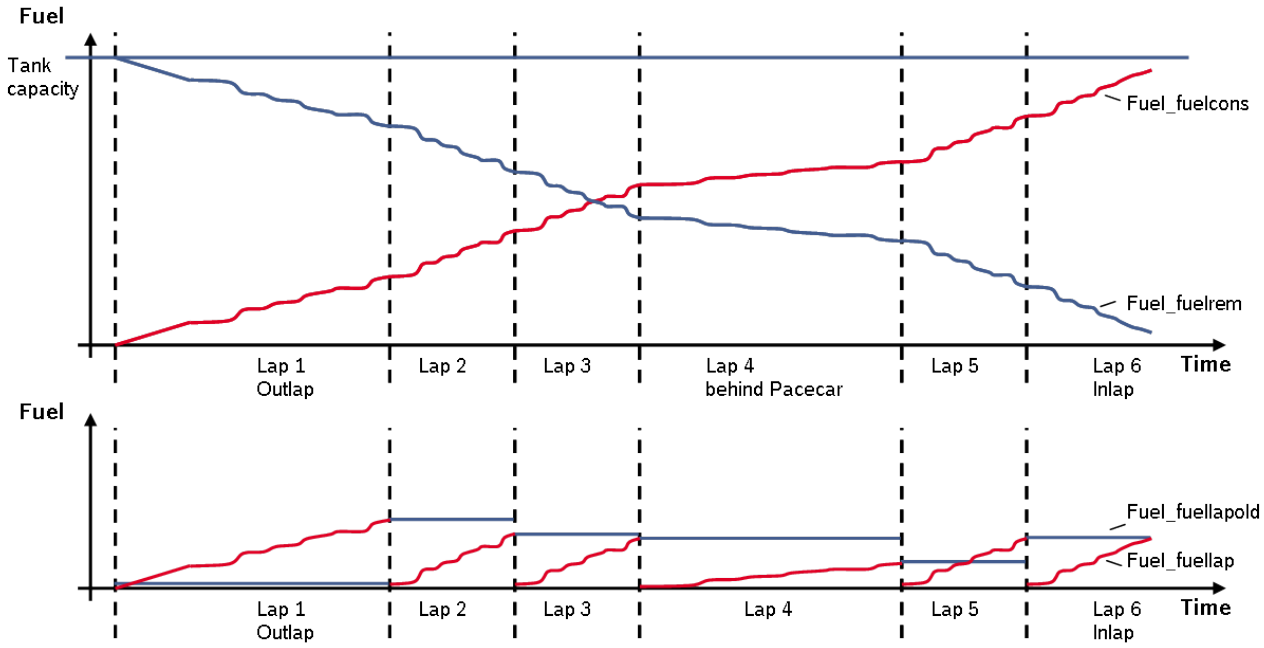
16.2 Fuel consumption diagnosis / counter reset

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.



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

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