CAR Sensor 3000

Dear friends,
we appreciate very much your trust in our products and especially your decision to purchase our controller CAR Sensor 3000, which is intended for controlling brushless (BLDC) as well as direct current (DC) motors. This controller contains the sum of experience and know-how collected during many years of motor control development at our company. It meets the high demands of users and in some respects it offers a surprising adaptability to your application wishes by its exact adjustment feasibility. Usually the Sensor 3000 is deliverede together with the programming device JetiBox which enables the user to program easily a large variety of controller adjustments. Furthermore the JetiBox can be used for programming of other JETI model products as for instance SPIN controllers, receivers REX JBC and other items. You can also use it for testing of your RC equipment. In connection with the CAR sensor 3000 the JetiBox can read out controller data which have been continuously measured and collected in the controller memory during its operation. Essential data will certainly be the controller temperature, supply voltage, average current, motor operation time, maximum vehicle speed, average speed and other useful data (remark: some of the parameters are only accessible in combination with BLDC motors).

The controller CAR sensor 3000 is set for the control of alternating current (brushless BLDC) motors with SENSORS (i. e. only for motors which are equipped with rotor position transducers like Hall sensors or optical scanners) as well as for direct current (DC) motors. As the controller is able to recognize the type of the BLDC motor, its sensor set up and mechanical advance settings, any type of motor of any manufacturer can be connected to it.
As standard devices the controller grants heat protection, low discharge protection of batteries, overcurrent limiting, a possibility of reverse revolution, a programmable brake as well as a high mechanical rigidity combined with water and dust proof design.

Basic data:

Type	Dimensions mm	Weight including cables	Sustained current /max. 30s	Input voltage	Number of cells
CAR sensor 3000	41x31x37	80 g	60A / 100A	3 – 9 V	1-2 LiXX / 4-7 NiXX

Type	Voltage BEC	Max. current BEC	Max. temperature	Conducting state resistance	Programming
CAR sensor 3000	5,4V	5 A	100℃	2 x 0,00055 Ω	Jeti Box

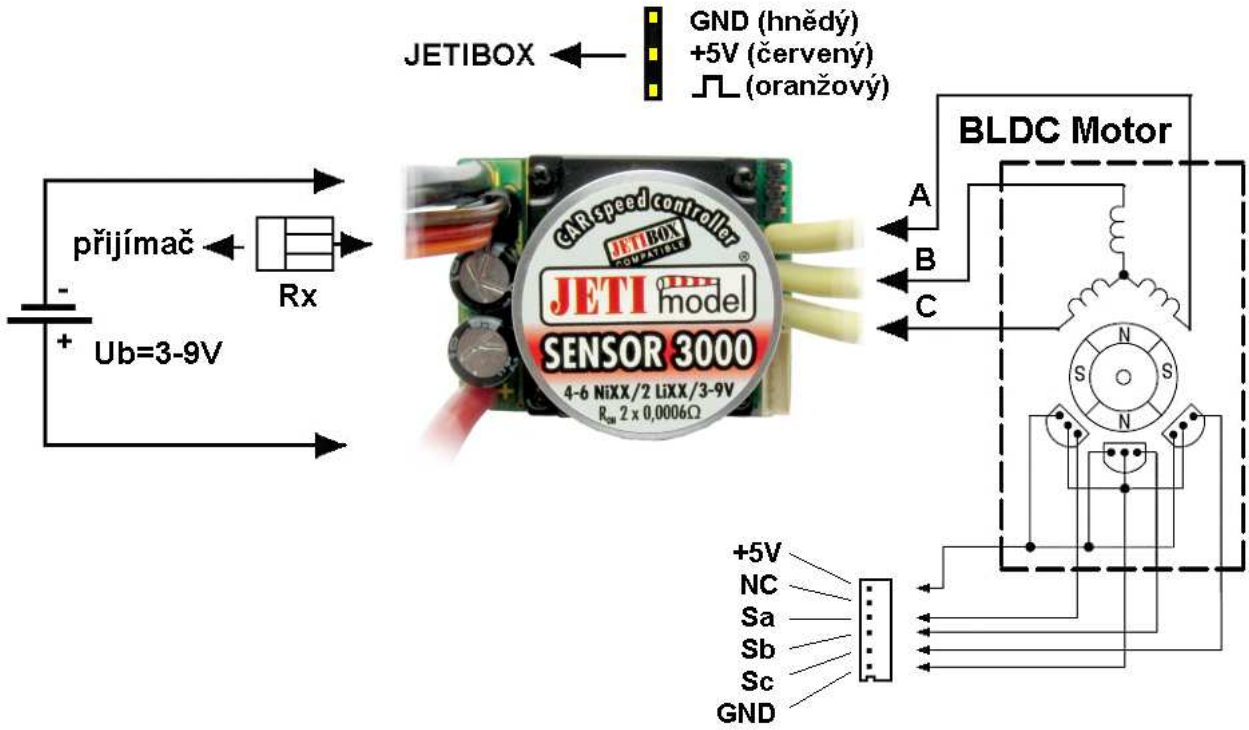
Basic principles:

- please read this guide carefully
- use only new high quality connectors and solder them properly to the controller (remove remnants of soldering flux from the connectors)
- keep all cables as far away off as possibble of the receiver and its antenna
- check the correct adjustment of the controller for BLDC or DC motors
- as long as you do not immediately use your model and the batteries are still connected, always switch off the switch which is part of the controller and receiver supply
- prevent the possibility of reversing polarity of the controller or connecting the battery to motor exit cables (use different types of connectors)
- do not connect the controller to other types of supplies except the appropriate battery (which provides the correct input voltage and current consumption)
- prevent possibilities of injury by mechanically moving parts of the model (motor, gear train etc.); always behave in a manner as if the motor could start any moment
- before switching on always check wiring of the controller, receiver and the appropriate frequency of your RC equipment
- accomodate the controller in your model so that a maximum of streaming cooling air may be available for it

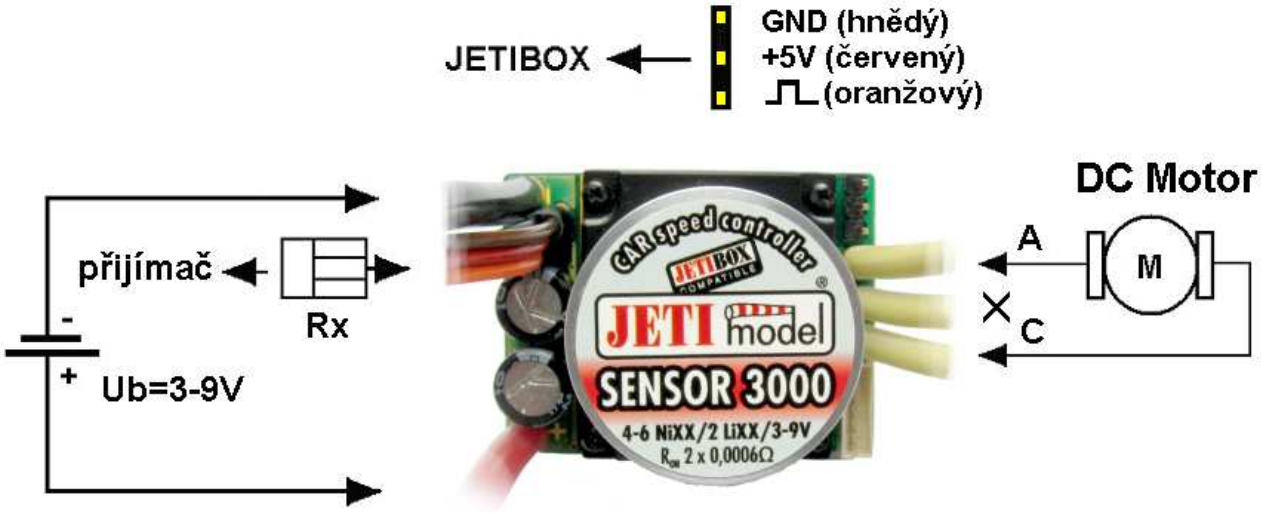
Instalation of the controller into the model:

- choose the best location for the controller with respect to cooling, cable lengths and accommodation of receiver and antenna
- connect the controller in accordance with conditions as shown below
- plug the JR connector into the throttle channel of the receiver, switch off the switch (receiver supply)
- situate the model in such a way that a prospective start of the motor will not injure yourself or other persons
- connect the JetiBox and the batteries (watch polarity)
- switch on the switch and check the controller adjustment in the menu (motor type etc.), in case of a BLDC motor start the automatic calibration
- switch off the switch, disconnect batteries and the JetiBox

Controller wiring of a BLDC motor: (NC – pin not connected)



Controller wiring of a DC motor:



In oreder to ensure correct operation of the controller the first step must be to start the automatic adjustment of the controller for the BLDC motor (*Auto setup*). This calibration is not provided for DC motors!!

<u>During this procedure the controller will drive the motor. If the motor is installed in the model ensure that the wheels may rotate freely in the air (without ground contact)!!!</u>

Automatic calibration procedure:

- connect the BLDC motor to the controller (individual phases and sensors)
- connect the receiver
- connect the JetiBox
- switch on the transmitter and the controller switch
- set the JetiBox to the menu *MeasureOrSetting – AUTO SETUP*
- in the following there appears *Align sensors* – START, start with arrow right
- the controller is waiting for the stop position (neutral position at the transmitter) (*wait for stop*), after this sets in you will be notified by a beep signal
- in the following you will be called for to start the motor full throttle (*wait for full*), the controller drives the motor and looks for a best optimized combination
- further on follows the confirmation of the correct direction of motor rotation (*Check direction*), by the arrow right the direction of motor rotation can be corrected, by the arrow down you can finish auto setup

Operation with a DC motor:

- make sure that motor and receiver are wired correctly, that the switch of the controller is in off position and that the controller setting is correct for DC motors
- switch on the transmitter and shift the throttle steering device to neutral position (motor stop)
- connect the drive battery and switch on the switch
- from the motor sounds a melody which confirms that wiring is correct

Operation with a BLDC motor:

- make sure that motor and receiver are wired correctly, that the switch of the controller is in off position and that the controller setting is correct for BLDC motors
- switch on the transmitter and shift the throttle steering device to neutral position (motor stop)
- connect the drive battery and switch on the switch
- from the motor sounds a melody which confirms that wiring is correct

If you hear instead of the confirmation melody a repeated motor beeping (error) check the wiring, the programming of the JetiBox for the particular motor type and the position of the transmitter throttle control device which should be in neutral position. As long as the controller does not receive pulses from the receiver the motor will not transmit any tones.

Controller adjustment by means of the JETI Box:

Connect the controller with the JetiBox by means of the extension cable (an accessory of the JetiBox), connect the battery to the controller and switch on the switch.

The menu in the LCD display of the JETI Box is divided into six submenus (lines), which show measurement (*Measure*), basic setup (*Basic setup*), extended setup (*Specific setup*), automatical setup of the controller for the particular motor type (*Auto setup*), storing of the setup into memory (*Save Settings*), loading from the memory (*Load Settings*).

Automatical setup of the controller for the particular motor type (Auto setup) (for BLDC motors only)

- this procedure must always be executed when a BLDC motor is replaced (motor type, wiring of phases and sensors)
- for the given motor an automatical calibration of the controller is executed
- the wiring of phases and sensors as well as the mechanical motor advance setup is beeing determined

Measurement (*Measure*) – in this menu you will find measured data which have been collected during the last operation of the motor. With an asterix * marked data are only functional when a BLDC motor is used.

- Maximum controller temperature (*Max. Temperature*),including the time of occurrence.
  - If the measured temperature exceeds 80℃ there is need for an improved cooling of the controller by streaming air.
- Minimum controller temperature (*Min. Temperature*), including the time of occurrence.
  - This figure will probably show the start temperature of the controller at begin of operation.
- Actual temeperature of controller (*Actual Temperature*).
- Maximum current (*Max. Cur*rent) including the time of occurrence.
  - Highest current flowing through the controller, in this case the measured current peak.
- Average current (*Avg Current*).
  - The controller is measuring and recording the current flow during the whole time of motor operation. The shown value is in accordance with the average current flowing through the controller during the time the motor is revolving and is indirectly showing the energy withdrawal from the drive batteries.
- Maximum voltage (*Max. Voltage*) including the time of occurrence.
  - The recorded voltage value will probably be in accordance with the starting voltage of the batteries befor motor operation.
- Minimum voltage (*min. Voltage*) including the time of occurrence.
  - Indicates the lowest value of battery voltage which occured during operation.
- The actual voltage of the actually connected batteries (*Actual Voltage*).
- Cut-off voltage (*Off Voltage*) including the time of occurrence.
- Time of motor operation (*Motor Run Time*).
- The complete time the controller was switched on (*Power On Time*), this means the sum of time when the motor was running and when it was switched of or braking.
- Setting up of motor pole number
- Total gear ratio (*Gear**).
- Wheel diameter (*wheel diameter**) for the calculation of the vehicle speed.
- Maximum speed of the motor rotor (*Max motor RPM*).
- Maximum speed of vehicle (*Max speed**) including the time of occurrence.
  - Shows the highest vehicle speed which has been registered during the ride. The correctness of this figure depends upon the setup (number of motor poles, gear ratio, wheel diameter) and maximum motor speed. If during the ride adhesion between wheels and ground is lost (wheel slip) the highest motor speed may be registered and this may result in a misinterpretation of the maximum speed.

- Average speed (*AVG speed**).
  - During the complete ride the vehicle speed is recorded and as a result we obtain the average speed, the correct interpretation depends upon the correct setup similar to the measurement of the maximum speed value.
- Errors which occurred during the course of controller operation (*Errors*).
  - If the motor has been switched off or cut down due to exceeding of some parameter limits is this fact marked by the character Y (error occurred) at the given parameter, if not, the parameter is marked with the character N (error did not occur).
    Individual parameters are marked by following characters. U-low voltage, T-high
    temperature, S*-erroneous response of motor probe, M-erroneous setup of motor type.

Basic setup (*Basic setup*)

- Type of applied motor (*Motor type*).
  - *BLDC* (brushles motor, with sensors only)
  - *DC* (direct current)
- Drive modes (*Drive mode*).
  - *Reverse-stop-forward-* activated reverse gear
  - *stop-forward* –without reverse gear, one direction drive only
- Setup possibilities of the cut-off voltage (*Cut off mode*):
  - *Direct voltage* – setup of the lowest battery voltage directly in volts
  - *Per accu type* – according to battery type, this additionally comprises the choice of the applied battery type (*Accumulator Type*) and of the allowed lowest voltage per cell for the given battery type (*Cut off voltage per cell*).
- Control figure of the set cut-off voltage (*Off voltage Set*).
- Setup of the neutral travel (*Stop point*).
  - *Auto* – after switching on the controller the actual travel is automatically related to the transmitter throttle channel as its neutral. If this travel is outside of the desired range the controller will announce this error by beeping sounds of the motor.
  - *FIX* – setup for a concrete value of neutral travel. If the motor throttle channel after switching on is not within the adjusted range, then again this error will be announced by beepeing of the motor **as long as we do not shift the throttle steering device to the preadjustet fixed travel position.**
- Width of the neutral range (*Neutral range*).
  - On this occasion it is possible to adjust the range of the neutral travel (of the throttle steering device), i. e. the point of which controlling of the motor starts working.
- Adjustment of the travel control range , i. e. the range of the throttle control device at the transmitter.
  - *Forward* – forward direction, in the first line of the Jeti Box LCD display there is shown in brackets the actual travel as received by the receiver (as far as transmitter and receiver are switched on). Shift the motor throttle control device on the transmitter to maximum position – direction forward and adjust by the left and right push buttons in the lower line of the JetiBox LCD display the required value of the maximum travel, following the actual value as shown in the first line.
  - *Rev/brake* – setup of the maximum travel of the brake and reverse gear (as far as allowed). The adjustment is executed in the same way as shown above but with the only difference, that the throttle control device on the transmitter must be shifted to the maximum position of the brake.

- Throttle curve (*Throttle curve*).
  - At this point it is possible to adjust the course of the throttle control curve in dependence of the position of the throttle control device.
- Setup of the direction of the motor rotation (*rotation – left / right*).

Extended setup (*Specific setup*)

- acceleration (*acceleration*), adjusts the time, after which control changes from 0 to 100% power
- heat protection (*Temp. Protection*).
  - After exceeding the adjusted controller temperature the motor is cut off and *Error T=Y* is shown. After the controller cools down below the preset value an immediate start of the motor is possible again.
- Current limiting, forward ride (*Max Fwd Current*).
- Current limiting, backward ride (*Max Rev Current*).
- *Max Start current* – current limiting, motor start up from stand still, i. e. when the model is not riding in any direction, this limit is valid for both forward and backward direction.
- Start current limit time (*Max Start current, Time*).
  - Specifies how long after motor start the „start“ current limit wil be active before it changes into operational state, which is setup to *Max Fwd / Rev. Current.*
- *Turbo*, increase of current limit at full throttle (*Turbo Current*).
  - Enables an increase of current limit by a given value only in case of an order of the motor throttle control device for full throttle.
- Brake (*Brake*)
  - *off* - off
  - *on* - on, it is a matter of a proportionally controlled brake intensity according to the position of the throttle control device
  - *On+ABS* – switched on simultaneously with the activation of a wheel antiblocking device
- Maximum brake effect (*Max Brake*).
  - If use of the brake is admitted there exists the possibility to adjust the maximum amount of energy, which the controller will apply for braking the motor.
- Neutral brake (*Neutral Brake*).
  - Allows presetting of the brake effect in the neutral-stop motor controlling device position. This actually means a brake extension already from the neutral position by a preset value.
- Maximum power in forward direction (*Max. Forvard Power*).
  - It is a matter of percentual setup of the maximum voltage which the controller relates to full throttle position. It is therewith possible to control the maximum motor speed if its rpm/Volt relationship is known. This setup can be realized also for reverse gear.
- Maximum power in backward direction (*Max. Reverse Power*).
- Motor timing – advance setting (*Timing**).
  - By setup of the motor advance timing you are enabled to optimize requested properties. For timing 0° efficiency is at optimum and the motor consumes the lowest amount of current for a given load. In case of higher advance timing values the speed as well as current consumption increase, torque decreases.
- Transistor switching frequency (*Frequency*).
  - For a given design and type of motor generally a switching frequency of 2 kHz can be recommended for DC motors and 8 kHz for BLDC motors. Setup of a

lower frequency brings the effect of lower controller transistors switching losses, but can on the other hand decrease motor efficiency.

Storing of setup figures into memory (*Save settings*)

- it is possible to save in the controller memory your personal setup data, particularly parameters of the menu *Basic setup* and *Specific setup.* The controller offers the possibility to save a maximum of 4 personal data presets with the designation *Profil 1-Alfa* till *Profil 4-Delta*. Storing of these data is particularly important if you use several motors in the model, for instance DC and BLDC motors with different setups. When the motor is replaced the complete setup of the controller only requires loading of parameters from the relevant memory in *Load settings*. The memories are also useful for presetting properties of different kinds of race types, tracks, surfaces etc.
- storage itself is executed after selection of memory by pushing of the right push button of the JetiBox.

Loading of stored preset values from memory (*Load settings*)

- existing data in the menu *Basic setup* and *Specific setup* will be overwritten by data stored in the relevant memory.
- after selection of the memory loading of data is executed by pushing of the right push button of the JetiBox.

For the controller we grant a warranty of 24 months from the date of purchase on under the assumptions, that it was operated in accordance with these instructions at the defined voltage and that it does not show any mechanical damages. Warranty and post warranty repairs are provided by the manufacturer.

We wish you good luck with your JETI controlled models: JETI model s.r.o., Příbor, www.jetimodel.cz