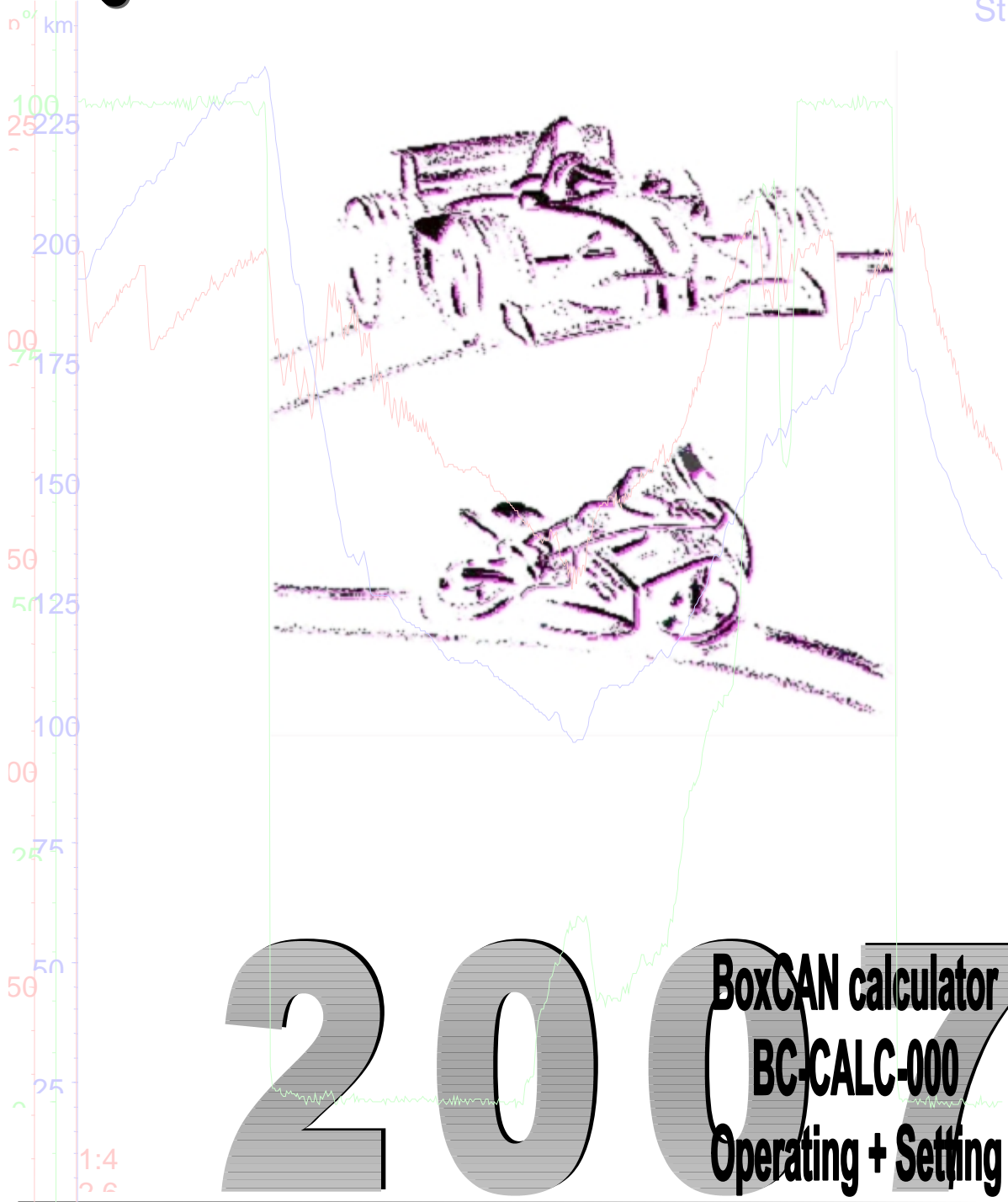


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2007
BoxCAN calculator
BC-CALC-000
Operating + Setting



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Symbols used in the text



In the paragraphs highlighted with this symbol, you will find tips and practical advice to work with the 2D Software.



In the paragraphs highlighted with this symbol, you will find additional information and it is very important that you follow the instructions given.

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Calc-Module



The 2D Calc-module allows the user to create new CAN-data from existing CAN channels via mathematical formulas. The created data can be sent via the CAN-Bus and then be used for other purposes.

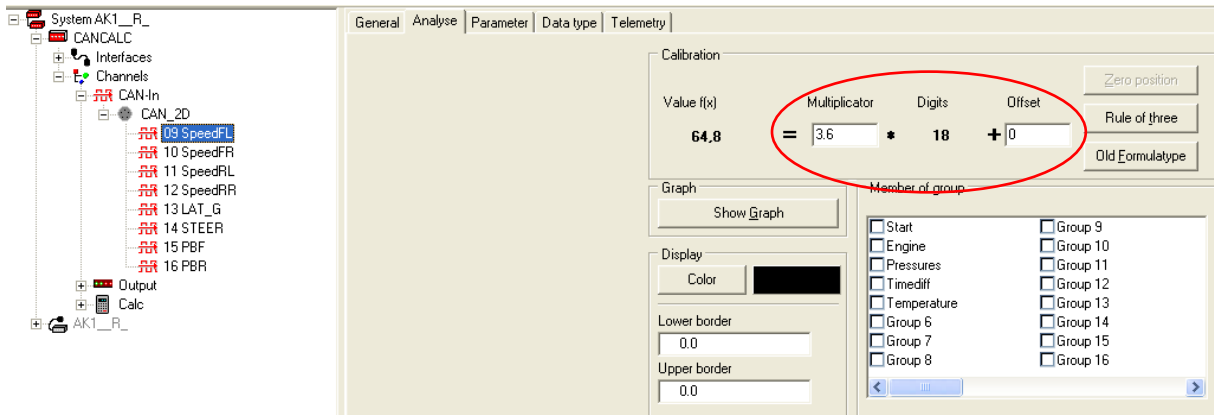
For the calculations, all CAN channels can be used as input as well as other calculated channels from the Calc-module.

Channels are identified with the # sign followed, by their respective number. A maximum of 20 characters may be used per formula.

By using the received values from the CAN Bus, a new physical value can be created by applying a multiplier and offset.

e.g. The Speed data from the CAN Bus in km/h are converted into a Speed in m/s

à $18\text{km/h} * 3.6 = 64.8\text{ m/s}$





The Calc-channel then reads the modified value of the CAN-channel.

The actual calculation formula is put in the **<Calculation formula>** window.

With a multiplier and offset, the calculation result is changed into a CAN Bus transferable 16-bit value. (Refer to **Display and transmission of the calculated channel**)

If the result of a Calc-channel has negative values, the user has 2 options:

Option 1: **<Digits are signed>** can be selected (the transferable range of values shifts from 0-65535 to -32766-32766) to create a signed integer output.



Option 2: an Offset can be added to change the values into a range of positive numbers to create an unsigned word output. (Refer to **Display and transmission of the calculated channel**)

Example: Brake balance calculation



With a data logging system the front and rear brake pressure are measured and sent via the CAN bus. The Calc-module reads the values from the CAN bus on channel

- #14 (brake pressure front)
- and #15 (brake pressure rear)

Brake balance is defined as =
$$\frac{100 * \text{Brake pressure front}}{(\text{Brake pressure front} + \text{Brake pressure rear})}$$

The **Calculation formula** to enter is: **#14/(#14+#15)*100**

The screenshot shows the 'CANCALC' module configuration. On the left, a tree view shows '01 BBALANCE' selected under the 'Calc' category. The main window has tabs for 'General', 'Analyse', 'Parameter', 'Data type', and 'Telemetry'. The 'Calibration' section shows: Value f(x) = 55,000, Multiplier = 1, Digits = 55, Offset = 0. The 'Calculation formula' field contains '#14/(#14+#15)*100'. Below this, there are sections for 'Graph' (with a 'Show Graph' button), 'Display' (with a color selector and 'Lower border'/'Upper border' fields set to 0.000), and 'Member of group' (with various checkboxes like Start, Temperatures, Pressures, etc.).

The calculated result is 55.26 brake bias to the front. If a result with a resolution of 1% accuracy is enough, a multiplier of 1 is used (channel result 55).

For higher resolution e.g. 0.1% use multiplier 0.1 (channel result 55.2)

This screenshot is similar to the previous one but shows a higher resolution setup. In the 'Calibration' section, the 'Value f(x)' is 55,200, the 'Multiplier' is 0.1, 'Digits' is 552, and 'Offset' is 0. The 'Calculation formula' remains '#14/(#14+#15)*100'. The rest of the interface, including the tree view and other settings, is identical to the previous screenshot.

Example: Triggering an alarm channel when Oil pressure is low

Under hard braking or cornering engine Oil pressure can suddenly drop and could destroy an engine. While driving the driver should be warned if this condition occurs.

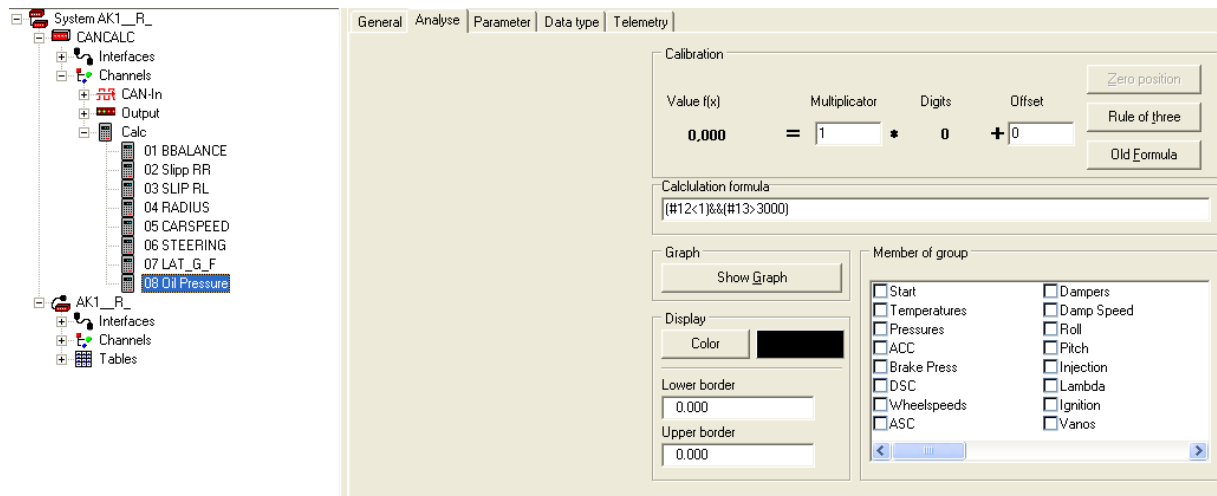
With the engine is idling, the Oil pressure is usually low but poses no threat as the engine is not under load.

#12 RPM and #13 Oil pressure are read from the CAN bus.

A channel is to be calculated that has the value of 1 when the engine is above 3000rpm and Oil pressure below 1 bar otherwise the Calc-channel is 0.

An alarm channel will use the Calc-channel and turn on warning LED's when the condition is valid (Refer to **Alarms**)

Calculation formula: **(#12<1)&&(#13>3000)**



Multiplier: 1 as in this case, the channel can only have the values of 0 and 1 and therefore resolution of 1 is suitable.

Display and transmission of the calculated channel

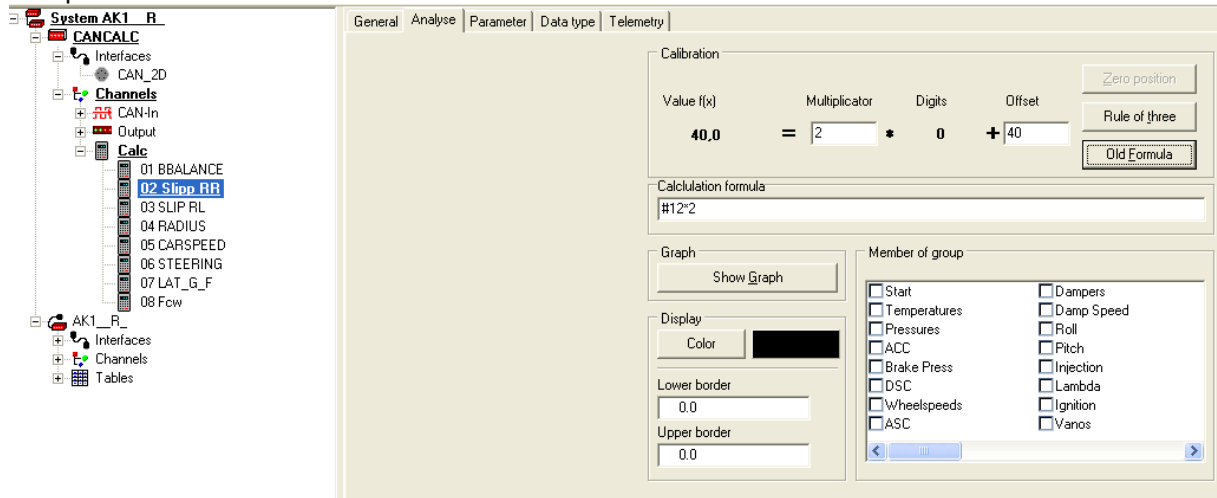


As the 2D CAN Bus can send 16bit values, the maximum transferable range is from 0 to 65535. To transfer a broader range of values, the resolution has to be sacrificed.

If for example, physical values from 0 to 120000 have to be transmitted, the multiplier has to be 2 as the range has to be doubled to 0-131070. The channel resolution will change from steps of 1 to 2.

I.e. The range of values and resolution increase with the multiplied value.
 Multiplier and offset can be specified in 2 ways **<Old Formula>** and **<New Formula>**.

The **<New Formula>** type subtracts the offset from the physical value and divides the result with the multiplier.

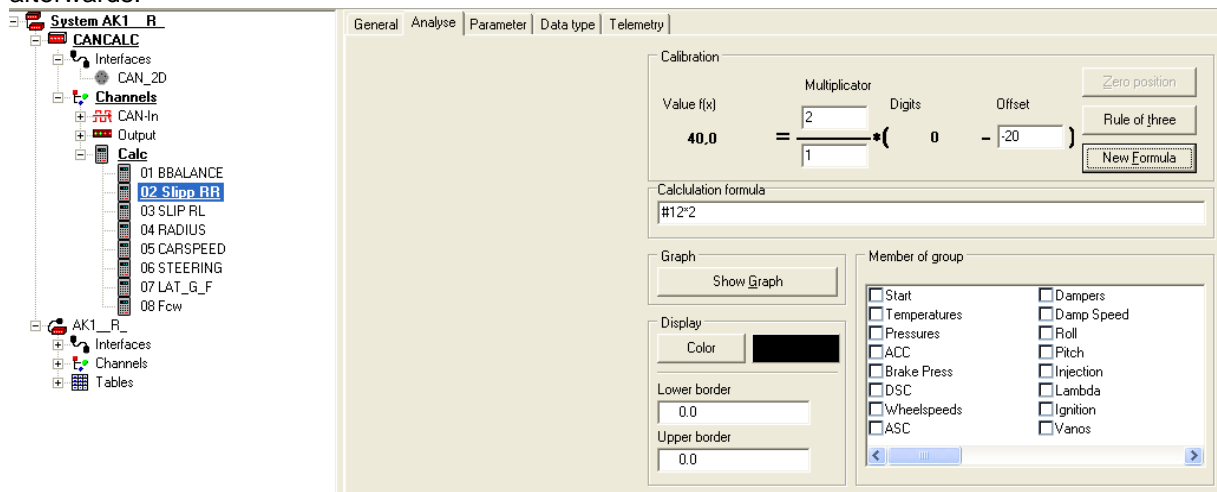


The screenshot shows the 'Parameter' tab for channel '02 Slipp_BR'. The calibration settings are as follows:

Value f(x)	Multiplier	Digits	Offset
40.0	2	0	+40

The formula type is 'Old Formula' (selected). The calculation formula is '#12*2'. The 'Member of group' section includes checkboxes for Start, Temperatures, Pressures, ACC, Brake Press, DSC, Wheelspeeds, ASC, Dampers, Damp Speed, Roll, Pitch, Injection, Lambda, Ignition, and Vanos.

The **<Old Formula>** type divides the physical value by the multiplier and subtracts the offset afterwards.



The screenshot shows the 'Parameter' tab for channel '02 Slipp_BR'. The calibration settings are as follows:

Value f(x)	Multiplier	Digits	Offset
40.0	2	0	-20

The formula type is 'New Formula' (selected). The calculation formula is '#12*2'. The 'Member of group' section includes checkboxes for Start, Temperatures, Pressures, ACC, Brake Press, DSC, Wheelspeeds, ASC, Dampers, Damp Speed, Roll, Pitch, Injection, Lambda, Ignition, and Vanos.

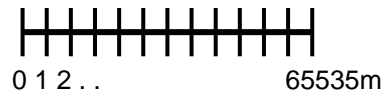
Examples:

Range of channel values

A distance of maximum 50000m is to be used on a CAN-channel

Multiplicator 1

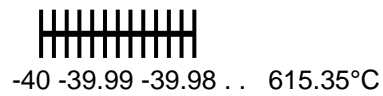
Offset 0



A temperature value from -40°C to 120 °C with an accuracy of 0.01°C is to be used on a CAN-channel.

Multiplicator 0.01

Offset -40



Calculation Functions of the Calc-module



For a detailed explanation of the supported functions refer to the Calctool manual:
 Art.No.: AC-DOC_CalcTool_e-000
 Take a look at the 2D Homepage or the 2D CD-ROM
 <Support><Download><2D manuals><Software manuals>
 <The 2D Reference manual for the 2D software>
 à “Calculate and editing channels”

Type of function	Syntax
Standard arithmetic functions:	+, -, *, /,
Extended arithmetic functions:	^, sqrt(), ln(), log(), log10()
Comparative functions:	<, <=, >, >=, ==
Binary functions:	& (binary AND), (binary OR)
Logical functions:	&& (logical AND), (logical OR)
Trigonometric functions:	rad(), deg(), sig(), sin(), cos(), tan() asin(), acos(), atan(), dsin(), dcos(), dtan(), dasin(), dacos(), datan()
Min-max functions:	min(#y,#y) calculated channel is the minimum of channel x and y max(#x,#y) calculated channel is the maximum of channel x and y hmin(#x,t) calculated channel holds the minimum of channel x for a time t in seconds hmax(#x,t) calculated channel holds the maximum of channel x for a time t in seconds
Filtering function:	flt(#x,t) filters channel x with a duration t in seconds