BEP2.0 User Manual

Inhaltsverzeichnis

1 Disclaimer

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1.1 **Schematic**

This schematic is available as a separate PDF file

1.2 Compatible Motorbikes

The BEP2.0 (the "breadbox") was developed for those who wish to equip their BMW K-bike with a third party aftermarket gauge in place of the original equipment manufacturer (OEM) gauge. It requires no modification to the harness or the vehicle: simply plug and play. The following motorcycles are supported:

- 1983-1987 K 100 (Series I)
- 1983-1989 K 100 RS
- 1984-1988 K 100 RT
- 1986-1991 K 100 LT
- 1987-1990 K 100 (Series II)
- 1988-1993 K 1
- 1990-1992 K 100 RS 4V
- 1991-1997 K 1100 LT
- 1992-1996 K 1100 RS
- 1985-1990 K 75 C
- 1985-1995 K 75 S
- 1986-1996 K 75 Basic
- 1989-1996 K 75 RT

1.3 Harness Variants

Since the K-bikes were built from 1983 to 1996, eventually a new harness connector was created during this time. That means there are two variants of connectors, one with round pins (one-piece black connectors, see Figure 1 below right) and one with square pins (two-part white plug, see Figure 2 below left). In both variants, the pin assignments are equivalent. Please note before ordering which type connector you have, so that the BEP2.0 is properly configured for your K-bike.
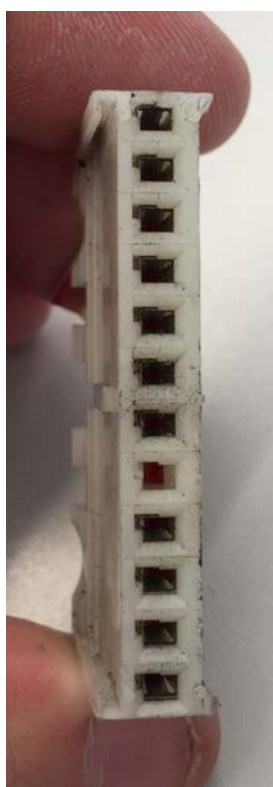

Figure 2 two-part
white plug

Figure 1 one-piece black plug

1.4 Functions

When the OEM gauge is removed from the bike, the following functions are no longer available:

- The battery charging circuit is lost.
- The start button no longer functions (only with clutch pulled).
- The start enable capability is lost.
- The speed signal from the final drive is unusable.
- The 4L reserve fuel indicator is lost.
- Provisioning for Automatic Signal Indicator cancellation no longer functions.

The breadbox is not just a display instrument; it decodes signals (BCD code from the transmission switch code), amplifies signals (the speed signal from the final drive is amplified by an op-amp), compares signals (the low fuel indicator light is triggered via a comparator and a delay) and sends itself out signals (the start enable capability is restored).

The BEP fulfills all these tasks in a small circuit and allows the Connecting of commercial after-market instruments:

- It can be all after-market speedometers with a Reed-switch speed sensor. A reed sensor always has two lines.
- Speedos with Hall encoder sensors are likely also compatible with the BEP; the Hall transducer-sensor (which is included with the BEP) is not needed. A Hall effect sensor has three lines (the third line provides power to the active sensor).

Please indicate in advance whether your desired speedometer is on the list of compatible speedometers. If not listed in the Appendix, a procedure can be followed that can find the correct input without risk of damage to the multimeter or the gauge itself.

Note 1: The speed conditioning must customized to the supplied gauge. It is difficult to develop a universal circuit that is suitable for all aftermarket gauges.

Note 2: The reserve indicator is not equivalent to the "level indicator". The Reserve light output switches to ground when the level of the fuel drops below 4 Litres for longer than 15 seconds (signal differential, also known as hysteresis). A LED with a series current limiting resistor can be connected to the output. Some gauges have a level indicator (bar graph). The BEP is unable to drive this input directly. If your K-bike is equipped with a float sensor, the Connection for the original BMW level gauge is under the tank. This is a white 4-position Plug (green, purple, yellow and gray). The level signal is located on the YELLOW wire. The sensor is a 0 / 100ohm type.

1.5 **Inputs and Outputs**

1.5.1 Inputs

The BEP2.0 has 24 inputs (see on the drawing below on the LEFT side). If you are interested in the exact assignment of the individual inputs, you can read about the technique in the field of Flyingbrick or HERE. For the function of BEP2.0, it is crucial that the harness connector is inserted in the correct orientation. Top left is Pin1 (permanent 12V). Everything else follows from this orientation.

Warning! The harness connector was not a "polarized plug" designed by BMW. Therefore, It is possible to insert the connector upside down. In this particular case, pull fuse 15 before turning on the ignition (in this orientation, the ignition 12V plus PIN6 would then be on ground PIN18). Neither the BEP2.0 nor K-bike wiring should thereby be damaged. Nevertheless, please make sure to insert the connectors properly. The correct orientation is the harness is in the same orientation as the engraving on the BEP -- down.

1.5.2 Outputs

The BEP2.0 has 24 outputs (see drawing below on the RIGHT side). For the outputs, WAGO terminal blocks are installed which are resistant to vibration unlike screw strips. The wires can simply plug in. Depress the white buttons with a small screwdriver and the clamping mechanism automatically opens. The WAGO connectors work with $0.08mm^2$ to $2.5mm^2$ wire cross-section.

Input   Output
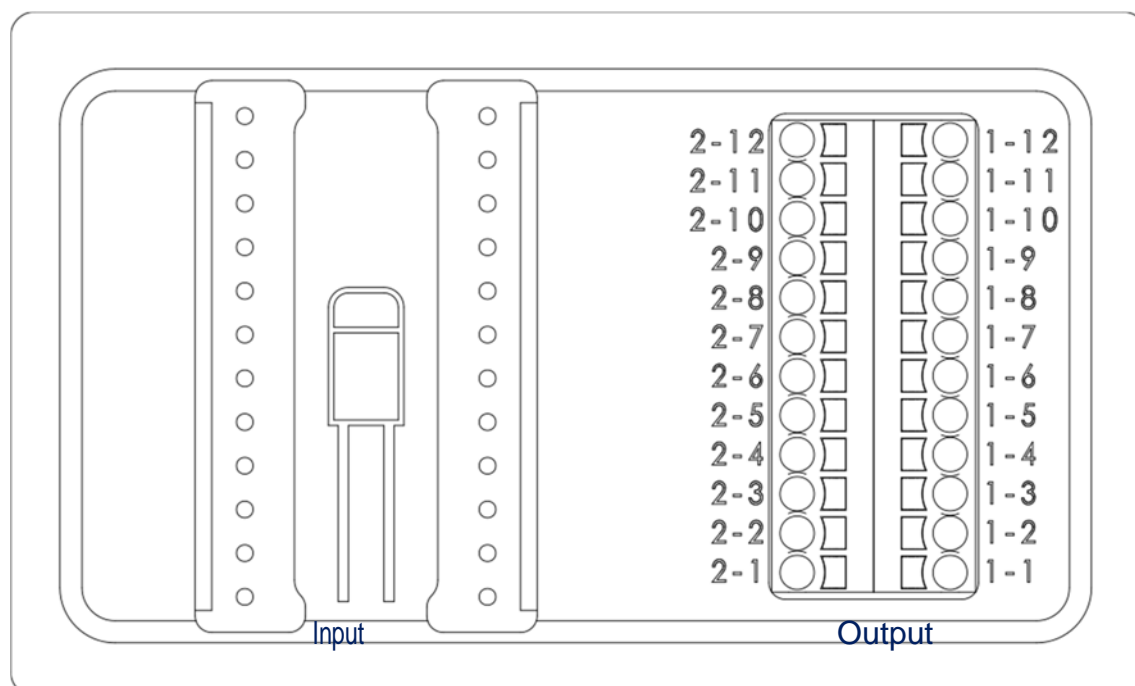
The outputs are assigned as follows:

Left label	Pin		Pin	Right label
Menu button (ground)	2-12	GND	GND 1-12	Ground
Speedo signal	2-11	Spd	⇦+ 1-11	Turn signals left
High beam indicator	2-10	≣O +	⇦⇨+ 1-10	Turn signals (both)
Warning indicator	2-9	⚠-alle	⇨+ 1-9	Turn signals right
BMU Indicator	2-8	⚠☀-	N- 1-8	Neutral indicator
ABS-indicator	2-7	ABS	G5- 1-7	Gear 5
Low fuel indicator	2-6	▮ 4l-	G4- 1-6	Gear 4
Start Enable	2-5	▭-	G3- 1-5	Gear 3
Temp	2-4	♨-	G2- 1-4	Gear 2
Oil pressure	2-3	⬙-	G1- 1-3	Gear 1
Choke	2-2	Chk-	Cur 1-2	Current Source for LEDs
Switched 12V	2-1	Zünd	BAT 1-1	Unswitched 12V (Battery)

Ergänzungen

1-1 **Unswitched 12V (Battery)**

1-2 **Constant Current Source** supplies for the gear display a constant stream of 12mA. This eliminates the series resistors for the LEDs. As explained in the diagram, so two types of gear indicators can be realized. Option 1 is the "classic" version, in which only the gear lights up in the straight runs. In version 2 of the current gear and all underlying course also lights: for meadow glow in transition 3 gears 1, 2 and 3

1-3 **Gear 1 indicator** switches to ground when gear 1 is selected.

1-4 **Gear 2 indicator** switches to ground when gear 2 is selected.

1-5 **Gear 3 indicator** switches to ground when gear 3 is selected.

1-6 **Gear 4 indicator** switches to ground when gear 4 is selected.

1-7 **Gear 5 indicator** switches to ground when gear 5 is selected.

1-8 **Neutral indicator** output switches to ground when neutral is selected

1-9 **Right turn signal indicator** switches 12V pulses when signalling right

1-10 **Turn signals (both) indicator** switches 12V pulses when signaling irrespective of which turn signal direction was selected

1-11 **Left turn signal output** switches 12V pulses when signalling left

1-12 **Ground**

2-1 **Switched 12V (Ignition)**

2-2 **Choke indicator** switches to ground when the choke is selected

2-3 **Oil Pressure indicator** switches to ground when the oil pressure sensor triggers

2-4 **Temperature indicator** switched to ground when the cooling water sensor triggers

2-5 **Start Enable** is grounded, while the engine is not running. Once the engine is started and the current LIMA, located here at the board voltage.

2-6 **Low fuel indicator** switches to ground when the 4L threshold for longer than 15 Seconds is undershot

2-7 **ABS-indicator** is just "Looped". The breadbox and BEP2.0 do not make any modifications to the ABS-signal.

2-8 **BMU indicator** is also just "Looped" lights up when the K in the Ignition is. This light goes out only when both brakes are applied simultaneously, and the light bulb in the rear light function (as in the original)).

2-9 **Warning indicator**   combines all error messages (lamp test, Choke, oil pressure and Cooling water) to an output. The signals are separated with blocking diodes.

2-10 **High beam indicator** switches 12V on the output when high beam is switched on

2-11 **Speedo signal** The signal from the permanently installed Hall sensor (six signals per wheel rotation) is amplified and output through a transistor with OC (open collector) output. The transistor switches at each pulse to ground.

2-12 **Menu button** second ground terminal for the menu button

1.6   Connecting LEDs

Figure 3 below shows how the various outputs can be connected to the BEP2.0 LEDs. This can be useful if an after-market instrument is connected to the BEP, and it does not support the complete display capability of the BEP; the ABS light is as supported by any instrument. It can be simultaneously connected to the BEP and to the instrument's LEDs. For example, Neutral indicator can be attached simultaneously to the instrument and to an external LED directly to 1-8. In the future we will eliminate the LEDs as status display of the outputs already fixed to the BEP, if so desired by you. The outputs 1-3 to 1-8 (G1-G5, N) and 2-6 (reserve light) have an OC (open collector) output and provide a maximum of 40mA current. The same applies to 2-11 (speed signal), but it make little sense to attach a LED to this output anyway. Therefore, please do not connect under any circumstances an incandescent bulb of more than 0.5W to the OC output, as it risks possible destruction of the transistor outputs! All other outputs are exempt and behave like the original Brotbox.

1.6.1 Connection option 1: classic speed display

The transition LEDs can be implemented as individual LEDs or a bar graph. It only lights the LED for which the corresponding gear is selected.
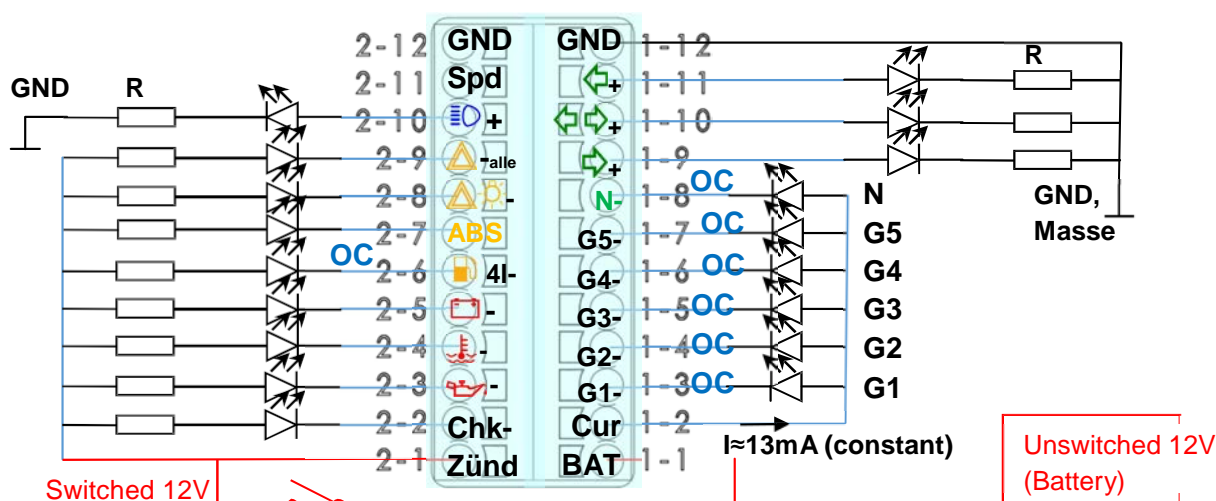

Figure 3 Variant 1: classic gear indicator

1.6.2 Connection variation 2: speed bar graph display

With the bar graph connected to the BEP as shown below, the display will indicate gears with an increasing number of lit LEDs. The behavior thus corresponds to an audio level indicator.
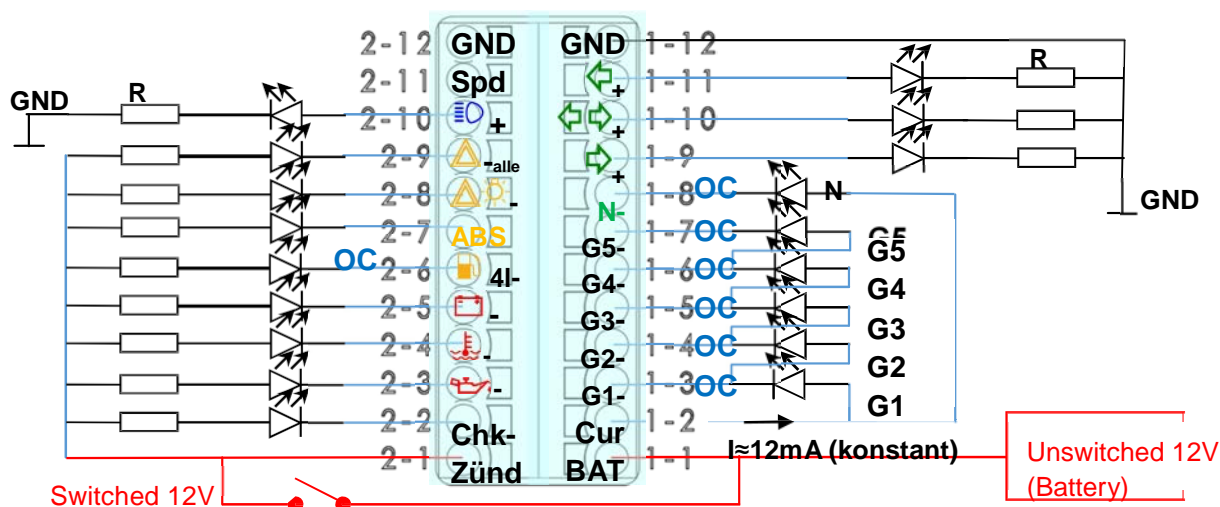

Figure 4 Option 2: speed bar display

If the bar graph as ten LEDs, two LEDs can be interconnected it, allowing all ten LEDs to indicate 5 gears. This is, in theory, not without balancing resistors. In practice, you can attempt to do without the resistors, and then add them later if the two LEDs have different intensities.
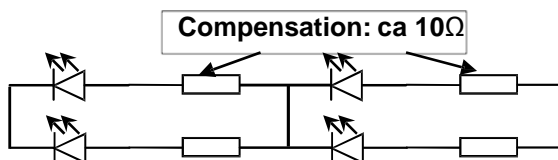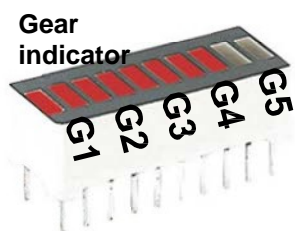

Figure 5 shows typical bar display with 10 LEDs. Each LED is freely accessible (2 connecting legs). In the Parallel connection of 2 LEDs it needs balancing resistors so that both LEDs are equally bright guaranteed

Restrictions on the choice of color of the bar graph: Each LED has a typical forward voltage, which drops almost independent of the current. Red, green and yellow LEDs have typically about 2V. Blue and white LEDs have up to approximately 3.6V. The sum of the five appended LEDs must not exceed 11V, otherwise the highest gears will not be indicated.

Rule of thumb: A maximum of one to two blue or white LEDs in the bar graph can function. Red, green and yellow LEDs should preferably be installed.

Notes on the types of connection 1 and 2

- **OC** (open collector) outputs: 40mA max !
- Resistors **R**: 270Ω to 1kΩ, **typ. 470Ω (ca. 21mA)**
The magnitude of the resistance R determines the current through the LED, and thus brightness, but different LEDs usually have a different brightness with the same current: efficiency, beam angle, matt or clear housing are crucial.
- The current for the gear indicator LEDs (G1 ... G5, N) may be increased if necessary.
A resistor can be soldered directly to the board, a wire or 0805 SMD next to the Output 1-2. Pro 1k additional resistance to flow 12mA in addition to the preset 12mA: 24mA in total.
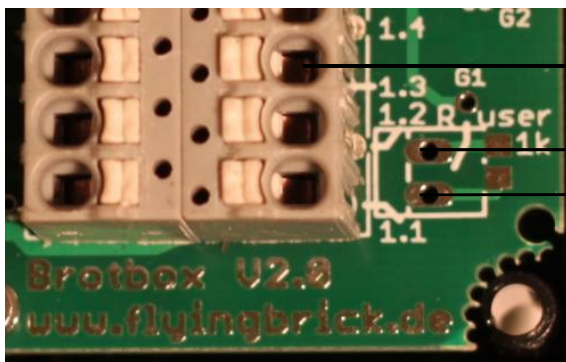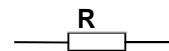
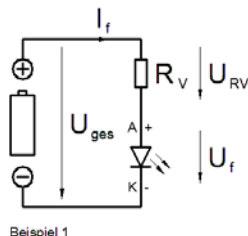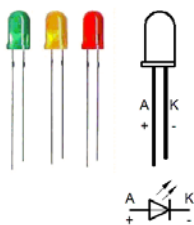$$I == \frac{Ubatt-0.5}{1ki1} + \frac{Ubatt-0.5}{R\_user}$$

ca. 12mA

R_user	I
	12 mA
1.5 kΩ	20 mA
1 kΩ	24 mA
470 Ω	38 mA

Figure 6 increase the output current I of starting 1-3 for the gear indicator by soldering a
Additional resistance R_user on the board

Polarity of a LED

1.7 Wiring diagram using the example Motogadget Motoscope Tiny

An example of correctly connecting the Motoscope Tiny, Speedster and Vintage from Serial number 00000003 at the BEP2.0 (October 2015)
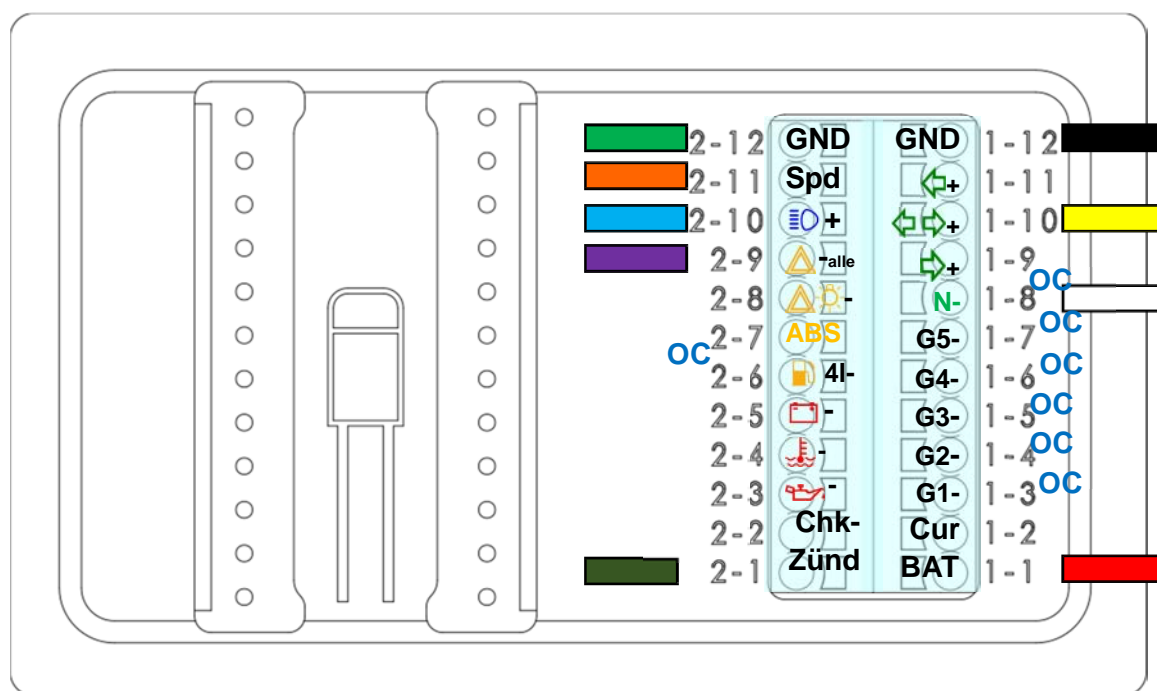

Abbildung 7 Anschlussplan am Beispiel Motogadget Motoscope Tiny

Then provide the wheel circumference (as in the guidance of Motogadget). This value varies from tire to tire, for example with a Michelin Pilot Activ is 1958mm wheel circumference. The number of pulses per wheel revolution is six.

1.8 Wiring diagram using the example Acewell ACE 4xxx series

An example of correctly connecting the Acewell ACE 4xxx series speedometers to BEP2.0 (October 2015). There are, according to instructions from Acewell a plug-A and a plug-B.
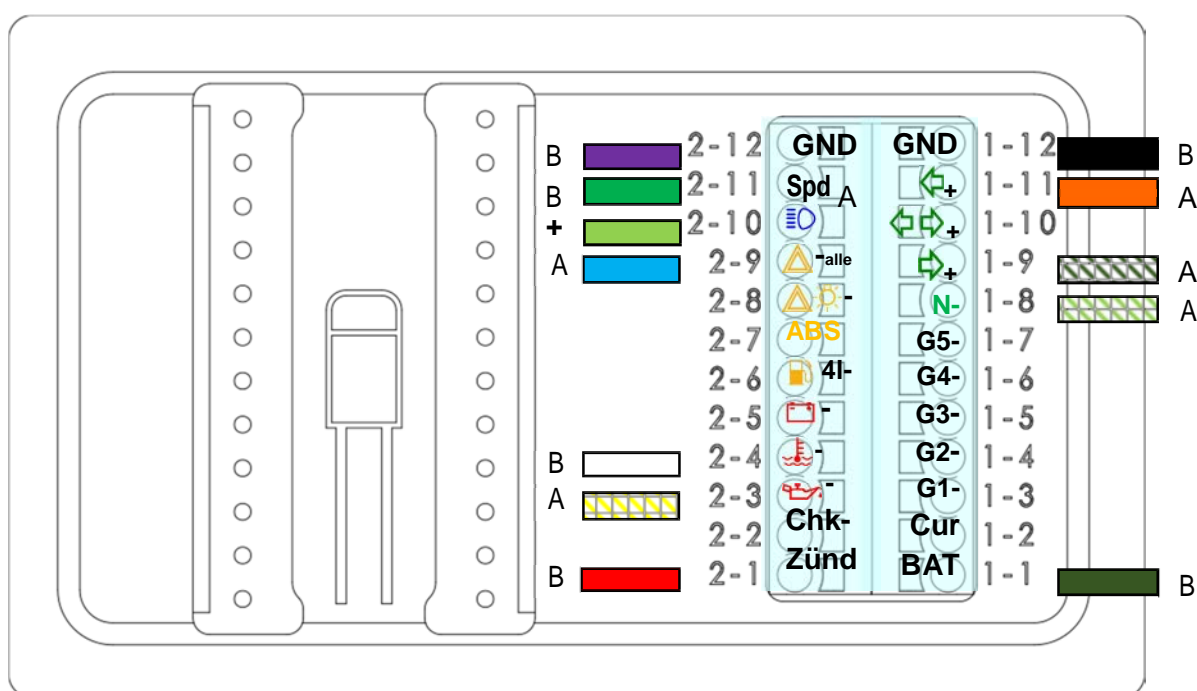

Figure 8 Wiring diagram using the example Acewell ACE 4xxx series

1.9 **Wiring diagram using the example Acewell ACE 2853H-1**

An example of correctly connecting the Acewell ACE 28xx series speedometers to BEP2.0 (October 2015). There are, according to instructions from Acewell plug-a plug-and b.
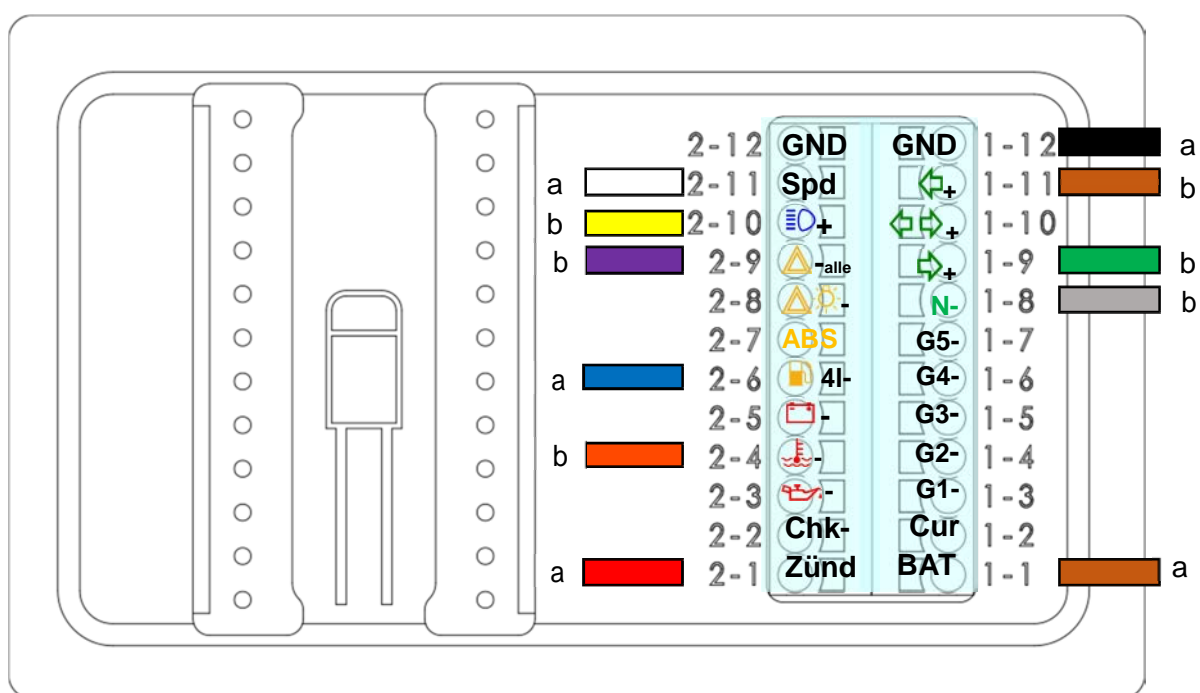

Figure 9 Connection diagram example Acewell ACE 2853 H-1

Fuel level indicator

The Acewell has a fuel level indicator (blue cable at connector A). This can be directly connected to the Yellow wire on the under-tank connector. See the following figure:
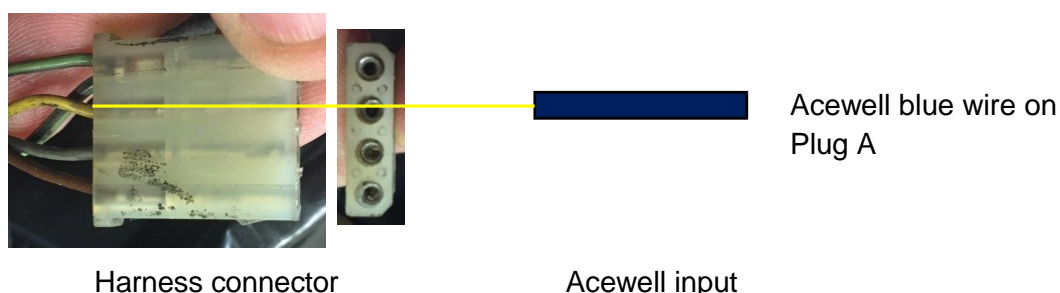

Harness connector   Acewell input

Figure 10 Connecting the level indicator at the float plug under the tank

Note: Please do not attach the Acewell level indicator to output 2-6 (reserve light) of the BEP. The BEP reserve output switches on (drops to ground potential) when the fuel level drops below 4 Litres. The Acewell would interpret zero ohms as a full tank (90Ω or larger indicates an "empty tank"). This fuel display would be "inverted".

However, if your K does not have a float, you can still invert the signal with with a simple transistor. With the Acewell there can be at least two states tank "full" and "empty, respectively. The exact fuel level display is lost however. The circuit is tested and working.

BEP switched 12V 2-1

10 kΩ (4.7 kΩ to 10 kΩ possible)

Acewell Blue wire on Conn. A

BEP low fuel indicator 2-6

C

B

any **NPN** small signal -Transistor (BC 548/547/238/237/337 2n2222, 2n3904,2n4401 etc…)
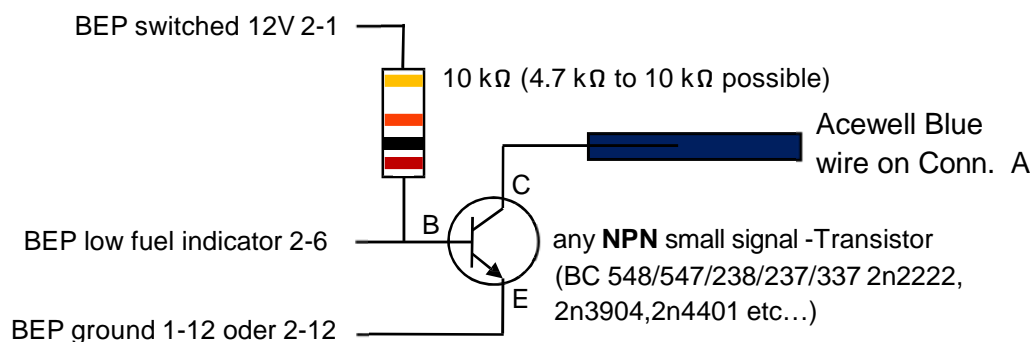
E

BEP ground 1-12 oder 2-12

Figure 11 Use the level indicator of Acewell if K does not float. The display is limited so but the two states "full" or "empty, respectively. small 4L "

1.10 Connection diagram example Koso replica, type SS 182

An example of correctly connecting the Koso SS182 to the BEP2.0 (Dec. 2015)
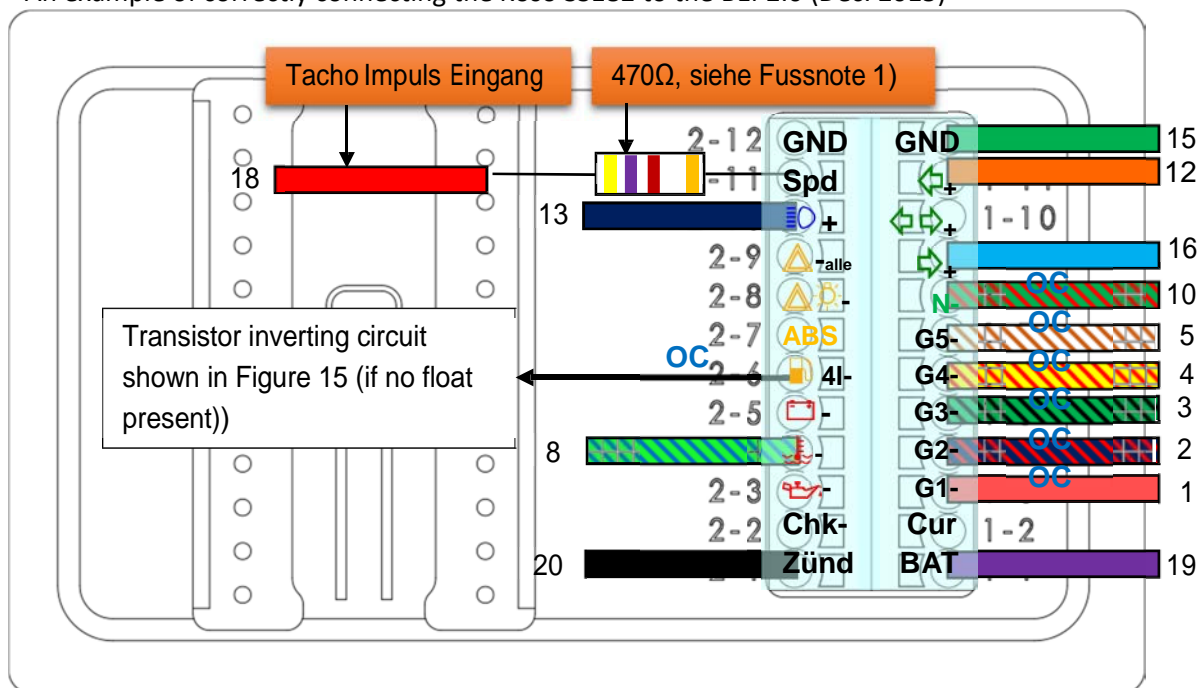

Figure 12 Connecting the example Koso replica, type SS 182

Koso Settings

The wheel circumference (. Closely wheel perimenter setting) is, as described in the manual, by pressing the lower left (A) - input and lower right (B) button. This varies from tire to tire, for example with a Michelin Pilot activ this 1958mm. The number of pulses (eg. Pulse number setting, 1-12 adjustable) per wheel revolution is six. The time is set by pressing the lower left button (A).

1) Optional protective resistor (220O, red-red-brown is to 1k, brown-black-red possible). It is recommended to use the protective resistor initially (see Figure 13 below) to the display of the speed on the speedometer really works, then the resistance and the plug can be removed and the red wire are clamped directly in the Wago-bar from Koso (at 2-11). The resistor ensures that take no harm in trying all three connection options, by changing the color coding of the terminals of Koso, the speedometer or the BEP.

Figure 13 connecting a 470O resistor protection

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Fuellevel

The Koso has a level indicator (yellow-white wire No.9). This can directly to the float-output of the 4-wire plug (with wires yellow, gray and violet) are connected under the tank, namely to the yellow wire. See the following image ((link to Insert picture, picture and number.)).
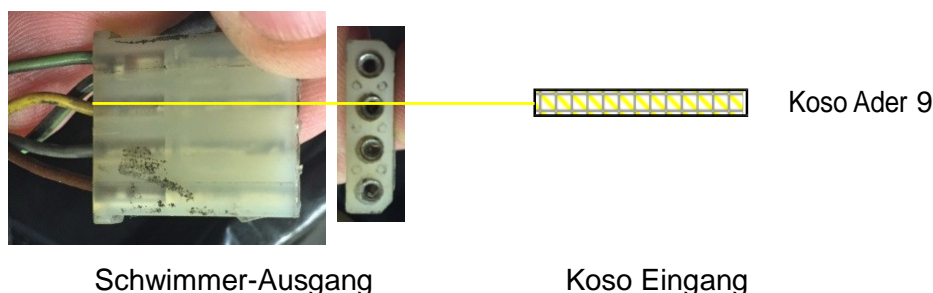

Schwimmer-Ausgang   Koso Eingang

Abbildung 14 Anschliessen der Füllstandanzeige an den Schwimmer-Stecker unter dem Tank

Note: Please do not attach the Koso level indicator to output 2-6 (reserve light) of the BEP. The BEP reserve output switches on (drops to ground potential) when the fuel level drops below 4 Litres. The Koso would interpret zero ohms as a full tank (90Ω or larger indicates an "empty tank"). This fuel display would be "inverted".

However, if your K does not have a float, you can still invert the signal with with a simple transistor. With the Koso there can be at least two states tank "full" and "empty, respectively. The exact fuel level display is lost however. The circuit (which for the Acewell ACE 2853 ran smoothly) should work so actually. However, since the detection of resistances to our Koso specimen was obviously broken, we cannot guarantee this.
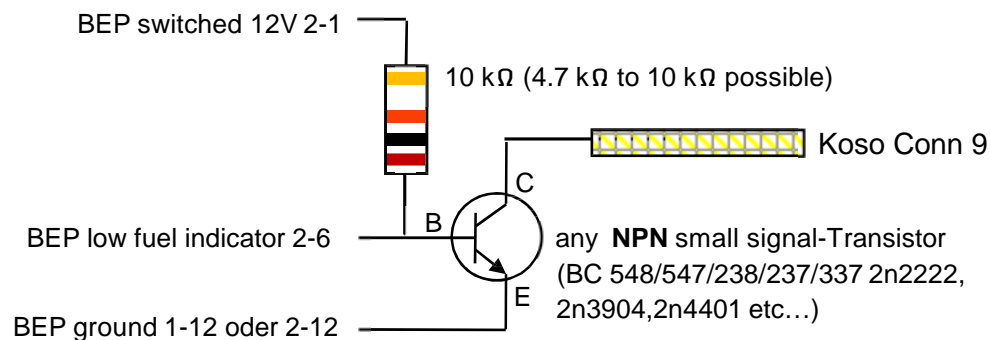

Figure 15 Use the level indicator of the Koso if K does not float. The display is limited so but the two states "full" or "empty, respectively. small 4L"

1.11 Wiring diagram using the example of T & T (Louis), Best. No. 10034907 or 10034806

An example of correctly connecting the T & T to the BEP2.0 (Stand December 2015)
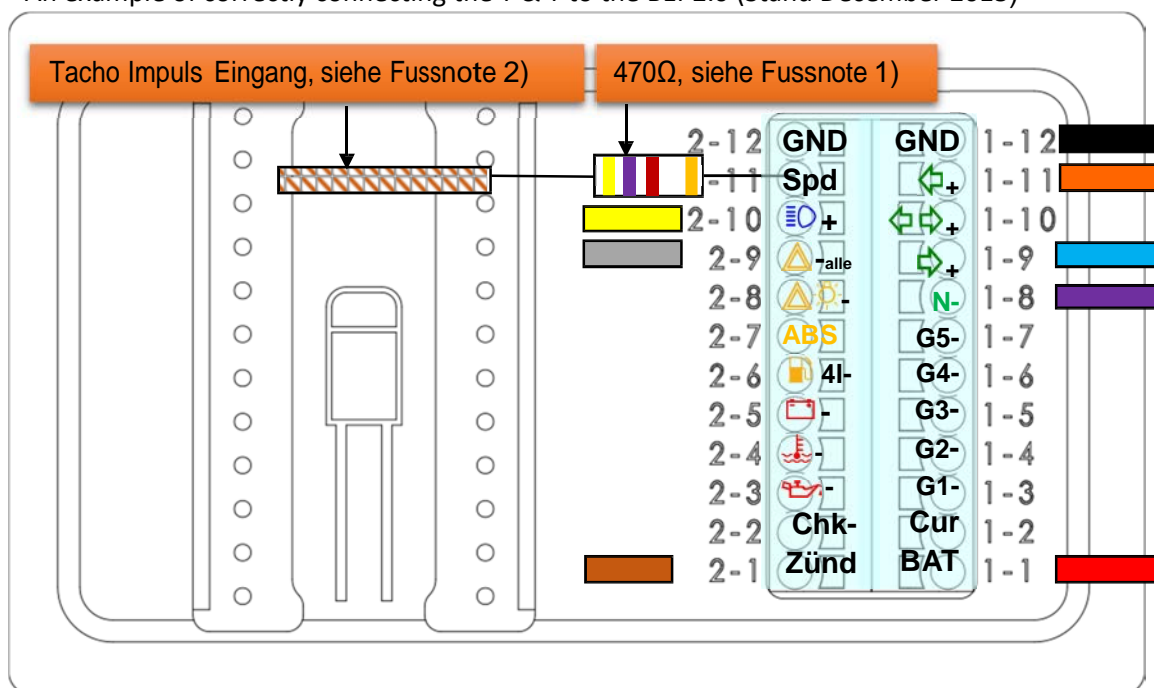

Figure 16 Wiring diagram using the example of T & T (Louis), Best. No. 10034907 or 10034806

1) Optional protective resistor (220O, red-red-brown is to 1k, brown-black-red possible).
It is recommended to use the protective resistor initially (see Figure 5 Insert ((link)) below) to the display of the speed on the speedometer really works, then the resistance and the plug can be removed and the brown-white cable from the T & T directly the Wago-bar are clamped (at 2-11). The resistor ensures that the probing all three connection options, by changing the color coding of the terminals of T & T, the speedometer or the BEP not damaged.
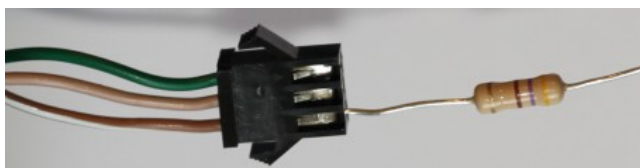
1)   The color coding of the Hall encoder input can also vary. Quote from the Manufacturer:

"The Hall sender has three connecting cable, red = positive input 5 volts white = pulse, Black = Minus"

Thus, the resistance to the white cable have to be connected, you should this
Color combination encounter.

1.12 **List of Compatible Speedos**

Basically every digital speedometer should fit. We tested the products listed in the table below. The order in the table corresponds to the assurance it functions correctly. I myself am very satisfied with Motogadget and would recommend their brand of speedometers listed here without restriction. But that does not mean that the other brands are bad.

Manufacturer	Restrictions
ACEWELL	without limitations, fully compatible
DAYTONA	without limitations, fully compatible
KOSO	Koso DB-01 Neutral und Warning light do not function.
MMB-MESSTECHNIK	without limitations, fully compatible
MOTOGADGET	without limitations, fully compatible
SIGMA	without limitations, fully compatible
T&T (LOUIS)	without limitations, fully compatible