Collision Avoidance System CAS-M 3 EVO

Manual

Version 1.2 28/03/2024

Content

1 System Overview

The Collision Avoidance System CAS-M 3 EVO features a Bosch mid-range radar sensor for a wider field of view in close-up range, a high-performance Bosch Motorsport display for fast video processing and a fast response high definition camera.

The CAS-M 3 EVO system provides real time visualization and warns the driver about approaching or overtaking cars via intuitive marking of the cars on the display. It helps prevent the most common collisions and allows drivers to focus on the race. With a momentary glance, the driver can tell how many cars are following and their classification depending on distance and relative speed. The radar tracks up to 40 objects and marks up to 4 objects on the display. In addition, bright flashing LEDs alert the driver when any car attempts a passing maneuver. All of these features work at night or in the rain when visibility is typically poor. Furthermore, the real time gap of a marked object is measured and can be provided over CAN or Ethernet.

The CAS-M 3 EVO system is fully integrated in the Bosch Motorsport Tool environment and can be configured with RaceCon.

More performance for the overall system

The CAS-M 3 EVO display is a multifunctional device incorporating the same processing power as our top of the range DDU 10 display. This powerful addition to the System is more than just a dumb screen! The additional computing power allows tasks to be shifted from other devices or to increase the overall system performance by implementing tasks (e.g. math channels, macros, conditional channels or CAN message generation) in the CAS-M 3 EVO display.

2 Technical Data

Application

Range	95 m
Horizontal field of view	
Radar	85° from 0 to 29 m
	70° from 29 to 46 m
	50° from 46 to 73 m
	42° from 73 to 78 m
	20° from 78 to 95 m
Camera	78°
Number of tracked objects	Max. 40
Number of displayed classified objects	Max. 4
Display format	7‘‘
Display resolution	800 x 480 pixel
User configurable CAN in/out messages	
User configurable LEDs	

Mechanical Data

Display Unit	
Size	198 x 134 x 35 mm
Weight	830 g
Protection Classification	IP67
Operating temperature internal	-20 to 85°C
Max. vibration	Vibration profile 1 (see Downloads or www.bosch-motorsport.com)
Rear Module	
Size	120 x 150 x 115 mm
Weight	880 g
Protection classification	IP67
Operating temperature	0 to 70°C (rearview camera internal temperature*)
Max. vibration	Vibration profile 1 (See Downloads or www.bosch-motorsport.com)

*If the temperature limit is reached, forced air cooling of the camera is recommended.

Electrical Data

Supply voltage (Display and Rear Unit)	6 to 18 V
Current consumption	
Display Unit	2 A (at 12 V)
Rear Module	0.7 A (at 12 V)

Communication

Display Unit	
CAN	1x private CAN for radar, 1x CAN
Ethernet	1x private 1GBase-T Ethernet for camera, 1x 100Base-T Ethernet
Time sync synchronization Ethernet	1
Rear Module	
CAN	1x private CAN for radar
Ethernet	1x private 1GBase-T Ethernet for camera

Software Tools (free download)

Data analysis tool	WinDarab 7 Light
System configuration tool	RaceCon

Connectors and Wires

Display Unit	
Motorsport connector on device	AS212-35PN
Mating connector AS612-35SN	F02U.000.443-01
Rear Module	
Motorsport connector on device	AS212-35PN
Mating connector AS612-35SN	F02U.000.443-01

Pin Configuration

Display Unit		**Rear Module for Vehicle Harness**
Pin No.		Pin No.
1	GigEthernet_TR3_N (private Eth camera **PEC**)	14
2	GigEthernet_TR3_P (PEC)	1
3	GigEthernet_TR2_N (PEC)	2
4	GigEthernet_TR2_P (PEC)	3
5	GigEthernet_TR1_N (PEC)	4
6	GigEthernet_TR1_P (PEC)	5
7	GigEthernet_TR0_N (PEC)	6
8	GigEthernet_TR0_P (PEC)	7
9	Ethernet_TXP	n/a - Connect to Bosch System Ethernet BSE
10	Ethernet_RXP	n/a - Connect to BSE
11	Ethernet_RXN	n/a - Connect to BSE
12	CAN_High_Vehicle	n/a - Connect to Bosch System CAN
13	+12 V KL30	n/a - Connect to Vehicle System Power **VSP**
14	+12 V KL15	n/a - Connect to VSP

15	GND KL31	n/a - Connect to VSP
16	GND KL31	n/a - Connect to VSP
17	Time_Sync	n/a – Connect Display to Bosch Logging System Time Sync
18	ETH_Screen	n/a - Connect to BSE
19	Ethernet_TXN	n/a - Connect to BSE
20	CAN Low Vehicle	n/a - Connect to Bosch System CAN
21	CAN High Radar (private CAN radar **PCR**)	11
22	CAN Low Radar (PCR)	12

Rear Module		**Display Unit for Vehicle Harness**
1	GigEthernet_TR3_P (private Eth camera PEC)	2
2	GigEthernet_TR2_N (PEC)	3
3	GigEthernet_TR2_P (PEC)	4
4	GigEthernet_TR1_N (PEC)	5
5	GigEthernet_TR1_P (PEC)	6
6	GigEthernet_TR0_N (PEC	7
7	GigEthernet_TR0_P (PEC)	8
8	+12 V Ubat	n/a - Connect to VSP
9	+12 V Ubat	n/a - Connect to VSP
10	+12 V Ubat (opt. to display)	13 (opt. if KL30 not connected)
11	CAN High Radar (PCR)	21
12	CAN Low Radar (PCR)	22
13	n.c.	
14	GigEthernet_TR3_N (PEC)	1
15	GigEthernet Screen	
16	n.c.	
17	CAN Screen	n/c
18	GND	
19	+12 V Ubat (opt. to display)	13 (opt. if KL30 not connected)
20	GND	n/a - Connect to VSP
21	GND (opt. to display)	15 (opt. if KL31 not connected)
22	GND (opt. to display)	15 (opt. if KL31 not connected)

2.1 Installation Notes

The rear unit must be mounted 90° to the vehicles vertical and horizontal axis and within ± 200 mm of the vehicle lateral centerline.
Mounting distance of radar over ground: 300 to 1,000 mm

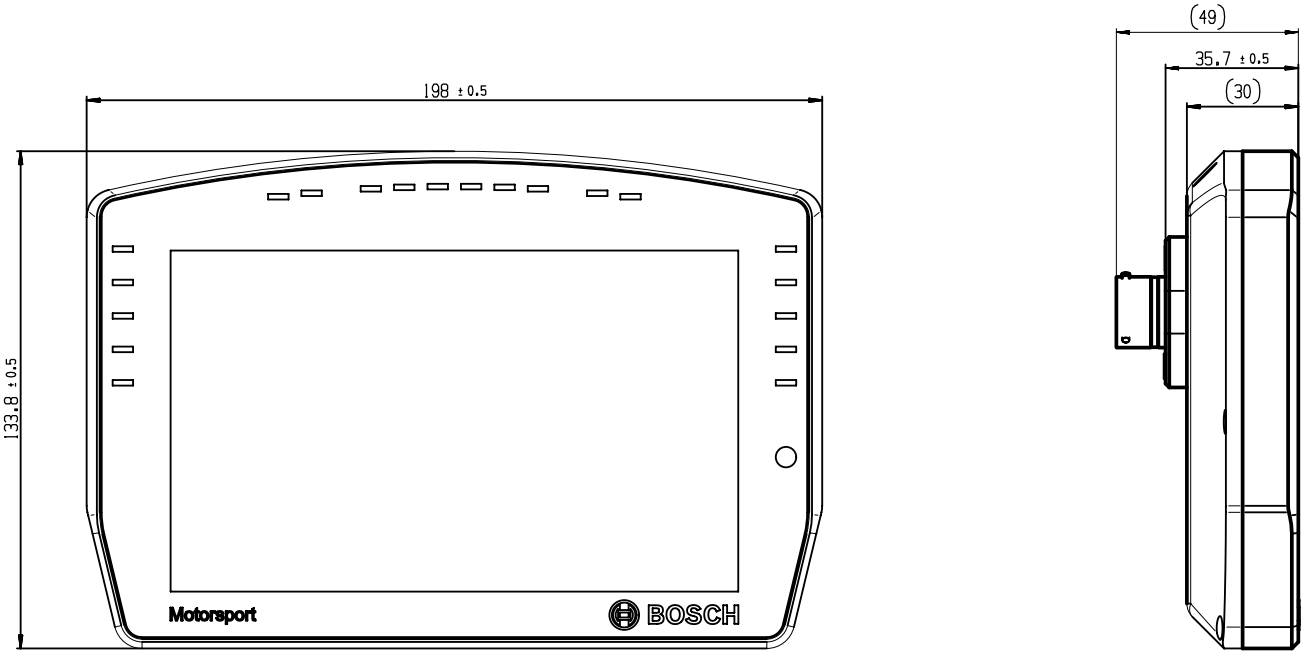
To achieve the expected performance from the radar sensor, it must have a clear and unobstructed view. There should be no material over the radar sensor and the sensor should be allowed a clear 180 degree field of view.
Consider the maximum vibration limits for the mounting position of the rear module. The system is approved referred to vibration profile 1, see www.bosch-motorsport.com.
Check the radar sensor for travel inside the radar bracket. In this case, remove the radar sensor and check the locking pins at both sides of the sensor. Due to vibrations, these pins can be deformed. Exceeding travel of the sensor can damage the electric contacts.
The system needs yaw rate and vehicle speed information.
Cat 6 A standard for Gigabit Ethernet.
This product may contain open source software. Information about license terms and other obligations is given in the manual.
For the private CAN network between display and rear module, no termination resistor is needed in the wiring harness. There are pre-installed termination resistors in the radar sensor and the display.

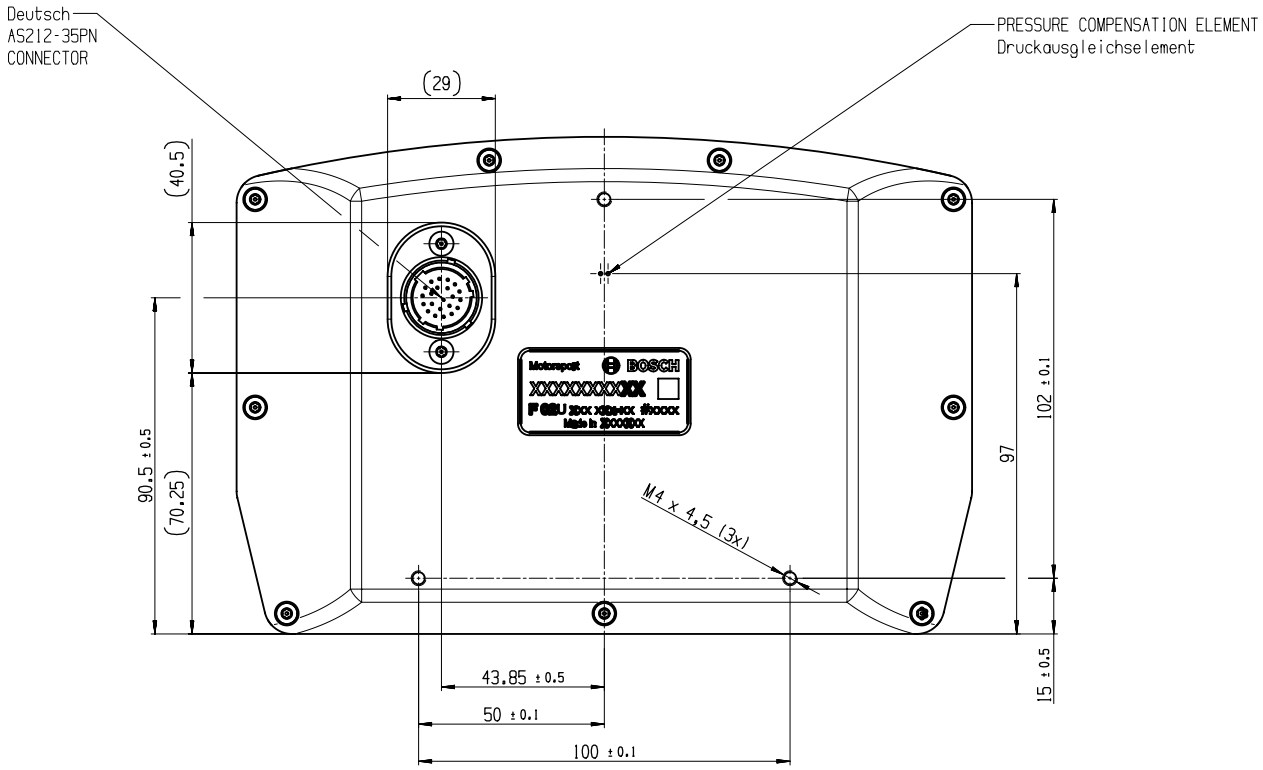
2.2 Safety notes

⚠ WARNING

It is not permitted to use the system as mirror replacement.

3 Mechanical Drawing





4 Installation Guide

4.1 Rear Module Installation

An individual concept for each car mounting situation must be developed by the car manufacturer. The following mounting restrictions must be fulfilled to secure a proper function of the system.

- The rear unit must be mounted 90° to the vehicles vertical and horizontal axis and within ±200 mm of the vehicle lateral centerline.
- Radar sensor mounting height from 300 mm to 1,000 mm above the ground.
- It is critical that the radar sensor has an unobstructed (or radar-transparent) view out the rear of the vehicle. Mounting without any material in front of the sensor is optimal. If it must be mounted behind material, the plane in front of the sensor surface must be free of conductive materials (e.g. a thin layer of vinyl, fiberglass, or Kevlar). The distance between sensor and surface depends on the material used and should be approximately 5 mm.
- The radome design of the CAS-M 3 EVO radar sensor is chosen to minimize detrimental absorption effects on the sensor's performance due to water droplets or film on the radome surface.
- During operation, it must be ensured that a minimum distance of 6 cm is kept between the radar sensor and humans and animals to adhere to the safety levels with respect to human exposure to electromagnetic fields (cf. IEEE Std C95.1-2005 or 1999/519/EC). This 6 cm distance is related to continuous exposure. If the 6 cm distance is undercut, an averaged exposure time of 42 seconds has to be considered. In this 42 s averaging period, a maximum exposure time to the radar beam of 4 s has to be adhered to. The minimum distance of 6 cm is smaller than the minimal distance the radar sensor can measure. Therefore, a function violating the minimum distance cannot be realized. Thus, this exposure limit does not impose functional limitations.
- Consider the maximum vibration limits for the mounting position of the rear module. The system is approved up to Bosch Motorsport vibration profile 1 (see Bosch Motorsport catalog appendix for more information).
- The camera and radar sensor cannot be removed from the housing and separated from one another.

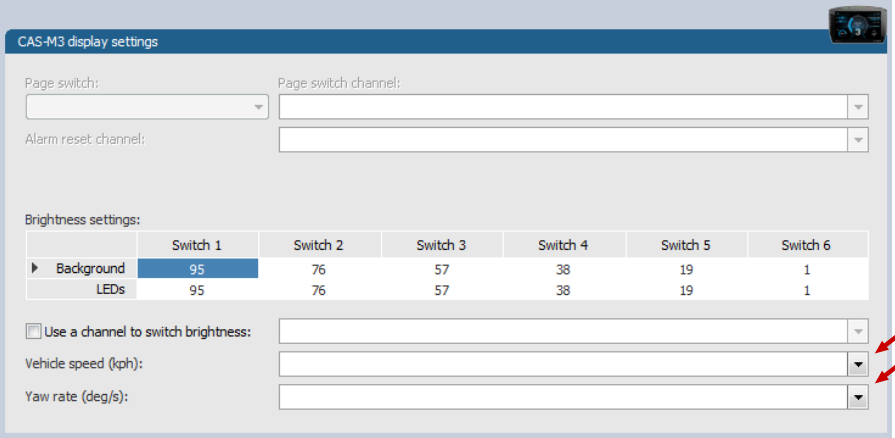
5 Quick Start Guide

5.1 Integration

Integrate and connect the system as described in sections “Pin Layout” and “Rear Module Installation [▶ 10]”.

5.2 Assign yaw rate and speed input signals

Power on the system and connect it with RaceCon. Go to the “Display” sheet and switch to the “Settings” page.



Choose the inputs for Vehicle speed and Yaw rate. If you use CAN signals, you need to define the messages on the CAN input first.
For further information see section “CAN input [▶ 36]”.

Now the system is ready to use with the predefined default settings. To adapt these settings to your needs, please see section “Display Configuration [▶ 25]”.

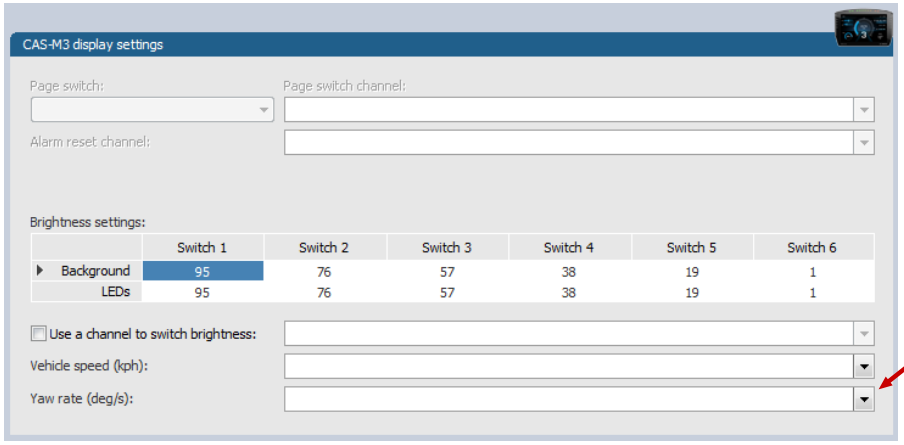
6 Input Signals

The system needs yaw rate and vehicle speed information for the object motion estimation. Vehicle coordinate system according to DIN 70000.

6.1 Yaw rate

Minimum resolution	0.005°/s
Minimum refresh rate (CAN)	50 Hz

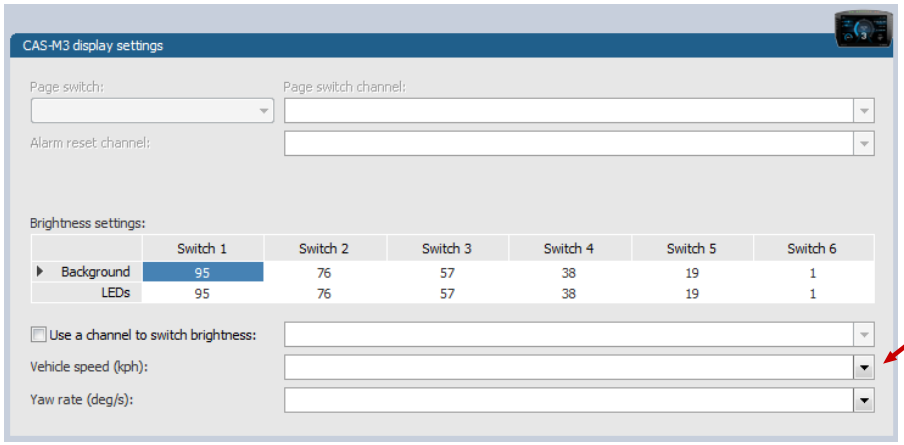
Assign the yaw rate input channel at the display settings page:



6.2 Vehicle speed

Minimum resolution	0.1 km/h
Minimum refresh rate (CAN)	50 Hz

Assign the vehicle speed input channel at the display settings page:



6.3 Default values

When receiving vehicle speed or yaw rate via CAN, care should be taken to configure signal time-outs and default values. These default values should then be reflected in the calibration parameters MRR_EGOVEHSPEED_INVLD and MRR_YAWRATE_INVLD to allow the system to detect and react correctly to signal losses.

6.4 MRR Signals Testmode

Value	Valid data	Default
CASM_TESTMODE	On/Off	Off

Add test mode to display current MRR signals (vehicle speed and yaw rate) on the CAS-M3 display for the first implementation

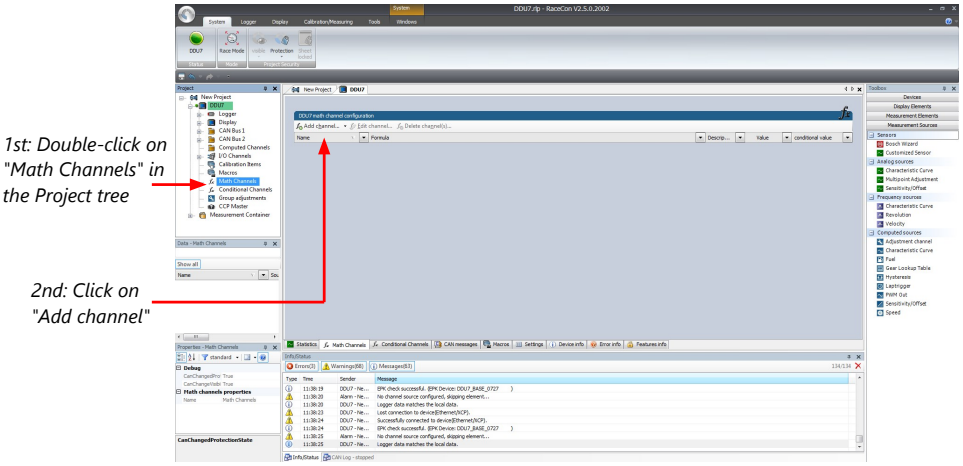
7 Project Configuration

7.1 Math Channels

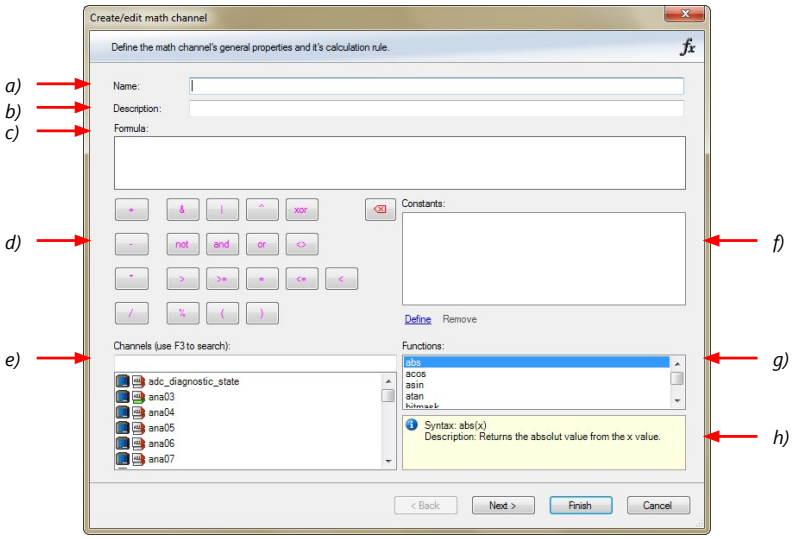
- Arithmetic and logical operations on up to 4 measurement channel(s)
- Numerical result
- Result can be used as input source for various display elements (numeric elements, alarms, bargraphs) and further calculations in the whole RaceCon project

Creating a new Math Channel

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



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



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

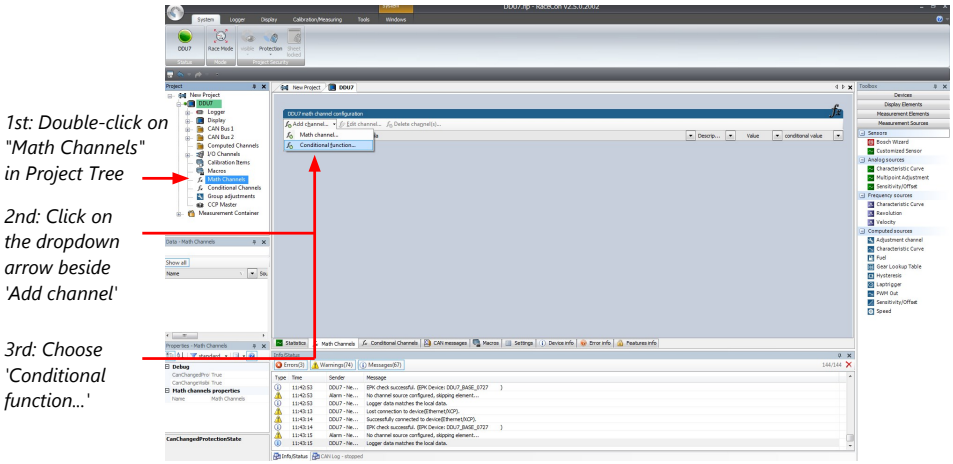
Click ‘Finish’ when done. The math channel is displayed in the math channel window.

7.2 Conditional Functions

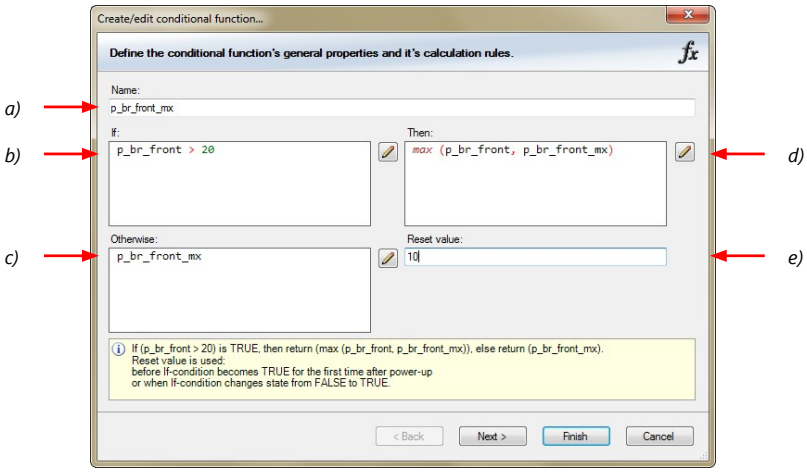
- Arithmetic and logical operations on one or more measurement channel(s)
- If-Else structure with reset
- Numerical result
- Result can be used as input source for various display elements (numeric elements, alarms, bargraphs) and further calculations in the whole RaceCon project.
  All math and conditional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

Creating a new Conditional Function

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



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



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

Click ‘Finish’ when done.

The conditional function works the following way:

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

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

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

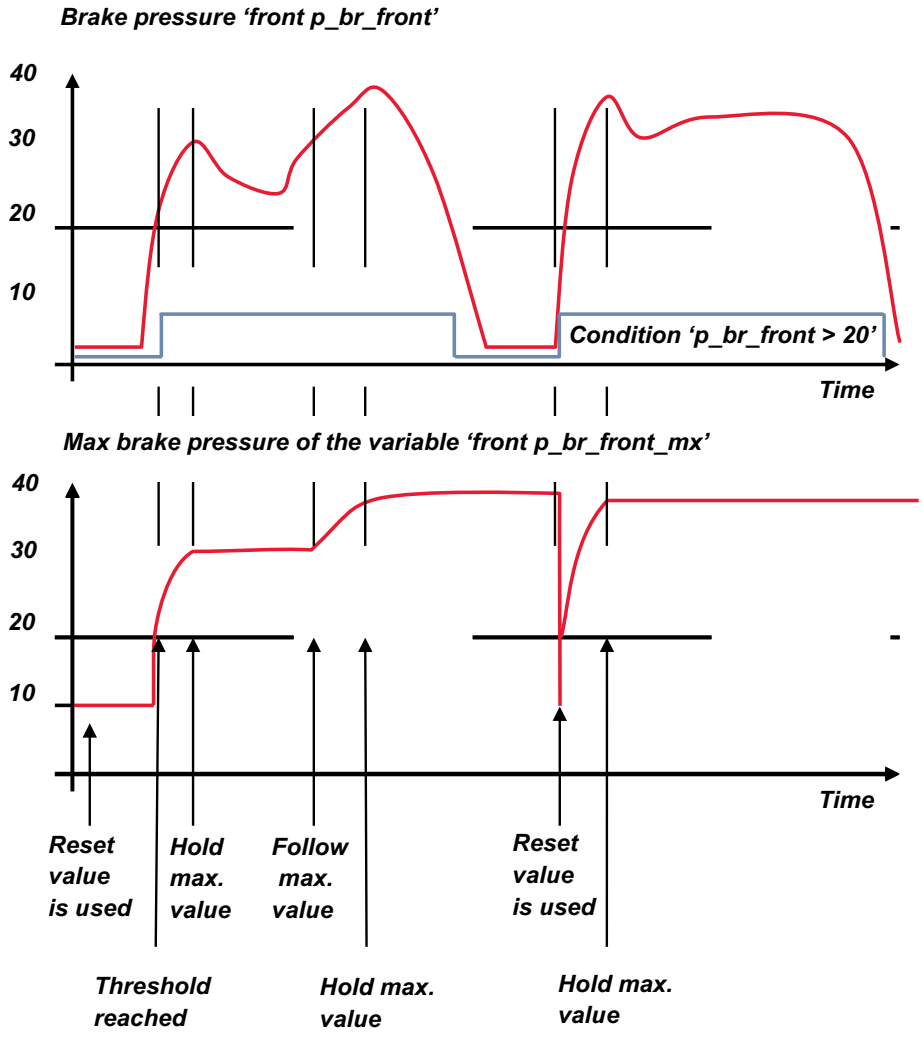
The reset value is always set for the new variable (entered in “Name”):

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

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

The conditional function is displayed in the CAS-M 3 EVO 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’.

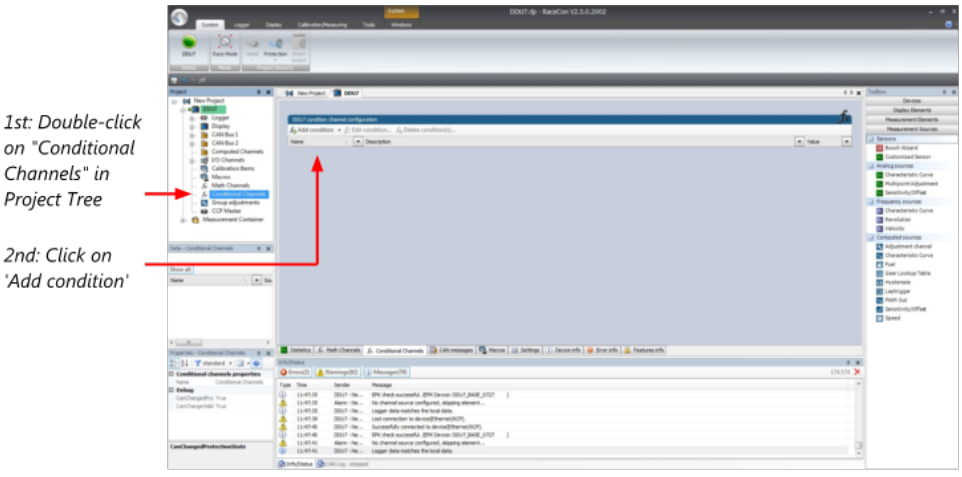
- ‘p_br_front’ rises to 30. As ‘p_br_front’ is > 20 (condition is TRUE), the condition ‘max (p_br_front, p_br_front_mx)’ in the THEN window is triggered. The condition sets the bigger value as new value for ‘p_br_front_mx’. As ‘p_br_front’ (30) is bigger than ‘p_br_front_mx’ (10), the new value for ‘p_br_front_mx’ 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).
- ‘p_br_front’ rises to 40. As ‘p_br_front’ (40) is bigger than ‘p_br_front_mx’ (30), the new value for ‘p_br_front_mx’ is set to 40.
- As ‘p_br_front’ falls below 20, the IF-condition turns to FALSE. Now the OTHERWISE-condition is triggered. Because the condition ‘p_br_front_mx’ sets the value of ‘p_br_front_mx’ and the value is already set to 40, nothing changes.
- When ‘p_br_front’ rises to 40, the IF-condition changes to TRUE again and triggers the THEN-condition. Now the reset value (10) is used for ‘p_br_front_mx’ in the THEN-condition.
- The new value of ‘p_br_front_mx’ is 40 because 40 is bigger than 10.

7.3 Conditional Channels

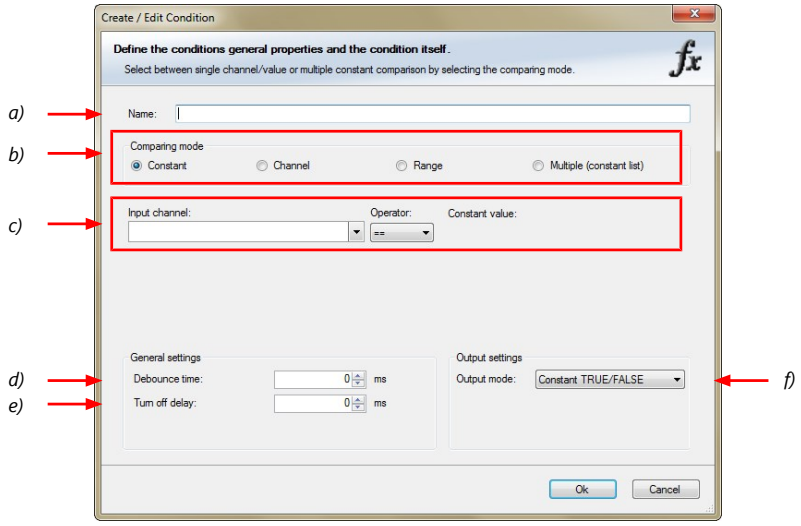
- Logical operations on measurement channel(s)
- If-Else structure with reset
- Logical result
- Result can be used as input source for alarm display elements and further calculations in the whole RaceCon project.

Creating a new Conditional Channel

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



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



a) Enter the name of the conditional channel.

b) Select the comparing mode:

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

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

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

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

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

f) Choose the output setting of the result.

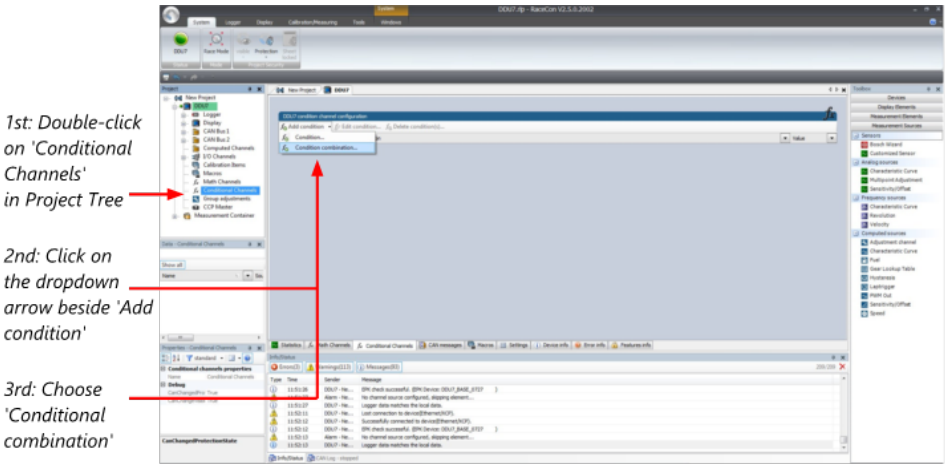
- Constant TRUE/FALSE: Result is as a constant with the value TRUE or FALSE.
- Blinking: Result is a blinking, if the condition is fulfilled.
- Pulse: Result is a short one-time pulse, if the condition is fulfilled.
- Toggling output: Result is a pulse that lasts until the next condition is fulfilled.
- Click ‘Ok’ when done. The conditional channel is displayed in the CAS-M 3 EVO condition channel window.

7.4 Condition Combination

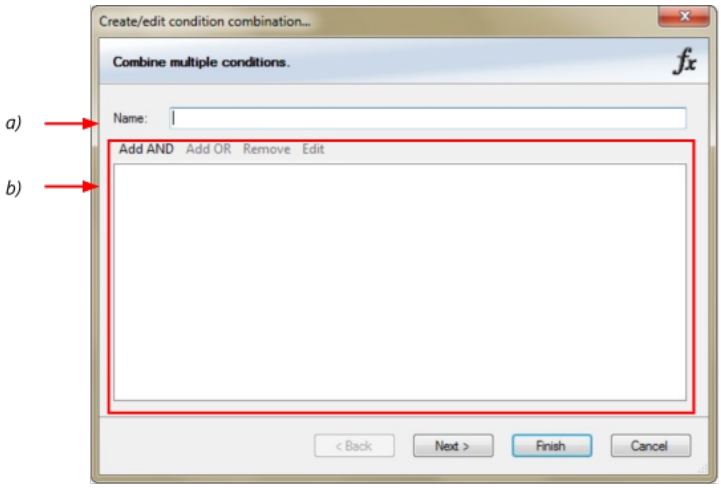
- Combination of several (up to 16) conditional channels for more complex calculations
- Logical results
- All conditions can be used globally in the whole CAS-M 3 EVO project.

Creating a new Condition Combination

Follow the steps shown in the screenshot.



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

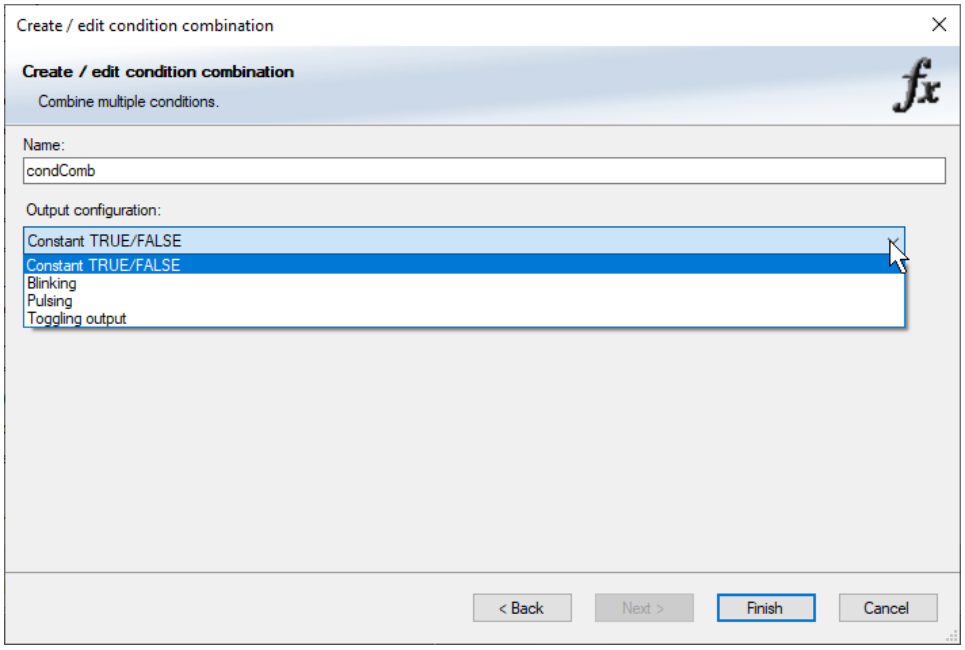


a) Enter the name of the condition combination.

b) Create the condition combination in the window.

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

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



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

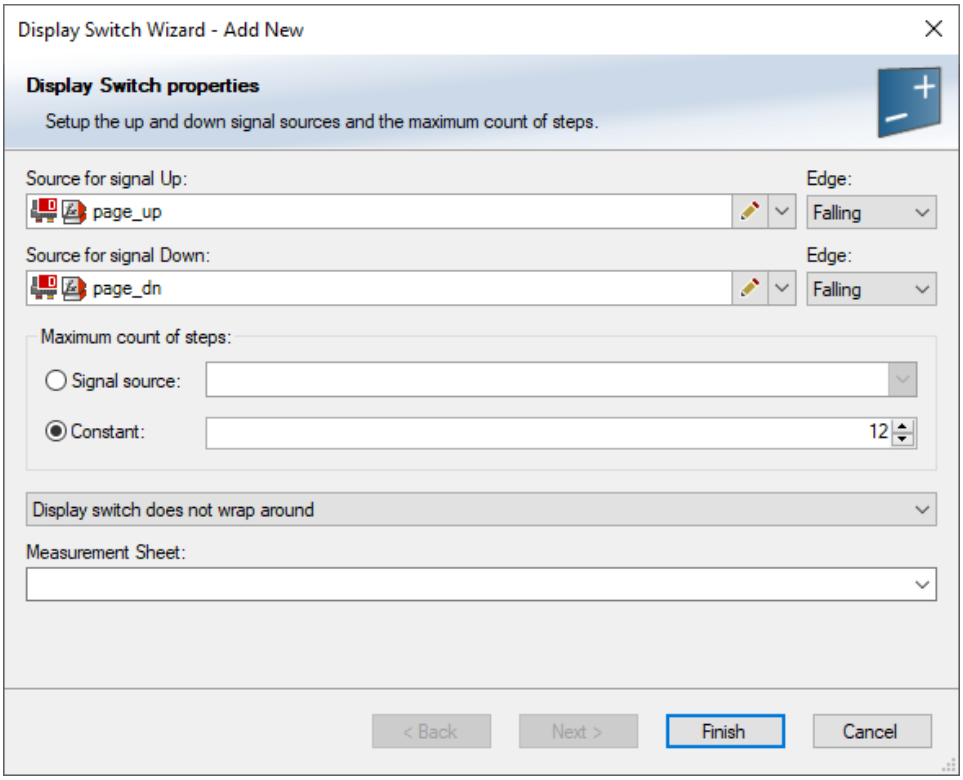
Click ‘Finish’ when done. The conditional combination is displayed in the CAS-M 3 EVO condition channel window.

7.5 Display Switch Module

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

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

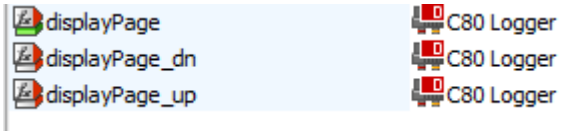
The page can be configured to wrap around. In this case, no page down condition is needed.



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

Measurement label	Function
name	page or brightness value
name**_dn**	input condition for decrement
name**_up**	input condition for increment

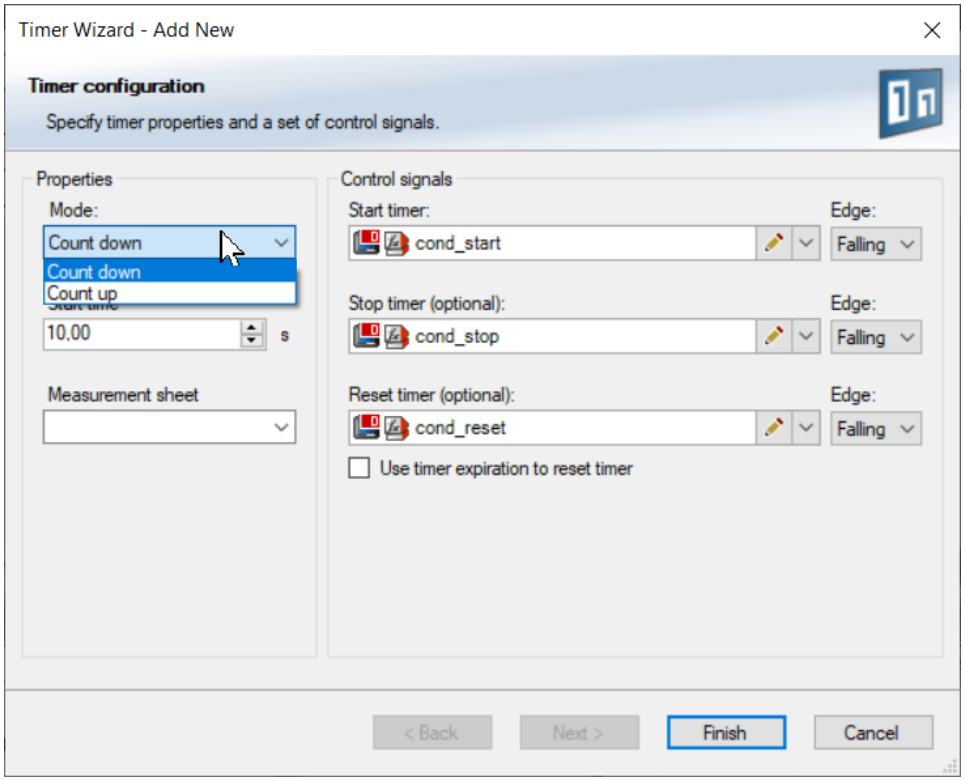
Example:



7.6 Timer Module

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

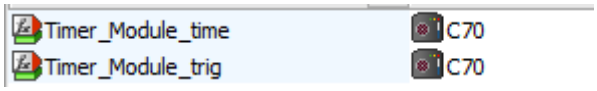
Up counting mode and down counting mode are available, triggers are fired at set time (up counting) or at zero (down counting). The running timer will keep its state over a power cycle.



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

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

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

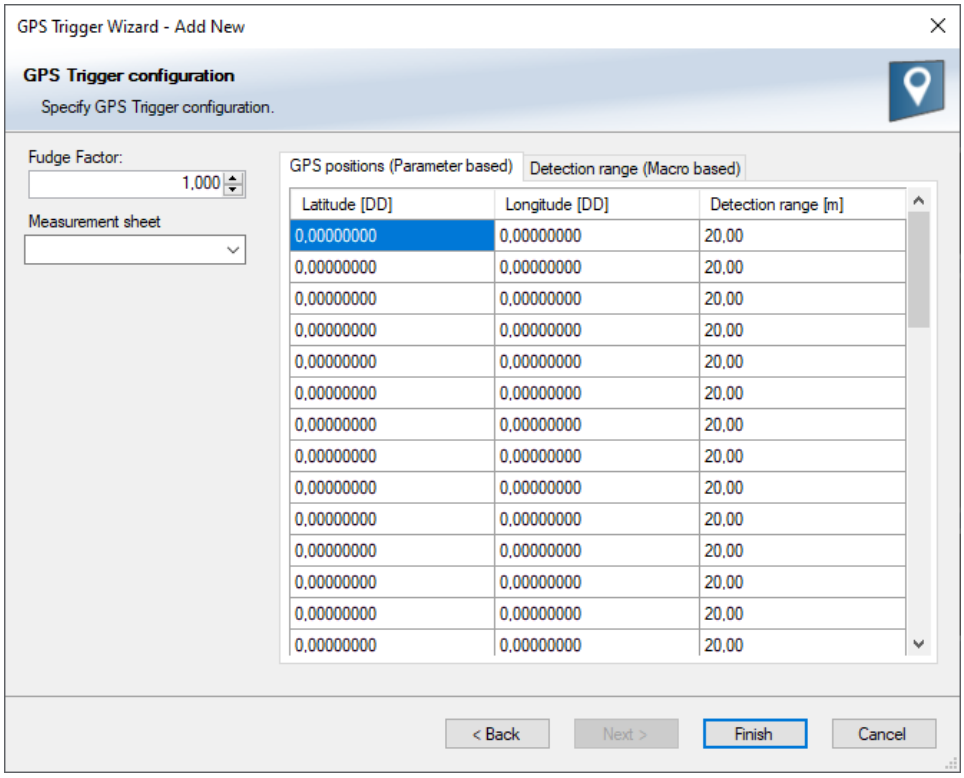


7.7 GPS Trigger Module

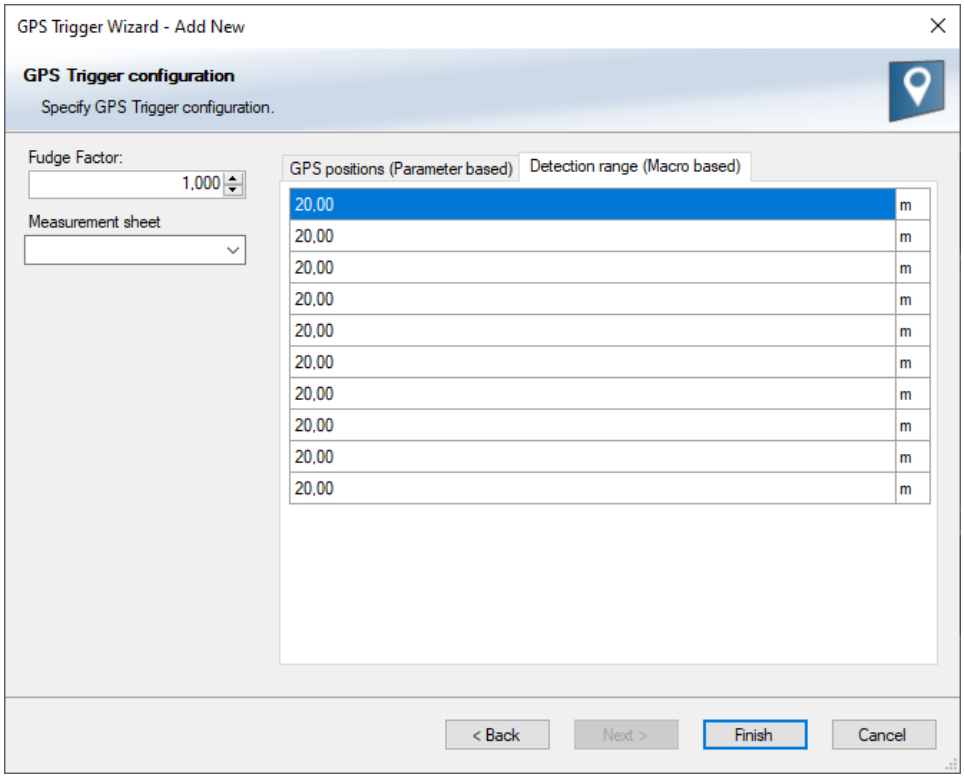
The GPS Trigger Module triggers depending on GPS-position, like the GPS-laptrigger.

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

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



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

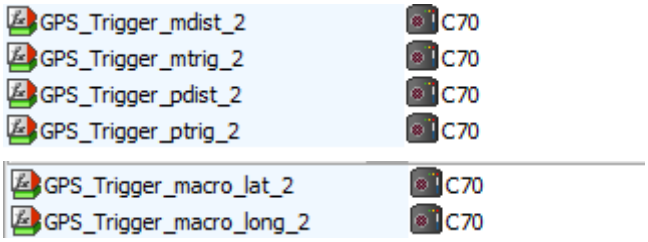


The GPS trigger points can also be used for segment triggering. If used as segment triggers and i.e., 3 trigger points are selected, the laptrigger module will use the first 3 trigger points on the list.

The channel names depend on the name used for the module, in this example GPS_Trigger. Each trigger has a distance and a trigger channel with the abbreviation m for macro or p for parameter based. The trigger channel will be set to 1, when the lowest distance to the trigger point is detected. For the macro-based trigger, the stored latitude and longitude values can be seen with the channels.

Measurement label	Function
name_**lat**	interpolated gps latitude
name_**long**	interpolated gps longitude
name_**ptrig_1..50**	trigger output of parameter based trigger (n)
name_**pdist_1..50**	distance to trigger of parameter based trigger (n)
name_**mtrig_1..10**	trigger output of macro based trigger (n)
name_**mdist_1..10**	distance to trigger of parameter based trigger (n)
name_**macro_lat_1..10**	stored latitude for macro based trigger (n)
name_**macro_long_1..10**	stored longitude for macro based trigger (n)

Example:



7.8 CPU Load Limits

As all microprocessors, the two processors of the CAS-M 3 EVO have limited capacities. The current load of the processors can be monitored using the channel “cpu_load_001” or “cpu_load_002”. When configuring your device, please make sure the used CPU load is in a save range below 100 %.

Bosch recommends a maximum CPU load of 85 % (averaged). Exceeding this limit might result in the CAS-M 3 EVO not being able to fulfill its required measuring/logging/display tasks or even in crashing and rebooting.

Main factors influencing the CPU load are:

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

To help respecting the limit of 85 % CPU load, the CAS-M 3 EVO creates an error memory entry. To trigger this error entry, the CPU load must exceed the limit for 5 minutes without interruption.

When being confronted with this error memory entry (see ‘Error info’ in RaceCon) or when being confronted with CAS-M 3 EVO resets due to complex configuration setups, please consider reducing the demands on the CAS-M 3 EVO adapting the influencing factors mentioned above.

8 Display Configuration

8.1 Overtake Warning

Warning position

Value	Valid data	Default
CASM_OVTK_POSITION_DISP	Top Middle Bottom OFF	Top

This value sets the position of the red overtake warning arrow on the display.

Warning display duration

Value	Valid data	Default
CASM_OVTK_TURNOFF_DELAY	0 to 5 s	1 s

This value sets the duration of the warning signal on the display after an object has passed due to overtaking. As long as the object which is below the time to overtake (TTO) threshold is tracked the warning signal is enabled.

Warning threshold

Value	Valid data	Default
CASM_OVTK_THRESHOLD_TTO	0 to 5 s	1 s

This value sets the trigger for the overtake warning based on the TTO of the tracked object behind. I.e. the time before the calculated overtaking moment of another object.

Warning signal size

Value	Valid data	Default
CASM_OVTK_SIZE_DISP	Small Medium Large	Small

This value sets the size of the red overtake warning arrow.

Illustration 1: Small overtake arrow

Illustration 2: Medium overtake arrow

Illustration 3: Large overtake arrow

8.2 Vehicle Markings

Threshold for color gradient

Value	Valid data	Default
CASM_WARN_YELLOW_THRS	0 to 100 km/h	10 km/h
CASM_WARN_RED_THRS	0 to 100 km/h	20 km/h

These values define the color of the object marking. Based on its delta speed threshold the objects will be marked as follows:

Green	Delta speed ≤ CASM_WARN_YELLOW_THRS
Yellow	CASM_WARN_YELLOW_THRS ≤ Delta speed ≤ CASM_WARN_RED_THRS
Red	Delta speed ≥ CASM_WARN_RED_THRS

Z Position offset of markings

Value	Valid data	Default
CASM_OFFSET_Z_ABSOLUTE	-240 to 240 pixel	0 pixel

This value sets the Z offset position of the object marking in Z direction with pixel step-size. Reference level is the horizontal center of the display.

Shape of the vehicle markings

Value	Valid data	Default
CASM_MARKER_SHAPE	Triangle	Triangle
	Chevron	

This value defines the shape of the vehicle marking.

Illustration 4: Triangle vehicle marking

Illustration 5: Chevron vehicle marking

8.3 Side gauges

Value	Valid data	Default
CASM_GAUGE_LEFT	Off	Off
	Distance	
	Real time gap	
	Time to overtake	
CASM_GAUGE_RIGHT	Off	Off
	Distance	
	Real time gap	
	Time to overtake	

With the side gauges, you can display one of the following information on each side of the screen.

Off: No side gauge

Distance: Distance to the currently marked vehicles behind you in meters

Real time gap: Gap to the currently marked vehicles behind you in seconds

Time to overtake: Estimated time to overtake of the currently marked vehicles behind you in seconds

The vehicles will be displayed as small rectangles in the same color of their markings on the scale.

Illustration 6: Side gauges example

8.4 Own Vehicle Information

Invalid values

Value	Valid data	Default
MRR_EGOVEHSPEED_INVLD	0 to 6.553,5 km/h	6.553,5 km/h
MRR_YAWRATE_INVLD	-163,84 to 163,835°/s	-163,84°/s

These calibration values can be used to mark specific values as invalid, disabling the vehicle overlays if these values are present. The main intention is to react to time-outs of CAN input signals (see section “Default values [▶ 12]”).

8.5 Camera Temperature Warning

Value	Valid data	Default
CASM_HIDE_TEMPERR_THRS	0 to 6553,5 km/h	6553,5 km/h

This calibration value sets the speed threshold above which to hide the camera temperature warning. Recommendation for a warning which appears just in Pit Lane or stopped vehicle is ≥20 km/h.

8.6 LEDs

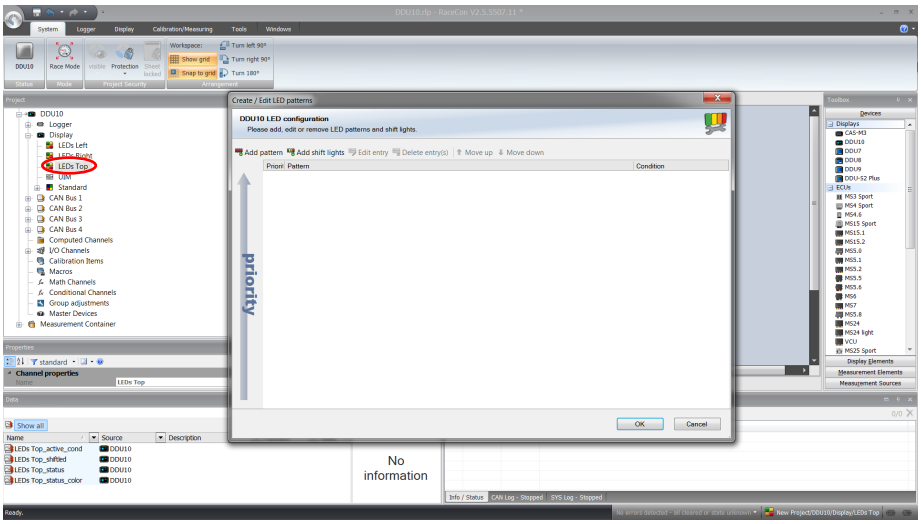
8.6.1 Configuring shift LEDs

To use shift LEDs, you need a channel with the unit RPM. It is also possible to use gear depending shift light.

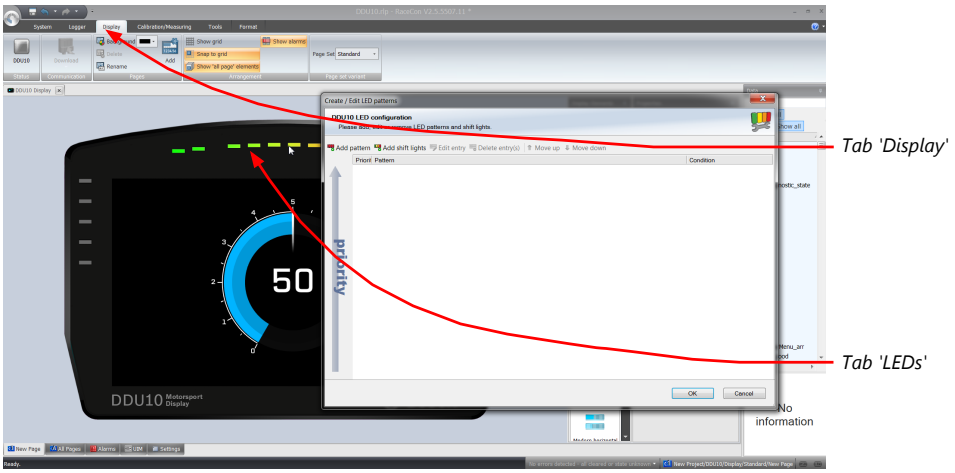
You can configure the shift LEDs only in the ‘LEDs Top’.

1. Double-click on ‘LEDs Top’ in the project tree.

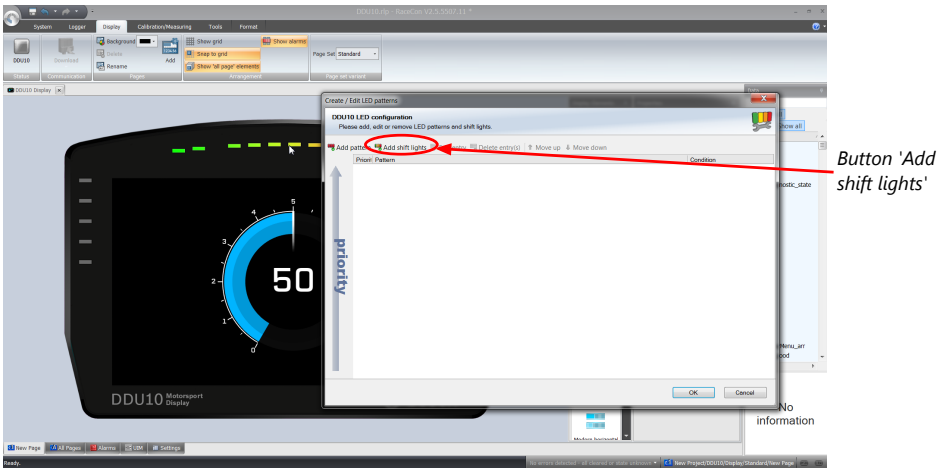
You will find them under ‘Display’.



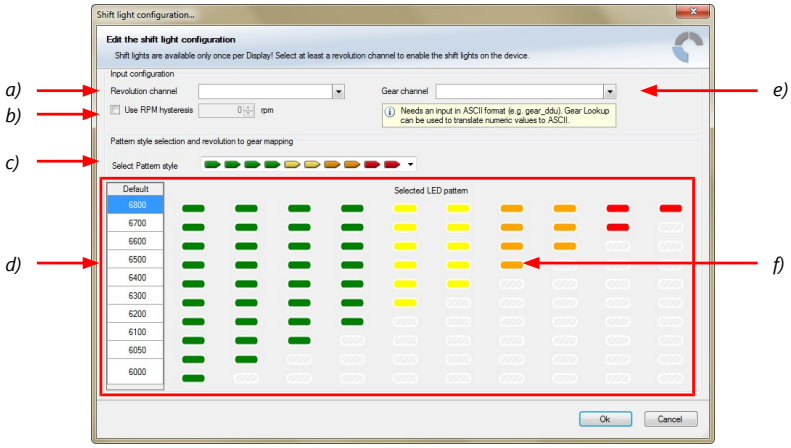
2. Alternatively, click on the ‘Display’ tab and then click on the colored LEDs at the top of the display image.



3. Click on the button ‘Add shift lights’.



4. The ‘shift light configuration’ window appears. Set up the shifting lights using the following configuration possibilities:



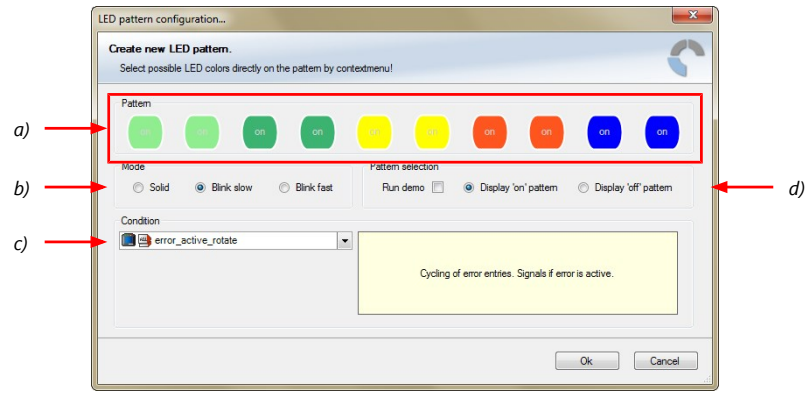
a) Choose the measurement channel for 'Revolution'. Revolution must have 1/min quantization.
b) Enter the limit value when the RPM hysteresis function is active. The RPM hysteresis function avoids the high-frequent switchover of the measurement channel value.
c) Choose a predefined Pattern style.
d) Define the rpm thresholds to show the LED pattern.
e) 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 "Converting a gear channel to ASCII representation".)
f) Click with the right mouse button on the LEDs to reconfigure the LED patterns.

5. Click 'OK' when done. The configuration is displayed in the CAS-M 3 EVO LED Configuration window.

8.6.2 Creating customized LED pattern

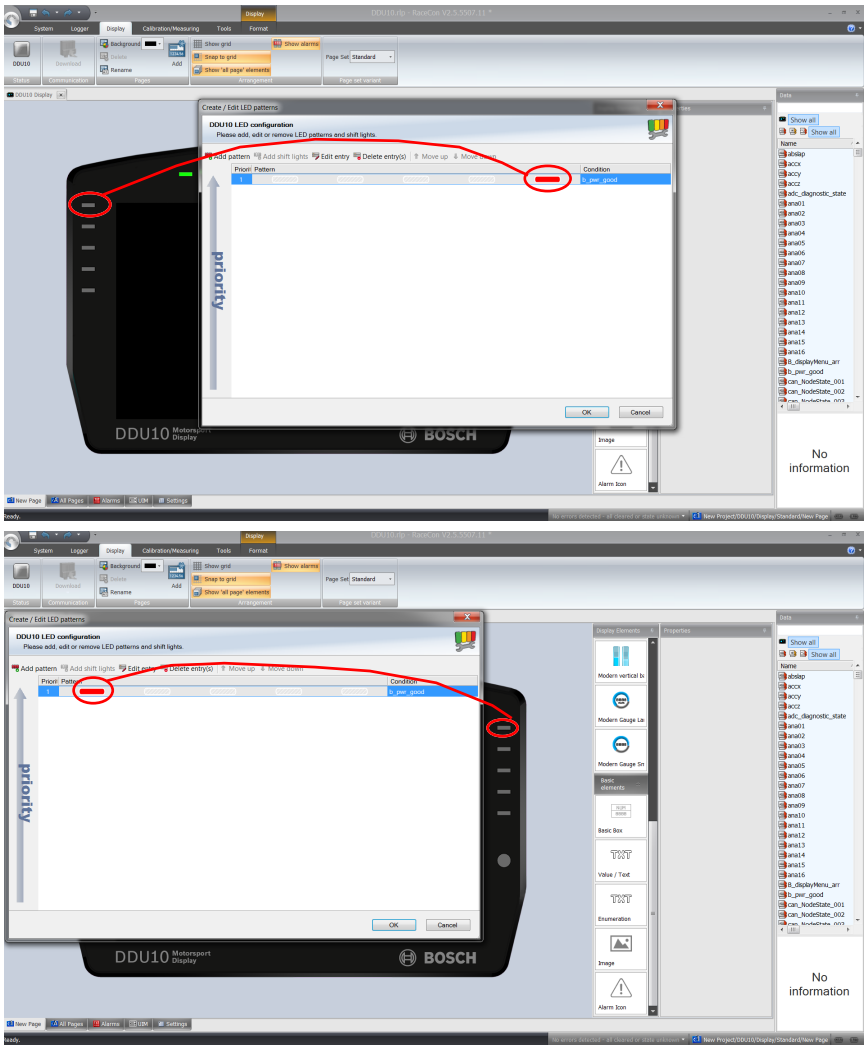
You can create your own LED pattern with an individually created condition, using the top LEDs and the ones on the sides. The LEDs illuminate or flash if the condition becomes true.

Click on the button 'Add pattern' in the display view. The LED pattern configuration window appears.



a) Choose the needed LEDs by clicking or via multiselect with ctrl + clicking and define the color of the LEDs by right-clicking on one of the selected LEDs
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 "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 first color. Then choose 'Display "off" pattern' and define the LEDs in the second color.

The direction of the pattern changes for each side. For the LEDs on the left side the pattern starts at the bottom LEDs (**right** side of pattern is for the top LEDs), and for the LEDs on the right side the pattern starts at the top LEDs (**left** side of the pattern is for the top LEDs).



Click ‘OK’ when done.

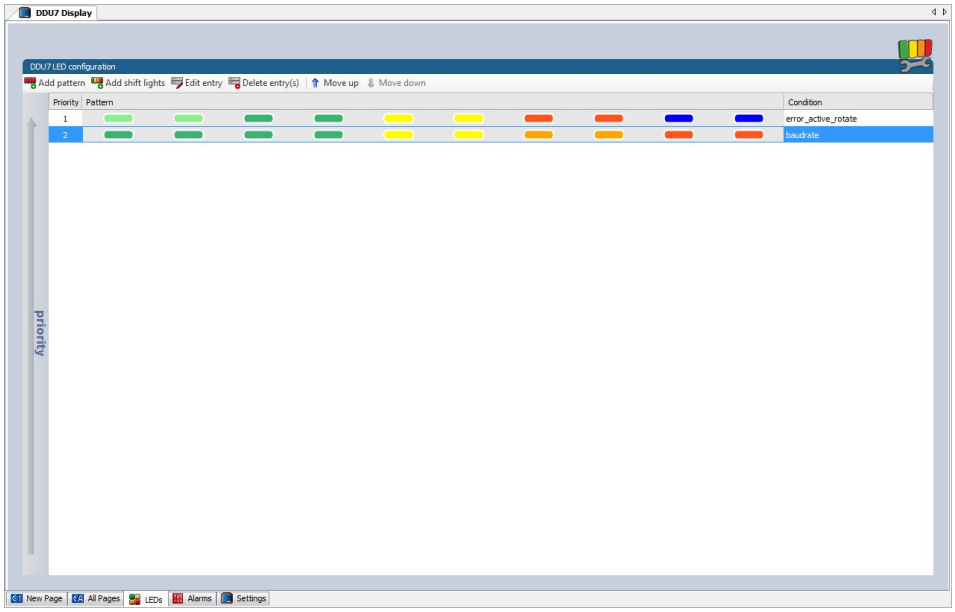
The configuration is displayed in the CAS-M 3 EVO LED Configuration window.

8.6.3 Assigning display pattern priority

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

The pattern with a higher priority will always cover patterns with a lower priority, when it becomes active. If a transparent (grey) LED is used in a pattern, the LEDs of lower patterns will be visible. Please ensure that for example shift lights do not cover important warnings.

Click the ‘Move up’ or ‘Move down’ button to change the priority. The pattern with the lowest number will have the highest priority.



8.6.4 Using LED sidebar for Overtaking warning

Additionally the LED sidebars of the CAS-M 3 EVO display can be used for overtake warnings.

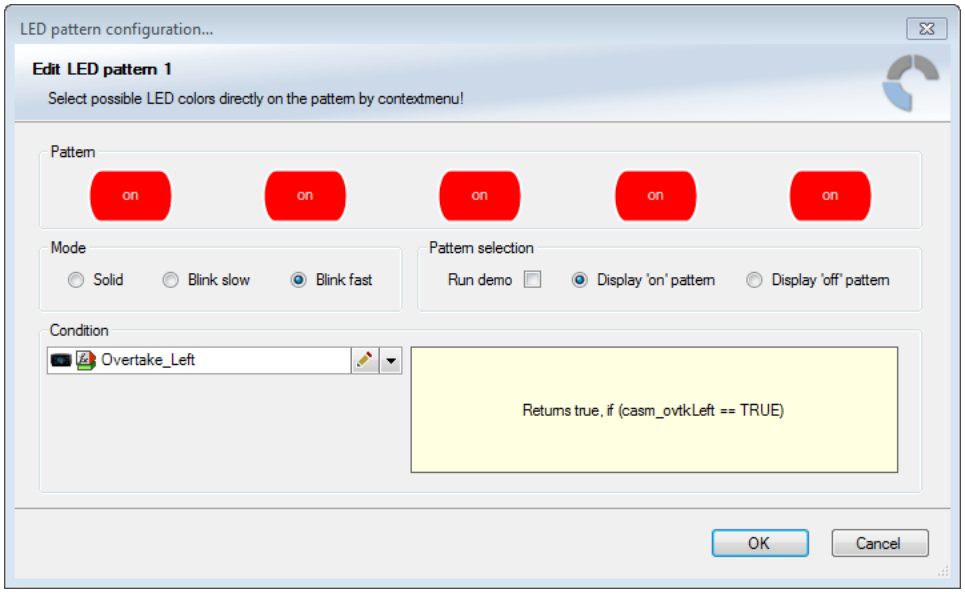
Trigger conditions for the overtake warnings are the following channels:

casm_ovtkLeft

casm_ovtkRight

These signals reflect the activation of the overtake-warning arrows on the display.

Example for overtake warning on the left:



Documents about this

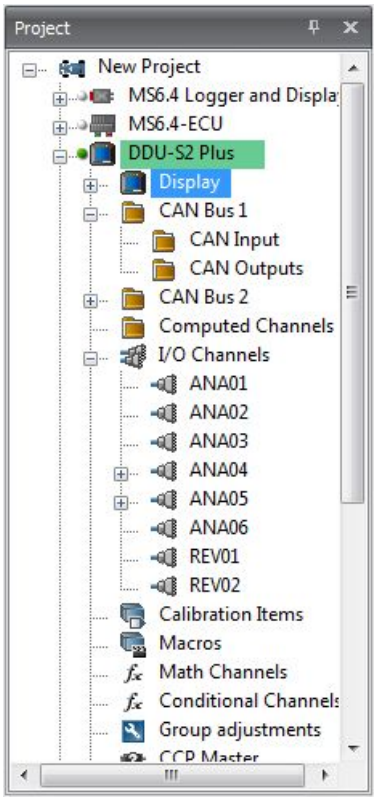
LEDs [▸ 28]

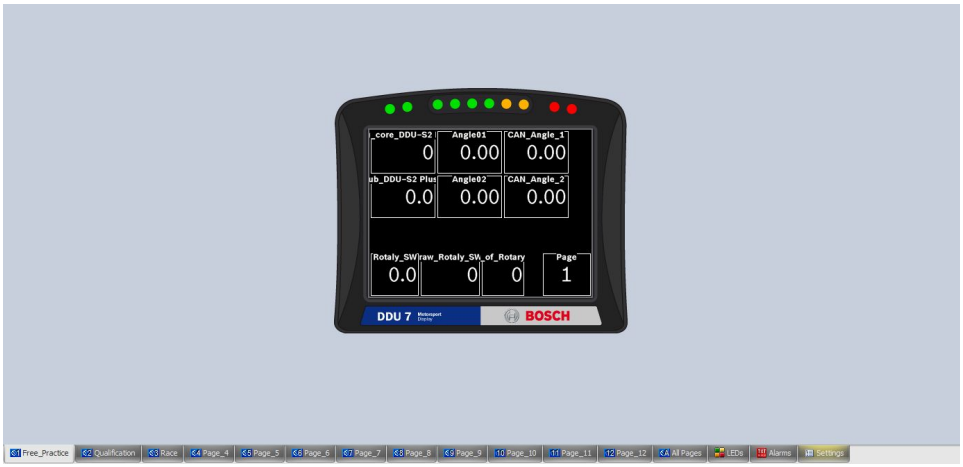
8.7 Display + LED brightness

Any “event” can be used to change display brightness. This can be a math channel etc.

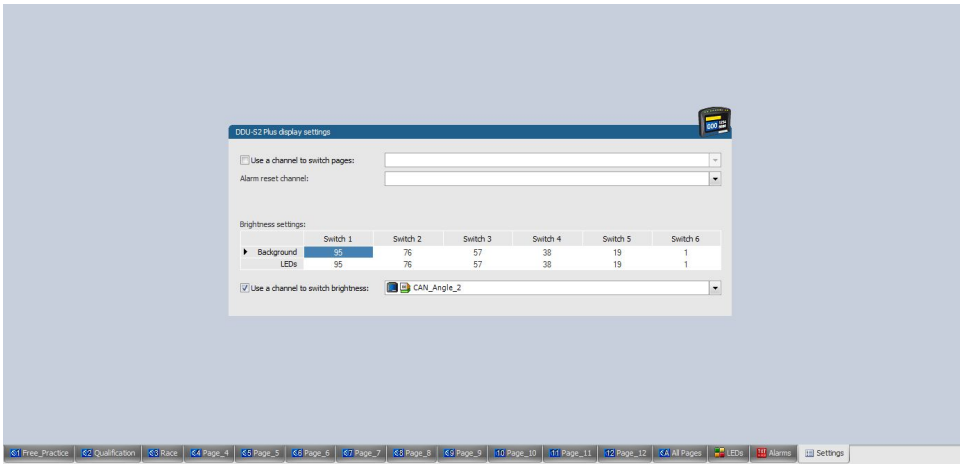
CAN input signal and math channel

Select Display and Setting.





Check “Use a channel to switch brightness:” and select CAN channel or math channel.
Change value for Background and LEDs for each switch position if it is needed.



The channel has to include value from 0.5 to 5.5.

Switch 1 is shown with the value <1.5

Switch 2 is shown with 1.5< = the value <2.5

Switch 3 is shown with 2.5< = the value <3.5

Switch 6 is shown with 5.5< = the value

9 CAN Configuration

The CAS-M 3 EVO has 1 (plus 1 private, hands off here!) fully configurable CAN bus(es).

- Baudrate 125 kbaud to 1 Mbaud
- 11 Bit or 29 Bit identifiers
- Input configuration: Read messages from CAN bus and convert to CAS-M 3 EVO measurement/display variables. CAN bus supports row counter configuration.
- Output configuration: Write RaceCon measurement variables to CAN messages; output frequency and row counter are configurable, CAN gateway functionality (transfer from one bus to another).

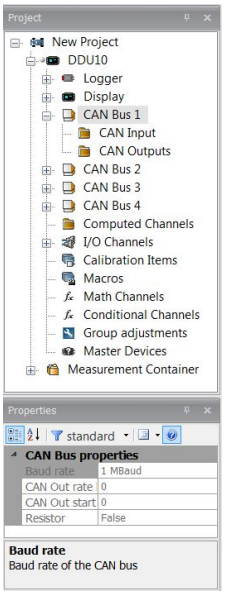
9.1 CAN Bus Trivia

CAN Message

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

CAN Bus

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



Row Counter Concept

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

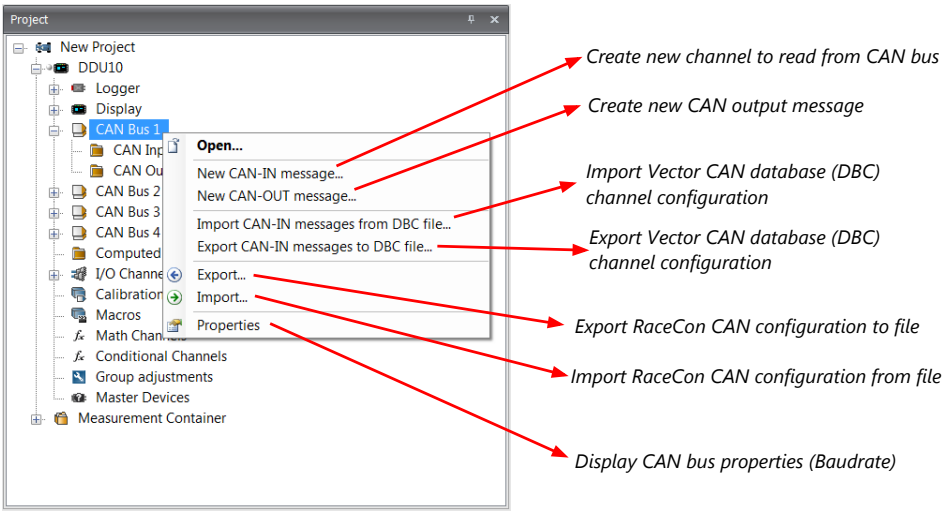
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x100	0	p_oil		t_oil				
0x100	1	s_dam_fl		s_dam_fr				
0x100	2	s_dam_rl		s_dam_rr				

Message Id ***Row Counter*** ***Payload Area***

9.2 CAN input

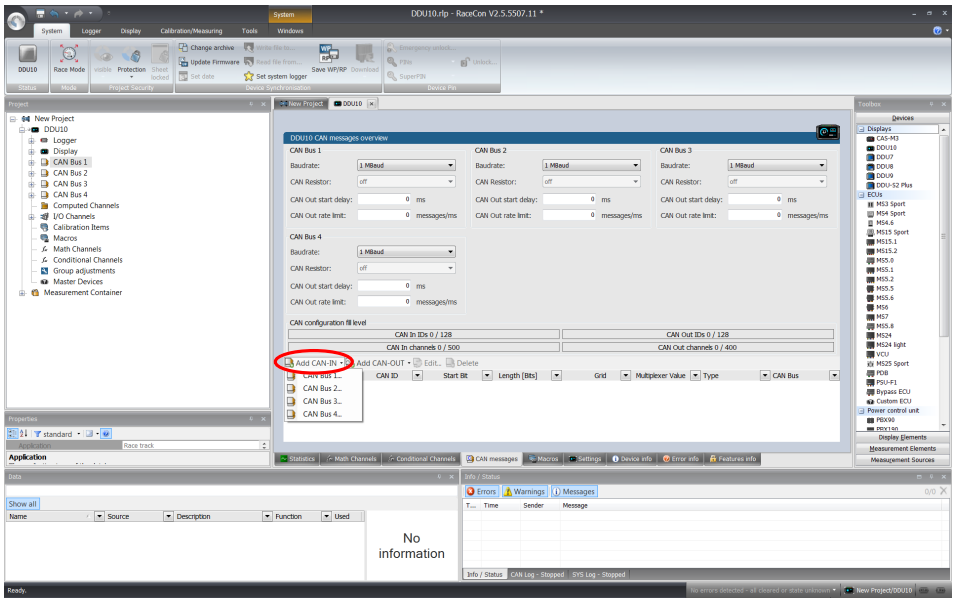
9.2.1 Input configuration

Click with the right mouse button on the desired CAN bus to open the CAN bus drop-down menu.



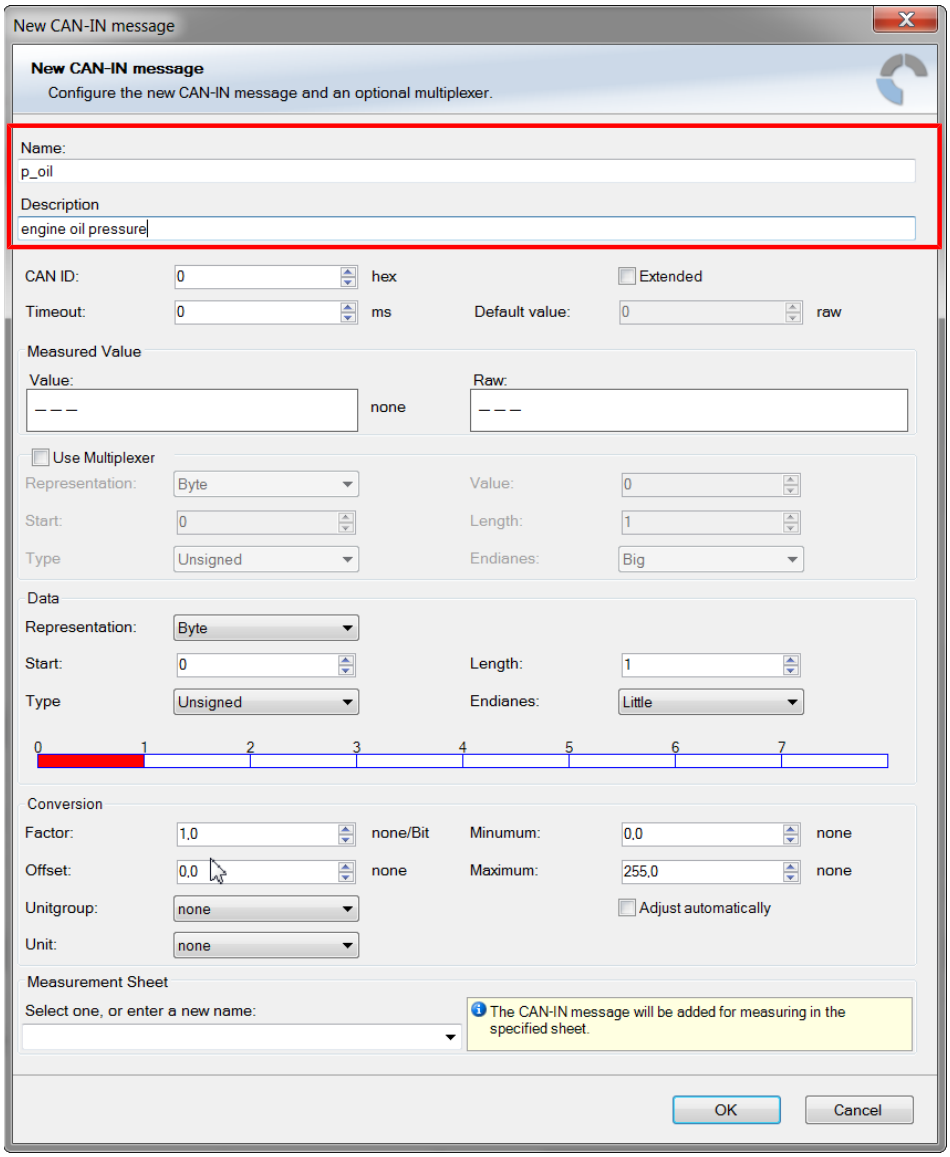
9.2.2 Create new CAN Input channel

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

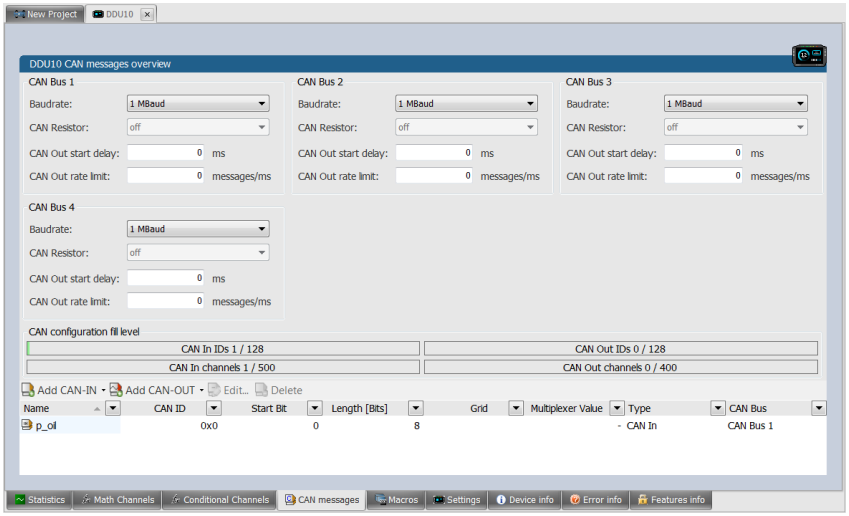


3. A CAN channel configuration window opens.

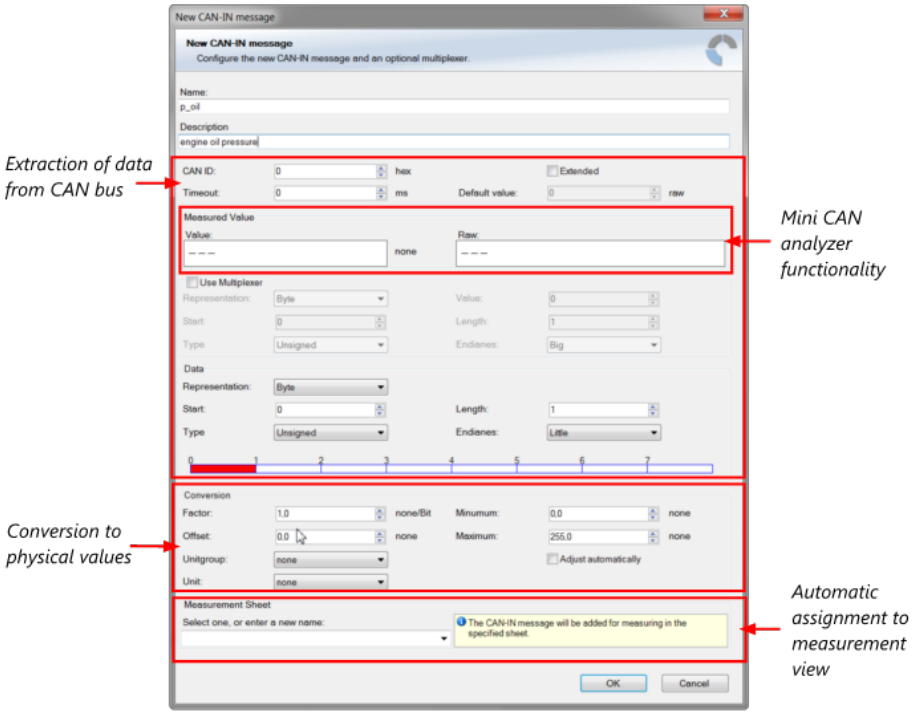
4. Insert the name and description of the channel.



5. Click ‘OK’ when done.
   The channel is listed in the Data window.



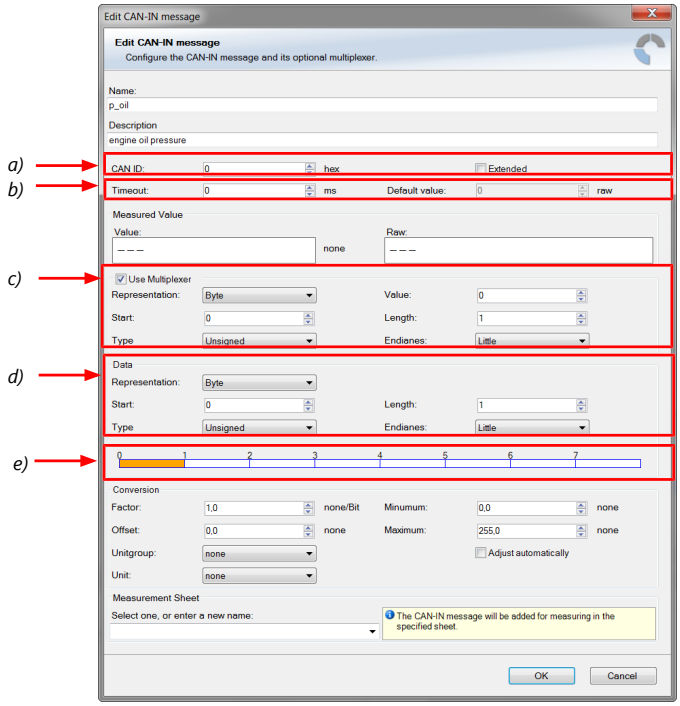
CAN channel configuration



9.2.3 Extracting data from CAN bus

Representation: Byte

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



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

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

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

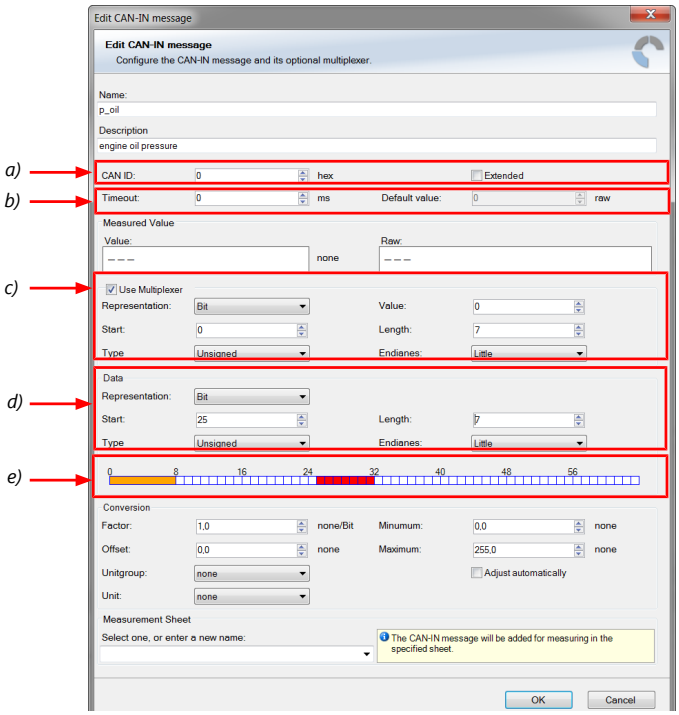
d) Enter data position, length and format.

e) The bargraph shows assignment of the bytes.

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

Representation: Bit

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



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

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

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

d) Enter data position, length and format.

e) The bargraph shows assignment of the bytes.

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

Conversion to physical value

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

b) Enter offset for conversion to physical value.

c) Select type of physical value.

d) Select unit of physical value.

e) Enter minimum physical limit of the channel. (for manual setup)

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

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

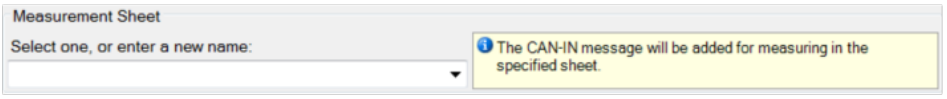
CAN analyzer functionality

This functionality is only available, if a MSA-Box (I or II) is used to connect the CAS-M 3 EVO 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.

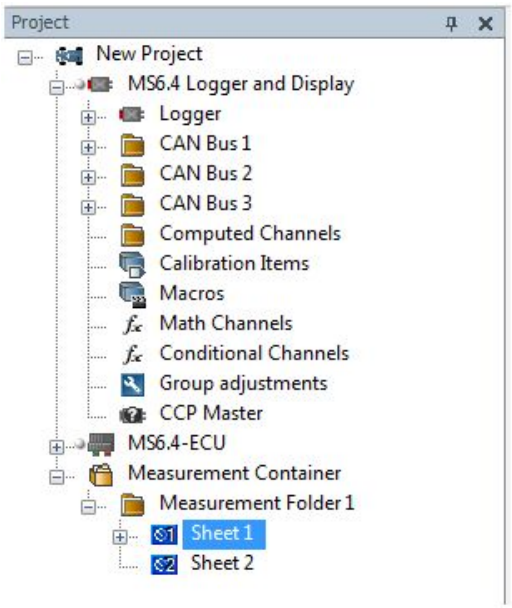
Automatic creation of online measurement sheets

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

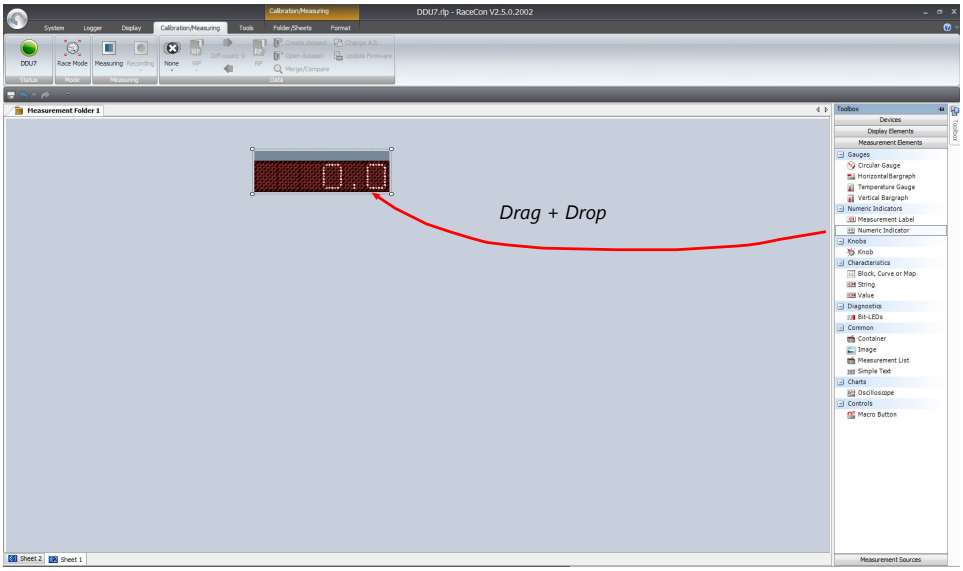
For an online view of the value measured by the CAS-M 3 EVO, insert the channel in an online measurement sheet which is described in the chapter Setting up an online measurement.



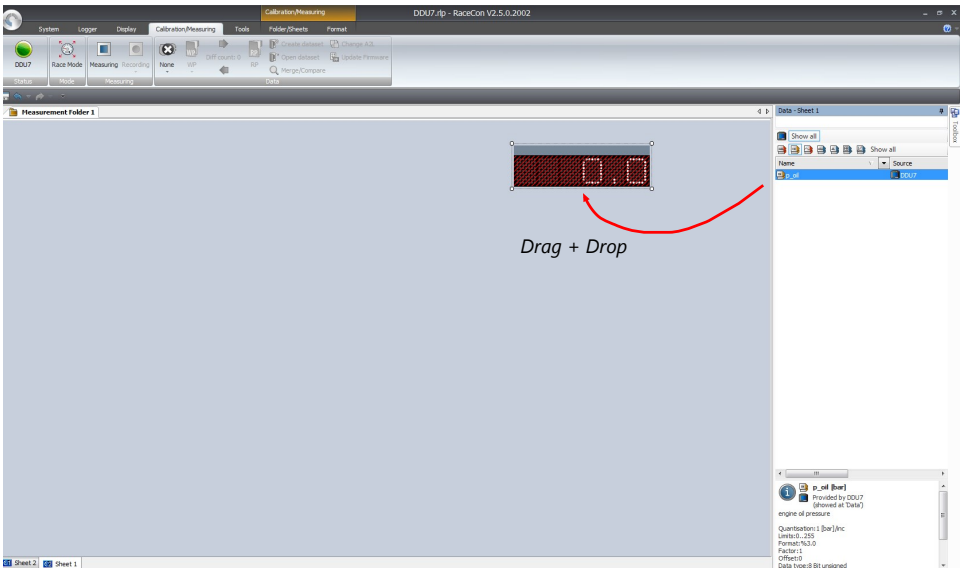
9.2.4 Online view of CAN channels in vehicle



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



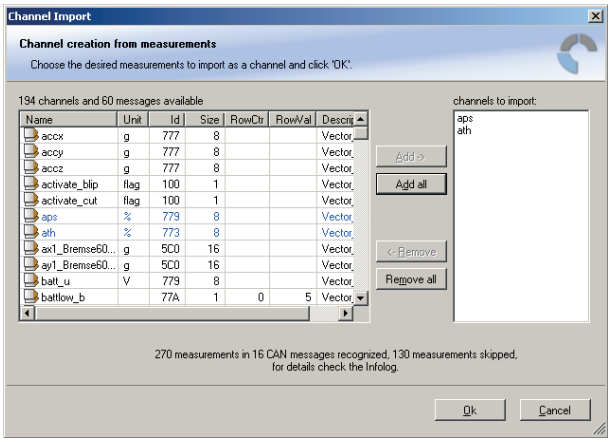
4. Click on folder ‘CAN Input’ of desired CAN bus to display available channels.
5. Drag desired Measurement channel and drop it on the Measurement element.



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

9.2.5 Import a CAN database (DBC) file

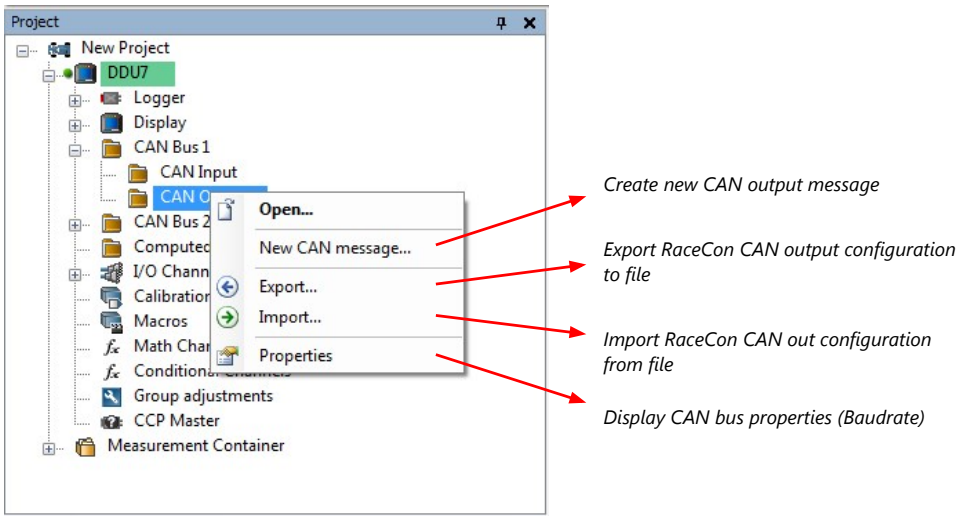
1. Right-click on CAN Input of desired bus (CAN1 or CAN2).
2. Select ‘Import DBC file’ from menu. A file browser opens.
3. Select DBC file to import and click ‘OK’ when done. A channel import window opens.



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

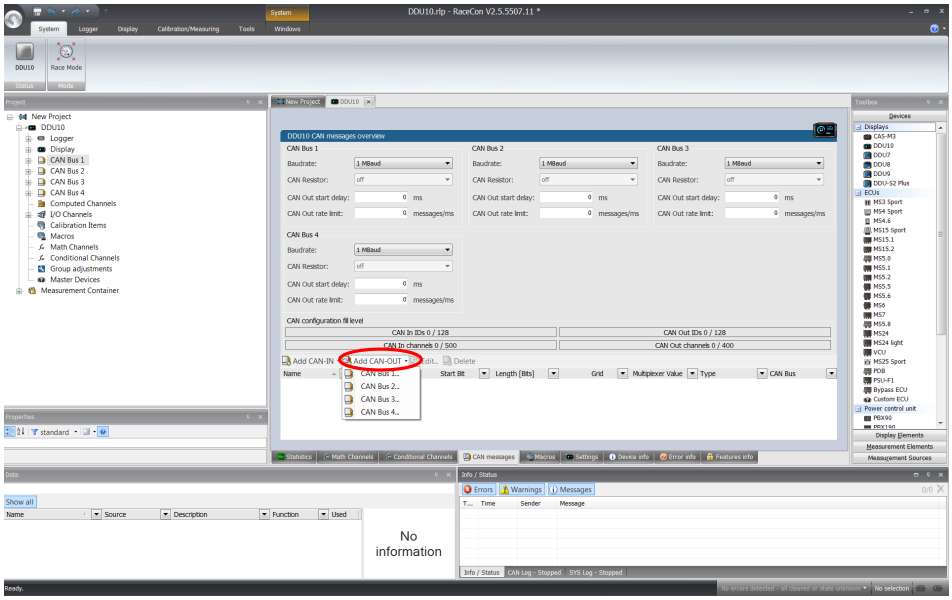
9.3 CAN output

9.3.1 Output configuration

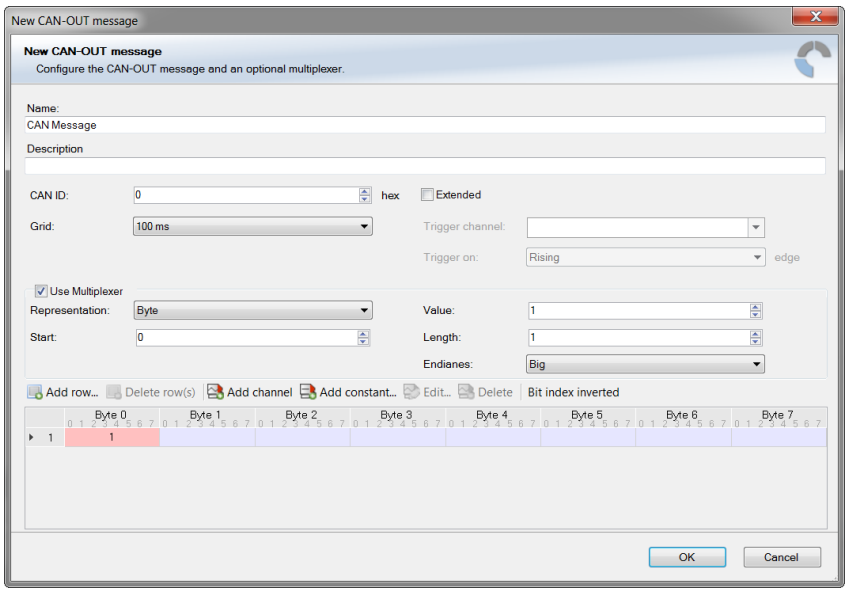


9.3.2 Create a new CAN output message channel

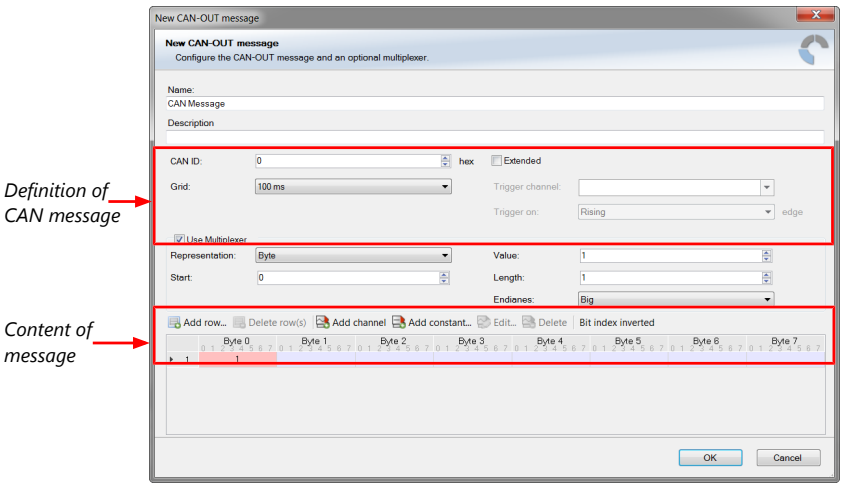
- Double-click on any CAN bus item to open the "CAN messages overview".
- Select ‘Add CAN-OUT’ and choose the desired CAN bus for the new output channel.



– The ‘New CAN-OUT message’ window opens.

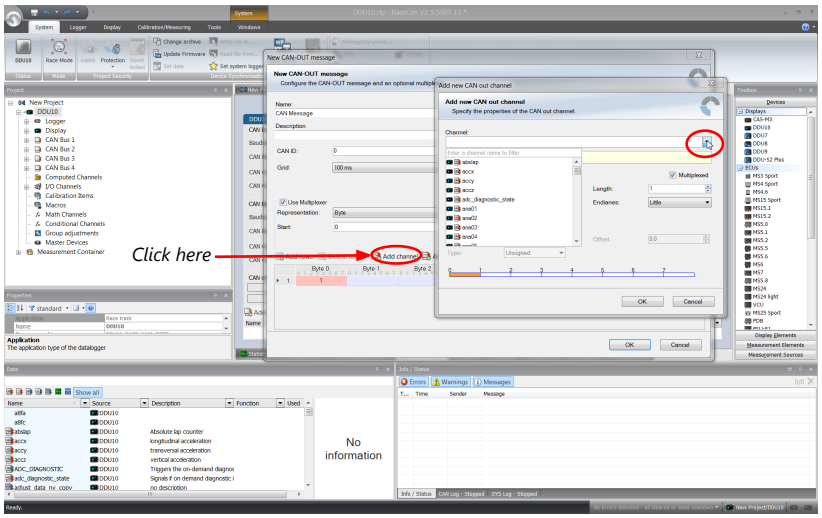


– Enter name of message, description, CAN-Id, and Grid (output interval). Optionally, specify a multiplexer.



– Click on ‘Add channel...’ or ‘Add constant...’, this opens the ‘Add new CAN out channel’ window.

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

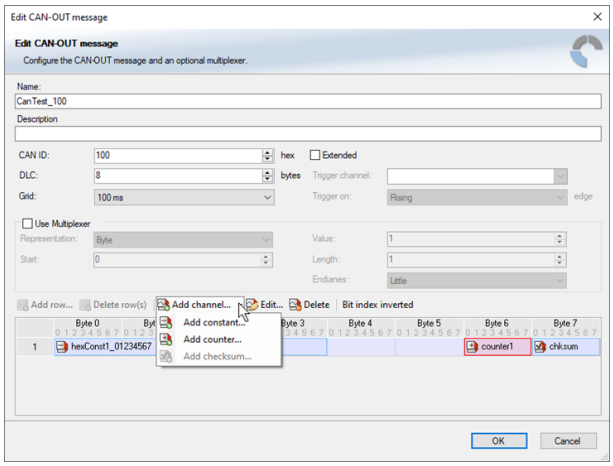


The measurement channel is now assigned to the CAN message.

9.3.2.1 Add CAN out constant

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

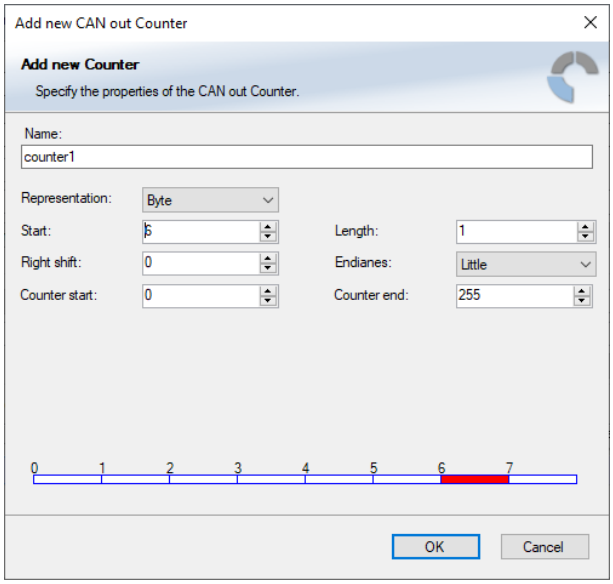
1. Create a new CAN output message or edit an existing message.
2. Click small arrow beside ‘Add channel...’ and select ‘Add constant...’. The ‘Add new CAN Out constant’ window appears.
3. Define the name of the constant, the required value in hex and define the CAN channel settings.
4. Click ‘OK’ when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



9.3.2.2 Adding CAN out counter

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

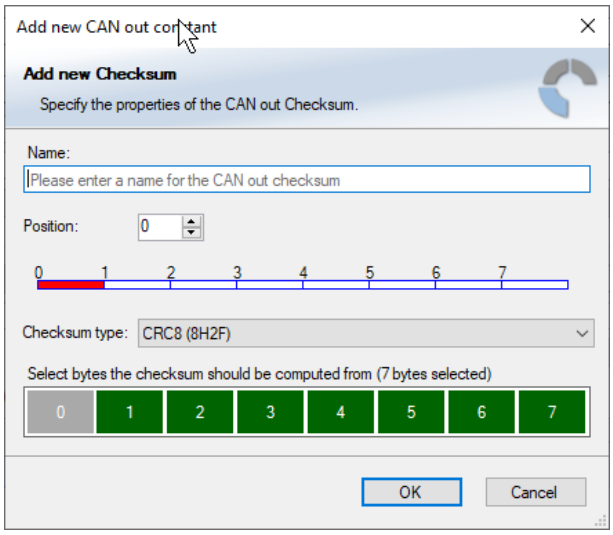
1. Create a new CAN output message or edit an existing message.
2. Click small arrow beside ‘Add channel...’ and select ‘Add counter...’. The ‘Add new CAN out counter’ window appears.
3. Define the name of the counter, define the CAN channel settings.
4. Click ‘OK’ when done.



9.3.2.3 Adding CAN out checksum

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

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



9.4 Multiplexer

Row counter concept

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

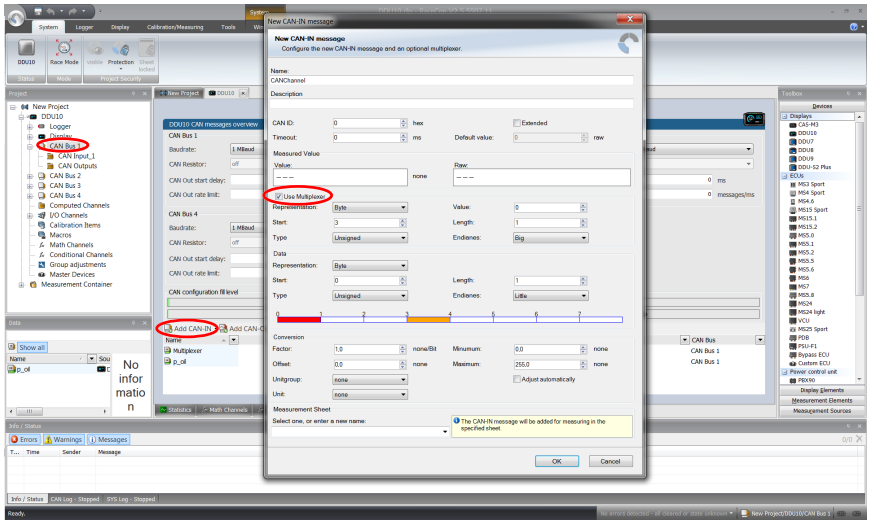
- Re-use (multiplex) of message identifiers by splitting it into several rows.
- Every row is assigned to a unique value of the multiplexer.
- One byte of message contains row counter.

– 7 bytes payload remaining. A multiplexer does not have to consist of one byte only, it can consist of several bytes as well as single bits.

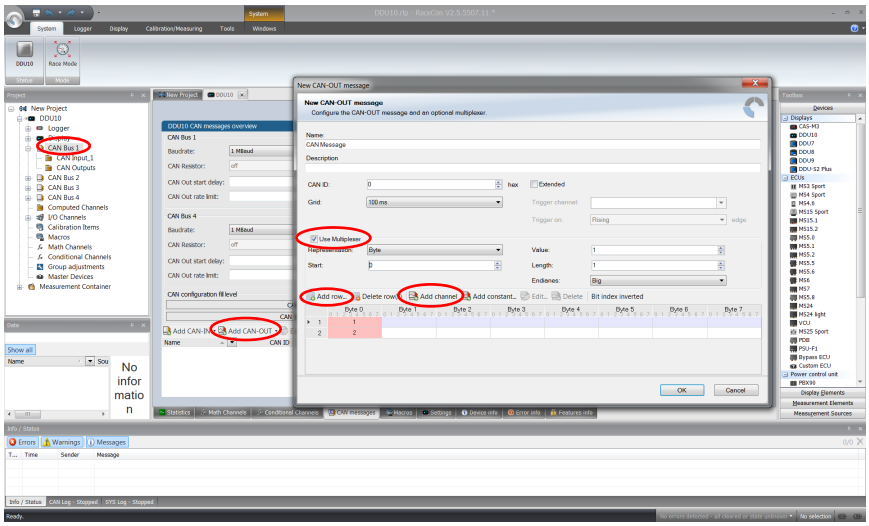
– Position of row counter is configurable.

To use a multiplexer perform the following steps:

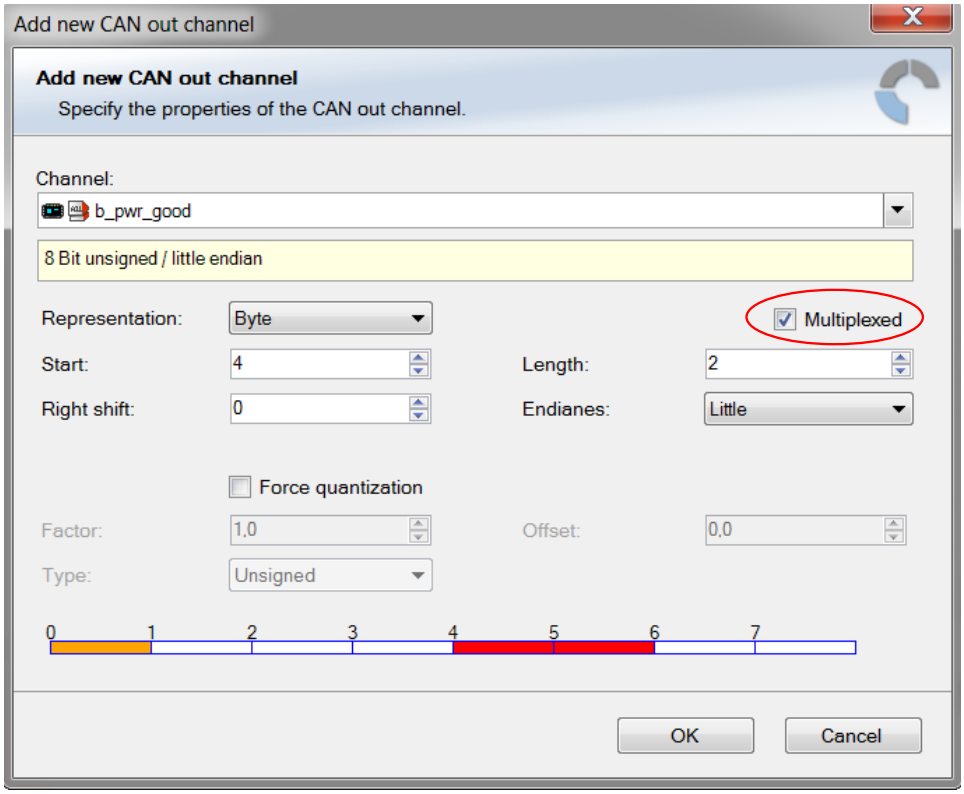
1. Double-click on any CAN bus item to open the “CAN messages overview”.
2. Select ‘Add CAN-IN’ and choose the desired CAN bus for the new input channel.
3. Check the box ‘Use Multiplexer’ and configure the multiplexer for the new CAN-IN channel.



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

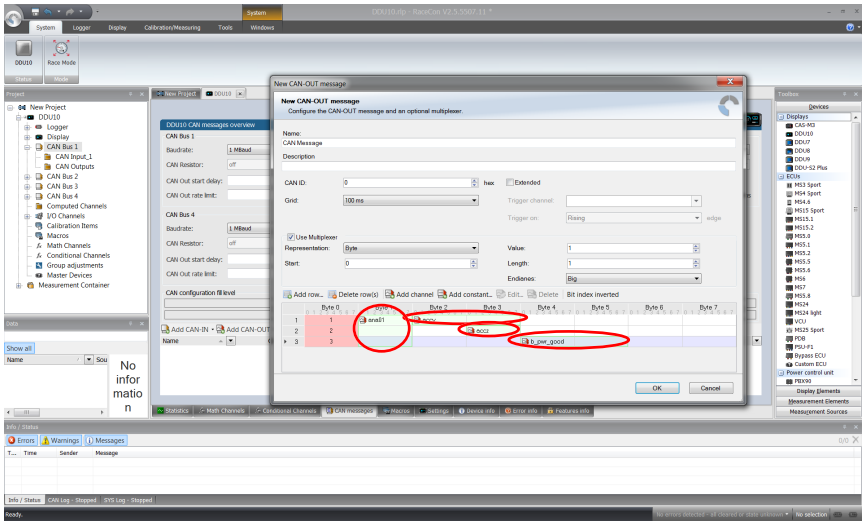


7. The ‘Add new CAN out channel’ dialog opens.
8. Select a channel and configure it. To assign it to the row selected before, check the box ‘Multiplexed’.
9. To move the channel message, change the “Start” value or click and hold the green field in the “Add new CAN out message” window.
10. Click ‘OK’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



11. The channel message is assigned to the selected fields.

12. Click ‘OK’ when done.



10 System Messages and Troubleshooting

In case of errors between the CAS-M 3 EVO display and the radar or camera, corresponding messages are shown on the display. Below is a list of the possible messages and their causes.

10.1 Camera status messages casm_cameraStatus

[0] OK

[1] Link down; searching for link partner

The Ethernet link is down on the camera interface; if the message persists beyond a few seconds after system power-up, this indicates an error condition.

Possible causes:

- camera powered off or disconnected
- cabling or connector issues
- internal display / camera fault

[2] Link up; searching for camera

The display has linked-up to an Ethernet network and is looking for a GigE-Vision camera; if the message persists beyond a few seconds after system power-up this indicates an error condition.

Possible causes:

- the display is connected to an unexpected Ethernet device
- internal display / camera fault

[3] Error: unknown camera

- The display is connected to a GigE-Vision camera but the camera model is unknown. Check / replace the connected camera.

[4] Error: locked camera

- The display is connected to a supported GigE-Vision camera model, but the camera is not unlocked for operation within the CAS-M 3 EVO system. Contact Bosch Motorsport.

[5] Error: video stream unstable

The display is correctly connected to the camera but fails to receive a (stable) video stream. The message can be permanent or indicate sporadic stream losses.

Possible causes:

- cabling or connector issues (vibrations)
- internal display / camera fault

[6] Overheat

The internal camera temperature has exceeded 70°C

For further information, see Camera Temperature Warning.

10.2 Radar status messages casm_radarStatus

[0] OK

[1] CAN bus error

This message indicates a physical error on the CAN bus to the radar sensor.

Possible causes:

- radar powered off or disconnected
- cabling or connector issues
- internal display / radar fault

[2] No data from radar

The display does not receive any CAN message from the radar sensor.

Possible causes:

- radar powered off or disconnected
- cabling or connector issues
- internal display / radar fault

[3] Incomplete data from radar

The display does not receive some CAN message from the radar sensor.

Possible causes:

- cabling or connector issues
- internal display / radar fault

[4] vehSpeed / yawRate error

This message indicates an error in the sending of vehicle information to the radar sensor.

Possible causes:

- Vehicle Speed / Yaw Rate signals are not configured (see section “Input Signals”)
- Vehicle Speed / Yaw Rate signals are configured but not received by the display
- Vehicle Speed / Yaw Rate signals are not received by the radar sensor
  - cabling or connector issues
  - internal display / radar fault

[5] Overheat

The internal radar temperature has exceeded 120°C.

11 CAS-M 3 Signals

11.1 Main Signals - Function CASM_Main

Beyond the overlay configuration parameters (see section “Display Configuration”), the function CASM_Main contains the following signals:

casm_camerastate

An enumeration reflecting the camera state is outlined in section “Camera status messages casm_cameraStatus [▶ 48]”.

casm_radarstate

An enumeration reflecting the radar state is outlined in section “Radar status messages casm_radarStatus [▶ 49]”.

casm_ovtk*

The current overtake warning states; see section “Using LED sidebar for Overtaking warning”.

11.2 Radar Signals - Function CASM_Radar

MRR_EgoVehSpeed

The ego vehicle speed as sent to the radar sensor.

MRR_EgoYawRate

The ego yaw rate as sent to the radar sensor.

MRR_Errors

A bitmask summarising possible errors on the CAN interface to the radar sensor:

- Bit 0: ego vehicle speed error (display-side: not configured or not received)
- Bit 1: ego yaw rate error (display-side: not configured or not received)
- Bit 4: “race car 0” message time-out
- Bit 5: “race car 1” message time-out
- Bit 6: “race car 2” message time-out
- Bit 7: “race car 3” message time-out
- Bit 8: “Object ID” message time-out
- Bit 12: “status” message time out
- Bit 16: ego vehicle speed error (radar-side: not received)
- Bit 17: ego yaw rate error (radar-side: not received)

MRR_RaceCar*

- The data on tracked race cars as received per CAN from the radar sensor.

MRR_Status*

– Radar sensor information (internal temperature + ego data acknowledgement).

11.3 Camera debug Signals - Function CASM_Camera_debug

CASM_Camera_debug contains various GigE-Vision error flags and counters which can be used by Bosch Motorsport to analyse video issues in the CAS-M 3 EVO system. Their description is beyond the scope of this document.

Name	Source	Description
GEV_Errors	CAS-M3	GEV video error states
GEV_frameDT	CAS-M3	GEV frame period
GEV_sessionState	CAS-M3	GEV session state (GVCP)
GEV_streamState	CAS-M3	GEV video stream state (GVSP)
gvcp_net_ACKed	CAS-M3	GVCP acknowledged packets
gvcp_net_sent	CAS-M3	GVCP sent packets
gvcp_net_unexpected	CAS-M3	GVCP unexpected packets received
gvsp_blocks	CAS-M3	GVSP received blocks
gvsp_err_blockId	CAS-M3	GVSP errors: unexpected block Id
gvsp_err_ethCRC	CAS-M3	GVSP errors: incorrect ethernet CRC
gvsp_err_packetId	CAS-M3	GVSP errors: unexpected packet Id
gvsp_err_payloadSize	CAS-M3	GVSP errors: unexpected payload size
gvsp_err_payloadType	CAS-M3	GVSP errors: unexpected payload type
gvsp_err_status	CAS-M3	GVSP errors: packet status not GEV_STATUS_SUCCESS
gvsp_err_watchdog	CAS-M3	GVSP errors: watchdog
gvsp_frames	CAS-M3	GVSP frame counter
gvsp_linkUp	CAS-M3	Ethernet link to camera up
gvsp_packets	CAS-M3	GVSP received packets
gvsp_VDMA_EOLEarly	CAS-M3	GVSP VDMA end of line early
gvsp_VDMA_EOLLate	CAS-M3	GVSP VDMA end of line late
gvsp_VDMA_SOFEarly	CAS-M3	GVSP VDMA start of frame early
gvsp_VDMA_SOFLate	CAS-M3	GVSP VDMA start of frame late
gvsp_VDMASR	CAS-M3	GVSP VDMA status register

Illustration 7: CASM Camera Debug list

11.4 Radar debug Signals - Function CASM_Radar_debug

CASM_Radar_debug contains the radar CAN message counters.

Name	Source	Description
MRR_OIDs_msgCtr	CAS-M3	OIDs CAN message counter
MRR_RaceCar0_msgCtr	CAS-M3	Racecar 0 CAN message counter
MRR_RaceCar1_msgCtr	CAS-M3	Racecar 1 CAN message counter
MRR_RaceCar2_msgCtr	CAS-M3	Racecar 2 CAN message counter
MRR_RaceCar3_msgCtr	CAS-M3	Racecar 3 CAN message counter
MRR_Status_msgCtr	CAS-M3	Radar state CAN message counter

Illustration 8: CASM Radar Debug list

12 Firmware

12.1 Firmware and configuration

CAS-M 3 EVO holds 2 types of data:

Firmware: The software (PST program file) of the CAS-M 3 EVO.

Configuration: The default parameters for controlling the output of the CAS-M 3 EVO.

12.2 Firmware update

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

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

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

13 RaceCon Shortcuts

The table shows important shortcuts simplify controlling the CAS-M 3 EVO 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

14 Disposal

Hardware, accessories and packaging should be sorted for recycling in an environment-friendly manner.

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

15 Order numbers and accessories

Parts	Order number
Collision Avoidance System CAS-M 3 EVO	F02U.V02.648-02
Acceleration Sensor MM5.10 Without wire (1)	F02U.V01.511-02
Acceleration Sensor MM5.10 Wire with open end (2)	F02U.V01.511-92
Acceleration Sensor MM5.10 Wire with motorsport connector (3)	F02U.V01.512-03
Accessories	
Display Unit	F02U.V02.660-02
Rear Module (Consisting of parts (A) to (E)	F02U.V02.630-02
Radar Bracket (A)	F037.D00.084-01
Radar Unit (B)	F02U.V02.647-01
Camera Unit (C)	F02U.V02.799-01
Wiring Harness for Radar and Camera (D)	F02U.V02.802-02
Interface Module (Housing and Electronics) (E)	F02U.V02.639-01

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16.2 Open Source Software (OSS) Declaration for the Camera of the Rear Module

These third party software components are used within the camera

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The primary ANTLR guy:

Terence Parr

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parrt@antlr.org

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Applies To:

libgre.dll, libgre.a

The Graphic Runtime engines used on most operating systems, including all Windows platforms (win32).

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16.3.6 EZXML License

The ezxml library (ezxml.sourceforge.net) provides XML model parsing support for the Graphic Engine.

Applies To:

libgre.dll, libgre.a

The ezxml xml parsing library is used by all Graphic Engine runtime configurations

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16.3.7 FreeType License

The FreeType Project's www.freetype.org) library is used by the Graphic Engine for non-bitmap font rendering.

Applies To:

All Graphic Runtime Engines using sbfreetype libraries

Applies To:

librender-plugin-*.dll, librender-plugin-*.a

Unless explicitly configured, all Graphic Engine render plugins link against the FreeType libraries.

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16.3.8 GNU LESSER GENERAL PUBLIC LICENSE (pthread-win32)

Applies To:

All Graphic Runtime Engines using Windows operating systems

Applies To:

pthreadVC2.dll, pthreadVC2.lib

This provides POSIX pthread API functionality in a Windows environment (win32, wince, wincompact7, wec2013).

Project Page: https://www.sourceware.org/pthreads-win32/

pthreads-win32 - a POSIX threads library for Microsoft Windows

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tests/rwlock7.c

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Why pthreads-win32 did not use the GNU General Public License

The goal of the pthreads-win32 project has been to provide a quality and complete implementation of the POSIX threads API for Microsoft Windows within the limits imposed by virtue of it being a stand-alone library and not linked directly to other POSIX compliant libraries. For example, some functions and features, such as those based on POSIX signals, are missing.

Pthreads-win32 is a library, available in several different versions depending on supported compilers, and may be used as a dynamically linked module or a statically linked set of binary modules. It is not an application on it's own.

It was fully intended that pthreads-win32 be usable with commercial software not covered by either the GPL or the LGPL licenses. Pthreads-win32 has many contributors to it's code base, many of whom have done so because they have used the library in commercial or proprietry software projects.

Releasing pthreads-win32 under the LGPL ensures that the library can be used widely, while at the same time ensures that bug fixes and improvements to the pthreads-win32 code itself is returned to benefit all current and future users of the library.

Although pthreads-win32 makes it possible for applications that use POSIX threads to be ported to Win32 platforms, the broader goal of the project is to encourage the use of open standards, and in particular, to make it just a little easier for developers writing Win32 applications to consider widening the potential market for their products.

16.3.9 log4j.jar License

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16.3.10 Lua License

The Lua engine (http://www.lua.org) provides a script interface for manipulating content in a Graphic application.

Applies To:

libgre-plugin-lua.dll, libgre-plugin-lua.a

The Lua Graphic Engine plugin

License for Lua 5.0 and later versions

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16.3.11 opencsv License

opencsv http://opencsv.sourceforge.net sconway@users.sourceforge.net arjones@t-online.de

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Version 2.0, January 2004

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SharpZipLib 0.86.0 © Mike Krueger and John Reilly https://github.com/icsharpcode/SharpZipLib

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16.3.14 Simple OpenGL Library License (SOIL)

The SOIL library (http://www.lonesock.net/soil.html) is used to load images in a Graphic application.

Applies To:

libgre.dll, libgre.a

The SOIL image library is used by all Graphic Engine runtime configurations

Jonathan Dummer

2007-07-26-10.36

Simple OpenGL Image Library

Public Domain

using Sean Barret's stb_image as a base

Thanks to:

* Sean Barret - for the awesome stb_image

* Dan Venkitachalam - for finding some non-compliant DDS files, and patching some explicit casts

* everybody at gamedev.net

16.3.15 stringtemplate License

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16.4 Radar Sensor

16.4.1 Regulations

The CAS-M 3 EVO radar sensor is based on the Bosch Engineering MRRe14HBW radar sensor. The MRRe14HBW meets the following statutory requirements for ground-based vehicles.

Country	Regulations
Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Iceland, Liechtenstein, Norway, Switzerland	Radio Equipment Directive 2014/53/EU Restriction of the use of certain hazardous substances (RoHS) Directive 2011/65/EU Chemical substances (REACH) Regulation (EC) No 1907/2006 ETSI EN 301 091-1 V2.1.1 (2017-01) ETSI EN 301 091-3 V1.1.1 (2017-02) ETSI EN 303 396 V1.1.1 (2016-12) ETSI EN 301 489-1 V2.2.3 (2019-11) ETSI EN 301 489-3 V2.1.1 (2019-03) ETSI EN 301 489-51 V2.1.1 (2019-04) EN 62368-1:2014/AC:2015 IEC 62368-1:2014(2nd Edition) + Cor. 1: 2015 EN 62311 (2008-01) DIN EN ISO 13849-1:2015 DIN EN ISO 13849-2:2012
USA	47 CFR §2.925 47 CFR §15.19 47 CFR §15.21 47 CFR §15.105 47 CFR §95.3331 47 CFR §95.3361 47 CFR §95.3367 47 CFR §95.3379 47 CFR §95.3385 UL 94 40 CFR §761.185 Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 - Sect. 1502. Conflict minerals
Canada	Canadian Environmental Protection Act, 1999 (CEPA, 1999) from 19.08.2018 RSS-GEN Issue 4 RSS-102 Issue 5 Section 2.6 RSS-251 Issue 2
Japan	ARIB STD-48 V2.2
Australia	Radiocommunications (Low Interference Potential Devices) Class License 2015 - F2016C00432 - Radiodetermination - sensors using radar for measurement, 69. Radiodetermination transmitters 76 - 77 GHz.
New Zealand	Radiocommunications Regulations (Radio Standards) Notice 2016 - Road Transport and Traffic Telematics (76 GHz) – Level A1 conformity based on the ETSI EN 301 091-1 V2.1.1 standard.

Country	Regulations
United Kingdom	Radio Equipment Regulations 2017 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

If the MRRe14HBW and hence the CAS-M 3 EVO radar sensor SCU is not operated within this context, it lies within the customer's responsibility to ensure compliance of the application with national regulations and standards, e.g., electromagnetic compatibility and radio spectrum matters.

Link to the up-to-date EU Declaration of Conformity DoC:

http://eu-doc.bosch.com

(Please enter the model MRRe14HBW on which CAS-M sensors are based on to find the correct DoC in the database.)

16.4.2 Intended Use

The application of the MRRe14HBW-based CAS-M 3 EVO radar sensor under the conditions described in this technical customer documentation and the associated arranged documents to described conditions (environment, application, installation conditions and loads) is a prerequisite for a warranty on the part of Bosch Engineering GmbH, that the product is suitable for the intended or usual application assumed after the contract, or has a certain state or quality.

All contractual requirements - including the aforementioned - are considered as fulfilled if the product passes the test range according to the technical customer documentation and the arranged documents. The safety of the application of the product in the vehicle is in the responsibility of the customer.

All changes in the surroundings of the product, which deviate from the technical customer documentation and the arranged documents, as well as use for applications not released by Bosch Engineering GmbH, are to be indicated to Bosch Engineering GmbH. Such an application or deployment of the product may take place only after release by Bosch Engineering GmbH on the basis of the changed surroundings or variance.

The product safety is ensured only if the permissible conditions are kept.

In the case of failure, the product needs to be replaced exclusively by an authorized body and is not serviceable.

The intended use of the CAS-M 3 EVO radar sensor is being mounted on ground based vehicles. These include but are not limited to construction equipment (excavators, dump trucks, bulldozers etc.), agriculture equipment (tractors, combine harvesters etc.), material handling equipment (forklifters, mobile industrial robots, cranes etc.), mobile work platforms, trains, trams, light rail vehicles, and automotive vehicles (passenger cars, trucks, busses).

It is not permitted to hand BOSCH ENGINEERING GmbH CAS-M 3 EVO **radar sensors, any documentation about BOSCH ENGINEERING GmbH** CAS-M 3 EVO **radar sensors, or any measurements using them to anyone who has not directly obtained the material from Bosch ENGINEERING GmbH.**

It is not permitted to re-sell BOSCH ENGINEERING CAS-M 3 EVO **radar sensors unless otherwise agreed upon.**

It is not permitted to publish any results using the data from the BOSCH ENGINEERING GmbH CAS-M 3 EVO **radar sensor, where it is publicly available unless otherwise agreed upon.**

It is not permitted to use the CAS-M 3 EVO **radar sensor as fixed infrastructure equipment.**

It is not permitted to use the CAS-M 3 EVO **radar sensor for military applications.**

It is not permitted to operate the CAS-M 3 EVO **radar sensor in any country where frequency homologation type approval is not available.**

In the case, frequency homologation is available in a country, it is not permitted to operate the CAS-M 3 EVO **radar sensor in applications not covered by this frequency homologation in said country.**

16.4.3 Radio Frequency Homologation

16.4.3.1 Basic information on radio frequency homologation and import requirements

Definitions

- In radio frequency homologation, the MRRe14HBW radar on which the CAS-M 3 EVO radar sensor is based on falls into the group of Short Range devices (SRD). This classification does not have any relation to the functional classification used for these radars.
- e.g.: a long range radar from Bosch also comes under the Short Range device classification.
- The radar sensor is a component that is part of a ground-based vehicle. The sensor as a component is not brought on to the market. This means that the sensor is not available for purchase by the target user.
- The radar sensor as a component cannot be operated stand alone. For the intended use of the component, a connection to the ground-based vehicle is required (data connection, supply voltage).
- In some countries, components that cannot be operated stand alone and also are designated to be mounted in a vehicle, are exempted from radio frequency licensing.
- The radar sensor intentionally radiates RF energy. Therefore, a radio frequency type approval license may be required for any country in which the sensor is intended to be operated.
- A ground-based vehicle consists of a number of components. Depending on the country, the vehicle may be subject to additional homologation requirements (e.g. registration of components).
- Type approval is the process by which any radio equipment is authorized to be used in a specific country. The equipment's compliance with the applicable standards and regulations has to be checked by the customer (upon request, BEG may assist in this process).

Overview Homologation: tasks and responsibilities

	Radio frequency homologation (component)	Equipment Type Approval / Import license (vehicle)
Required for	Legal operation of the device in a country	Import and sale of a device in a country
Responsible	Bosch Engineering for countries specified in Chapter Regulations [▶ 75]	OEM / (local registered) importer (Bosch Engineering customer)
Certificate holder	Bosch Engineering	OEM / local agent / entity of OEM
Responsible for maintaining the certificate	Bosch Engineering for countries specified in Chapter Regulations [▶ 75]	OEM
Timing	Available with Bosch Engineering SOP of the device	Must be obtained prior to importing of ground-based vehicles in a country

Responsibilities of the vehicle manufacturer

- It is in the responsibility of the ground-based vehicle manufacturer to obtain the required equipment type approvals or import licenses for bringing a ground-based vehicle into the market in a specific country.
- On customer request, Bosch Engineering will provide the necessary technical radio frequency related documentation to the OEM that is required for applying and obtaining the component (equipment) type approval / import license for the radar sensor as a component of the ground-based vehicle in a specific country.
- The maintenance and renewal for the ground-based vehicle type approval certificates and import licenses for the relevant vehicle platforms is in the responsibility of the vehicle manufacturer.

Impact of import destinations

- Depending on the location of the OEM´s manufacturing plants, it needs to be clarified who will act as the importer of the radar sensor component into these countries.
- The importer responsibilities relevant to that country have to be fulfilled by the party accordingly

Responsibilities of Bosch Engineering

- Bosch Engineering only provides radio frequency homologation for the sensor in the countries mentioned in Chapter Regulations [▶ 75].

The radio frequency homologation certificates for the specific sensor for the countries mentioned in Chapter Regulations [▶ 75] are maintained by Bosch Engineering.

16.4.4 Remarks on the Radio Frequency Homologation

16.4.4.1 General Points

- Radio frequency homologation is required to operate 76-77 GHz radar sensors in a country. Frequency homologation in a country must be granted and available prior to selling in a country.

- Granting and defining the requirements for obtaining radio frequency type approvals is a task in the responsibility of a country´s telecommunication authority. Rejections of approvals or country specific restrictions are administrative decisions and cannot be influenced by Bosch Engineering.
- Bosch Engineering cannot control the elements involved in the radio frequency type approval process of a country:
  - Incurring costs and fees
  - Lead-time for obtaining the type approval
  - Validity of a type approval certificate
  - Content and requirements for obtaining a type approval certificate
  - Availability of the frequency band for radar sensor operation, as regulation may change
- The requirements and procedures for obtaining radio frequency type approval in a country may change. In case of uncertainty, reconfirmation of the requirements that apply may be necessary.

16.4.4.2 Markings on the Component and Manual Phrases

With receiving frequency homologation for a specific country, certain requirements have to be satisfied regarding

- Marking of the device
- Reproducing specific statements and labels in the vehicle user manual
- The markings to satisfy the homologation requirements of the Bosch Engineering focus countries are printed on the label on the back-cover of the CAS-M 3 EVO radar sensors
- Some of the countries listed in chapter Regulations [▶ 75] of this document have requirements regarding specific markings and phrases for the vehicle´s user manual, which are described in chapter Country Specific User Manual Statements [▶ 80].
- For any country in which no type approval of the CAS-M 3 EVO radar sensor is available through Bosch Engineering, additional requirements regarding markings and user manual phrases may exist.
- A country may require additional product registration and/or markings to be added on the device or in the user manual, for a ground-based vehicle equipped with a radar sensor. Obtaining this information and the implementation of these requirements is the responsibility of the ground-based vehicle manufacturer.
- ExampleCAS-M 3 EVO radar sensor label (located on the back side of the sensor; measures are in millimeters):

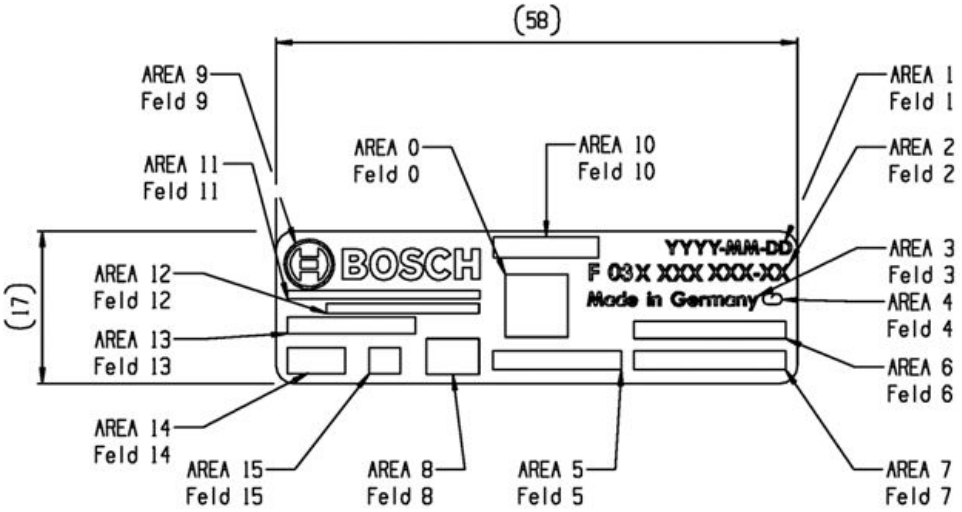

Illustration 9: Markings on the CAS-M 3 EVO Radar Sensor

Label area	Description
Area 0	Data matrix code
Area 1	Manufacturing date
Area 2	Product part number
Area 3	Designation of origin
Area 4	Business facility
Area 5	Naming
Area 6	Serial number
Area 7	Type naming
Area 8	CE conformity mark
Area 9	Bosch symbol and logotype
Area 10	Manufacturer address
Area 11	Frequency certification label / number USA
Area 12	Frequency certification label / number Canada
Area 13	Frequency certification label / number Japan
Area 14	Frequency certification label / number New Zealand
Area 15	Frequency certification label / number Australia

16.4.4.3 Countries where no type approval is obtained

Application for type approval in countries that are not listed in chapter Regulations [▶ 75] of this document may be handled on customer request and charged separately. In this case, the availability of the 76 GHz frequency range for ground-based vehicular radar, administrative requirements and incurring costs have to be confirmed by the customer prior to filing an application.

16.4.5 Country Specific User Manual Statements

The below mentioned countries have requirements regarding specific phrases that have to be reproduced in the vehicle user's manual. The specific phrases and labels result from the radio type approval requirements of those countries. The phrases have to be included in a conspicuous location in the vehicle user manual and accurately reprinted as indicated in the following sub-chapters:

16.4.5.1 Europe

16.4.5.1.1 Registration Name

MRRe14HBW

16.4.5.1.2 Required owner manual entry (DoC translations mentioned below)

Hereby, Bosch Engineering GmbH declares that the radio equipment type CAS-M 3 EVO radar sensor is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: http://eu-doc.bosch.com

Please enter the model MRRe14HBW to find the correct DoC in the database. The CAS-M 3 EVO radar sensor is based on the MRRe14HBW sensor mentioned in the declaration of conformity.

This Radio Equipment can be operated without member country restrictions related to Article 10(10) of the RE-D in the EU.

This Radio Equipment is constructed so that it can be operated in all EU member states without infringing applicable requirements with regard to the requirements on the use of radio spectrum.

Declaration of the technical parameters of the Radio Equipment under RE-D Article 10(8).

Frequency band	76-77 GHz
Nominal radiated power: e.i.r.p. (peak detector)	32 dBm
Nominal radiated power: e.i.r.p. (RMS detector)	27 dBm

16.4.5.1.3 Declaration of Conformity Translations

Following are the translations of the simplified DoC above in all EU languages.

Hereby, Bosch Engineering GmbH declares that the radio equipment type MRRe14HBW is in compliance with Directive 2014/53/EU.
The full text of the EU declaration of conformity is available at the following internet address: http://eu-doc.bosch.com

С настоящото Bosch Engineering GmbH декларира, че този тип радиосъоръжение MRRe14HBW е в съответствие с Директива 2014/53/ЕС.
Цялостният текст на ЕС декларацията за съответствие може да се намери на следния интернет адрес: http://eu-doc.bosch.com

Por la presente, Bosch Engineering GmbH declara que el tipo de equipo radioeléctrico MRRe14HBW es conforme con la Directiva 2014/53/UE.
El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente: http://eu-doc.bosch.com

Tímto Bosch Engineering GmbH prohlašuje, že typ rádiového zařízení MRRe14HBW je v souladu se směrnicí 2014/53/EU.
Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese: http://eu-doc.bosch.com

Hermed erklærer Bosch Engineering GmbH, at radioudstyrstypen MRRe14HBW er i overensstemmelse med direktiv 2014/53/EU.
EU-overensstemmelseserklær ingens fulde tekst kan findes på følgende internetadresse: http://eu-doc.bosch.com

Hiermit erklärt Bosch Engineering GmbH, dass der Funkanlagentyp MRRe14HBW der Richtlinie 2014/53/EU entspricht.
Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: http://eu-doc.bosch.com

Käesolevaga deklareerib Bosch Engineering GmbH, et käesolev raadioseadme tüüp MRRe14HBW vastab direktiivi 2014/53/EL nõuetele.
ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: http://eu-doc.bosch.com

Με την παρούσα ο/η Bosch Engineering GmbH, δηλώνει ότι ο ραδιοεξοπλισμός MRRe14HBW πληροί την οδηγία 2014/53/ΕΕ.
Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: http://eu-doc.bosch.com

Le soussigné, Bosch Engineering GmbH, déclare que l'équipement radioélectrique du type MRRe14HBW est conforme à la directive 2014/53/UE.
Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: http://eu-doc.bosch.com

Bosch Engineering GmbH ovime izjavljuje da je radijska oprema tipa MRRe14HBW u skladu s Direktivom 2014/53/EU.
Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: http://eu-doc.bosch.com

Il fabbricante, Bosch Engineering GmbH, dichiara che il tipo di apparecchiatura radio MRRe14HBW è conforme alla direttiva 2014/53/UE.
Il testo completo della dichiarazione di conformità UE è disponibile al seguente indirizzo Internet: http://eu-doc.bosch.com

Ar šo Bosch Engineering GmbH deklarē, ka radioiekārta MRRe14HBW atbilst Direktīvai 2014/53/ES.
Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē: http://eu-doc.bosch.com

Aš, Bosch Engineering GmbH, patvirtinu, kad radijo įrenginių tipas MRRe14HBW atitinka Direktyvą 2014/53/ES.
Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu: http://eu-doc.bosch.com

Bosch Engineering GmbH igazolja, hogy a MRRe14HBW típusú rádióberendezés megfelel a 2014/53/EU irányelvnek.
Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: http://eu-doc.bosch.com

B'dan, Bosch Engineering GmbH, niddikjara li dan it-tip ta' tagħmir tar-radju MRRe14HBW huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan l-indirizz tal-Internet li ġej: http://eu-doc.bosch.com

Hierbij verklaar ik, Bosch Engineering GmbH, dat het type radioapparatuur MRRe14HBW conform is met Richtlijn 2014/53/EU.
De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres: http://eu-doc.bosch.com

Bosch Engineering GmbH niniejszym oświadcza, że typ urządzenia radiowego MRRe14HBW jest zgodny z dyrektywą 2014/53/UE.
Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym: http://eu-doc.bosch.com

O(a) abaixo assinado(a) Bosch Engineering GmbH declara que o presente tipo de equipamento de rádio MRRe14HBW está em conformidade com a Diretiva 2014/53/UE.
O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet: http://eu-doc.bosch.com

Prin prezenta, Bosch Engineering GmbH declară că tipul de echipamente radio MRRe14HBW este în conformitate cu Directiva 2014/53/UE.
Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet: http://eu-doc.bosch.com

Bosch Engineering GmbH týmto vyhlasuje, že rádiové zariadenie typu MRRe14HBW je v súlade so smernicou 2014/53/EÚ.
Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese: http://eu-doc.bosch.com

Bosch Engineering GmbH potrjuje, da je tip radijske opreme MRRe14HBW skladen z Direktivo 2014/53/EU.
Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu: http://eu-doc.bosch.com

Bosch Engineering GmbH vakuuttaa, että radiolaitetyyppi MRRe14HBW on direktiivin 2014/53/EU mukainen.
EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: http://eu-doc.bosch.com

Härmed försäkrar Bosch Engineering GmbH att denna typ av radioutrustning MRRe14HBW överensstämmer med direktiv 2014/53/EU.
Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress: http://eu-doc.bosch.com

16.4.5.1.4 Homologation Label of Device

The homologation label is placed on the sensor label on its back side.

16.4.5.2 United Kingdom

16.4.5.2.1 Registration Name

MRRe14HBW

16.4.5.2.2 Required owner manual entry

Hereby, Bosch Engineering GmbH declares that the radio equipment type CAS-M 3 EVO radar sensor is in compliance with the relevant statutory requirements.

The full text of the EU declaration of conformity is available at the following internet address: http://gb-doc.bosch.com

Please enter the model MRRe14HBW to find the correct DoC in the database. The CAS-M 3 EVO radar sensor is based on the MRRe14HBW sensor mentioned in the declaration of conformity.

This Radio Equipment can be operated without restrictions on putting into service or requirements for authorisation of use in the United Kingdom with respect to Section 14 of the Radio Equipment Regulations 2017.

This radio equipment has been constructed so that it can be operated without causing an infringement of the applicable requirements on the use of the radio spectrum according to Section 8 of the Radio Equipment Regulations 2017

Declaration of the technical parameters of the Radio Equipment according to Section 13 of the Radio Equipment Regulations 2017.

Frequency band	76-77 GHz
Nominal radiated power: e.i.r.p. (peak detector)	32 dBm
Nominal radiated power: e.i.r.p. (RMS detector)	27 dBm

16.4.5.2.3 Homologation Label of Device

The homologation label is placed on the sensor label on its back side.

16.4.5.3 USA

16.4.5.3.1 Registration Name

2AM6A-MRRE14HBW

16.4.5.3.2 Required owner manual entry

User manual statement according to §15.19:

NOTICE:

This device complies with Part 15 of the FCC Rules

Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

User manual statement according to §15.21:

Changes or modifications made to this equipment not expressly approved by Bosch Engineering GmbH may void the FCC authorization to operate this equipment.

User manual statements according to §15.105:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

RF Exposure Information according 2.1091 / 2.1093 / KDB 447498 / OET bulletin 65:

Radiofrequency radiation exposure Information:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

16.4.5.3.3 Homologation Label of Device

The homologation label is placed on the sensor label on its back side.

16.4.5.4 Canada

16.4.5.4.1 Registration Name

23203-MRRE14HBW

16.4.5.4.2 Required owner manual entry

User manual statement according to RSS-GEN

NOTICE:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device must not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF Exposure Information according to RSS-102

Radiofrequency radiation exposure Information:

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

Ce transmetteur ne doit pas etre place au meme endroit ou utilise simultanement avec un autre transmetteur ou antenne.

16.4.5.4.3 Homologation Label of Device

The homologation label is placed on the sensor label on its back side.

16.4.5.5 Japan

16.4.5.5.1 Registration Name

202-LSF075

16.4.5.5.2 Required owner manual entry

This device is granted pursuant to the Japanese Radio Law (電波法) under the grant ID n° (認証番号): 202-LSF075

This device should not be modified (otherwise, the granted designation number will become invalid)

本製品の改造は禁止されています。（適合証明番号などが無効となります。）

16.4.5.5.3 Homologation Label of Device

The homologation label is placed on the sensor label on its back side.

16.4.5.6 Australia

16.4.5.6.1 Registration Name

n/a

16.4.5.6.2 Required owner manual entry

The minimum height of the RCM mark should be 3 mm.

16.4.5.6.3 Homologation Label of Device

The homologation label is placed on the sensor label on its back side.

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