TVC-B100

100A dual speed controller for RC tracked vehicles

The controller contains all components for controlling two DC motors in a tracked vehicle.

The behavior of the integrated mixer can be set for different vehicle types. The controller can thus be set for full tracks, half tracks and wheeled vehicles with differential drive. In addition, there are variants for historical tracked vehicles without tableturn as well as the possibility of an inertia simulation.

The controller has an adjustable EMF standstill brake, which is triggered in the center position of the throttle and steering stick.

1 Note

Installation of the module requires intermediate to advanced modeling skills. Soldering skills are required to connect the wiring. Inexperienced modelers and persons aged under 16 years old should seek the assistance of an experienced modeler. Always switch off power when working on the wiring. Especial take care when connecting more than one receiver energy source. Prevent the device from getting wet. Check loads before connecting them to the modul at a current limited, or fuse protected source.

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2 Introduction

The controller is designed for an input voltage range from 12V to 36V. Two standard automotive fuses (strip fuse) protect the model and the battery from excessive currents.

In addition, the controller has electronic overload protection (I^2t monitoring) and electronic temperature monitoring of the power output stage.

2.1 Technology

The controller is microprocessor controlled. The processor works with 16MHz clock frequency. The software is coded in C and assembler.

As a failsafe function, an extensive plausibility check of the transmitter signals is integrated in the software.

The power amplifier is built with N-channel MOSFETs, which have an inrush resistance of only 0.001 Ohm and a current capability of 180A. To make effective use of the low internal resistance, the output stage transistors are driven by sophisticated push-pull MOSFET output stages with integrated charge pump.

Under normal ambient conditions, a maximum continuous current of 100A is achieved. The controller operates with a PWM frequency of 16kHz.

. To prevent ground loops and resulting interference, the servo inputs are galvanically isolated. Accordingly, the receiver *not* is supplied by the controller.

The housing of the controller is CNC milled from aluminum.

3 Installation

3.1 mounting

The module can be screwed onto a flat surface with max. six M5 screws. Ideally, the module should be mounted on a large metal surface to improve heat dissipation.

The housing of the controller is on the ground potential.

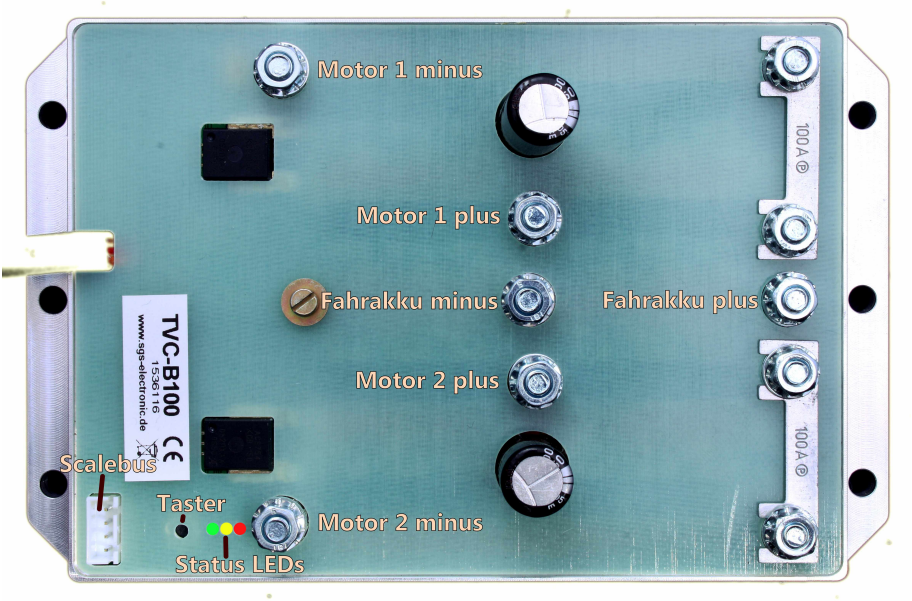

Figure 1: Connections overview

3.2 Driving battery and motors

High, high-frequency currents flow between the drive battery in both directions. Provide a low-resistance connection between the drive battery and the controller and use a suitable switch or a high-current relay. Use only fuses for protection. We strongly advise against the

use of electromagnetically tripped circuit breakers, anti-flash devices for limiting the starting current, rechargeable batteries with electronic current limiting, etc. We strongly advise against this.

The drive battery and drive motors are connected to the M5 screw terminals via ring cable lugs.

Insulate the ring cable lugs with the enclosed heat shrink tubing to avoid short circuits. Clamp the enclosed ring cable lugs in the following order (from bottom to top):

1. washer
2. ring cable lug
3. washer
4. Toothed lock washer
5. nut

Use a suitable ring or socket wrench to tighten the nut. Tighten the nut so that the toothed lock washer is compressed by approx. 0.5 mm. When tightening the nut, align the line in the desired direction when tightening. Please do not twist the already tightened ring cable lug by force.

Too much torque on the nut can damage the PCB!

A mix-up of the connection terminals for the power supply must be avoided at all costs!

It makes sense to provide a switch at the supply line from the battery to switch the model on/off. Commercially available battery switches or high-load relays are suitable for this purpose. The motors must be radio interference suppressed, as is usual in model building.

3.3 connecting the receiver

The controller feeds itself from the drive battery with a built-in switching regulator. The three servo lines are galvanically isolated from the controller. The receiver is therefore not supplied with power from the controller, but must be supplied from another power source.

This is usually from a receiver battery. The input circuit also requires the receiver supply voltage (approx. 15mA) and obtains this from the receiver

battery through the servo leads.

Figure 2: Control inputs. 1-throttle 2-steering 3-brake (optional usage)

3.4 EMF brake

The controller has an adjustable EMF brake. It is activated by moving the throttle and steering stick to the center position.

The braking effect with which the brake is applied is indicated by the yellow LED. The longer the yellow LED is on, the stronger the braking effect.

- LED Off corresponds to 0% braking effect.
- LED On corresponds to 100% braking action.

note When the brake is active (stick in center position and braking effect set greater than 0%) you can hear a hiss from the motors. This is the modulated braking current. As soon as you drive off or deactivate the brake, the noise disappears.

The adjustment of the brake can be done in two ways: Via an RC channel of the controller (so it can be changed via the transmitter at any time) or via a button on the controller. Adjustment via an RC channel of the controller Here the braking effect is adjusted directly via the transmitter. As soon as you press the corresponding slider/knob, you will see that the pulse/pause ratio changes.

You can use it at any time, for example, light braking and further increase the breaking effect.

If you have a channel free on your RC system, we recommend this method. Make sure that they do not stop from full speed with full braking effect, this puts a lot of stress on the entire drive train.

Without RC channel with button on the controller If you want to change the braking effect, you have to press the button. There is a small hole under the three LEDs for this purpose. Use a thin stick made of plastic or wood to push the button. The button has a clearly noticeable pressure point. If you move the throttle in one direction the on phase of the yellow LED gets longer and longer, in the other direction shorter and shorter until it is completely off. The stronger the lever deflection, the faster the adjustment.

The green LED lights up continuously as soon as you take the lever out of the neutral position to indicate that the controller is making a change.

If you press the button again, the brake setting is saved and is retained even after switching off and on again.

LED	function
red	Error (overtemperature, overcurrent,short circuit)
yellow	EMF Brake Brake effect (flashes with variable duty cycle) ;In Scalebus mode it is permanently on
green	operating status

Table 1: LED-Codes

4 Commissioning

4.1 startup

1. Put the throttle and steering levers into the receiver.
2. If the brake is to be adjusted via the transmitter, it must also be plugged into a free channel of the receiver.
3. Switch on transmitter
4. Set brake, throttle and steering levers to center position (The corresponding trim as well).
5. Turn on receiver power supply. Note that the controller does not provide receiver power (BEC voltage) due to galvanic isolation.
6. Switch on the drive voltage (= supply voltage of the controller).
7. The LED on the board flashes until the controller has detected the center position of the channels. If zero point detection is not possible, the green LED flashes and the yellow one is permanently on. A new determination of the zero point is only done after switching on/off the driving voltage. If the driving voltage is interrupted, please wait until the LEDs on the controller have gone out. This takes some seconds, because of the integrated switching regulator and the large capacities. the green LED is on continuously, the vehicle is ready to run.

This automatic calibration is done in this way at *every* switch-on. I.e. the position detected at switch-on is stored as the neutral position. This applies to all channels except for the brake channel.

4.2 error acknowledgement

The controller shuts down in the event of overtemperature,undervoltage, overvoltage, excessive motor currents, excessive current source impedance, and loss of receive signal. It indicates these error conditions by flashing the green LED (blink code) and lighting the red LED.

Special attention should be paid to the overvoltage error during regenerative power supply. A regenerative overvoltage fault is triggered when the

blink code	meaning	reset
double	no valid signal at control inputs	connect servo channels and switch on/off
triple	overtemperature	let cool down
quad	overcurrent (I^2t) shutdown	throttle and steering in neutral
fivefold	undervoltage supply voltage	apply minimum voltage , throttle and steering in neutral position
sixfold	overvoltage at regen	switch supply off/on
sevenfold	overvoltage supply voltage	switch supply off/on
eightfold	hardware overcurrent or fuse failure	throttle and steering in neutral position

Table 2: Error codes

power from the motor is prevented from being fed back to the battery via the controller. Generally this is called too high impedance of the power source. In particular, this can be caused by, among other things:

1. too small wire cross-section between battery and controller. circuit breakers between battery and controller (do not use circuit breakers for alternating current)
2. batteries with built-in electronic current limiter
3. operation on an alternator without buffer battery
4. operation on an electronic power supply unit
5. high contact resistance in the connections

If this error has occurred once, components and connections should be checked carefully. Since this error is very critical, it can only be acknowledged by switching the supply voltage off/on.

4.3 Correct driving direction

The direction of travel depends on the mechanical arrangement of the engines in the vehicle. Usually, the motors are mounted so that the motor shafts are in opposite directions. As a result, the motors must be connected

with different polarity in order to travel in one direction.

Of course, correcting the direction of travel can be done directly on transmitters with the servo reverse setting. If the transmitter does not have this facility, the following procedure can be followed:

1. *model moves forward when steered backward and vice versa:* Change connections on both motors (reverse polarity).
2. *Model moves left when steered to the right and vice versa:* Change connections from both motors, reversing polarity. (connecting line from motor 1 to motor 2 and vice versa).
3. *The directional control is set to neutral, but the model does not drive straight ahead:* Correct with steering trim

4.4 Scalebus operation

As an alternative to control via the servo connectors, the controller can also be controlled via the Scalebus. To do this, connect the controller to the other modules using the scale bus cable (white, four-pin connector). For example, the FO module TVC-MF-10 can control the controller. The controller switches to Scalebus mode if there is no servo signal on the servo cables when it is switched on.

4.5 Changing the mixing function

Different vehicles and transmission types need different mixers. In the past, we offered different versions of the controller (”OG”, ”CM”, ”HT”, etc.).

With this controller, you can now define the mixer function yourself. An overview of the available mixers is shown in table 3 on page 14.

Notes Note that the maximum current consumption of mixers with tableturn is not significantly higher because the drives work against each other in tableturn.

Be careful when operating with inertia simulation. The vehicle then naturally reacts with a delay to the commands of the radio remote control.

4.5.1 How to change mixer function

1. Connect everything as described under commissioning and switch on the transmitter.
2. press the button when switching on the controller. The setting mode is indicated by the red and yellow LEDs lighting up.
3. With the throttle and steering channel you can now select nine positions by setting the sticks in left/right stop or leave neutral position. The position number is indicated by the red LED flashing while the green LED is lit. If the green LED goes out, the cycle starts again.
4. For example, if the red LED flashes three times, mixer number three of the table is selected. save this, hold the sticks in position and press the button again.
5. Then release the stick. Now the mixer is selected and saved.

Code	drive type	name	table-turn	vehicle type	description
1	full track	simulation superposition gearbox 100%	yes	tracked construction machines, modern tanks, snow groomers	Simulation of the driving behavior of a mechanical superimposed transmission without limitation of the drive power
2	full track	simulation superposition gearbox 80% / 60%	yes	tracked construction machines, modern tanks, snow groomers	Simulation of the driving behavior of a mechanical superimposed transmission with straight-line driving limited to 80% and steering limited to 60%. Only when cornering is 100% given to the drives to account for the increased friction.
3	half track/ wheeled	classic mixer	no	wheeled construction machines, halftracks	The chain inside the curve is reduced from 100% to 50% of the driving speed at steering angle
4	full track	mechanical superimposed gearbox	yes	modern tanks, snow groomers	This setting is for mechanical superimposed gear units
5	full track	no mixer, single chain control	yes	Operation via manual mixer or mixer in radio	This variant has no mixer, only a brake that acts when both drives come to a standstill.
6	full track	classic mixer with tableturn	yes	tracked construction machines, modern tanks, snow groomers	Mixing function as used e.g. by Tamiya
7	full track	classic mixer without tableturn	no	historical construction machinery and tanks	Mixing function as used for example in Tamiya but when cornering the chain does not run backwards.
8	full track	simulation superposition gearbox 100% and inertia simulation	yes	tracked construction machines, modern tanks, snow groomers	

Table 3: list of optional mixing functions available

5 Glossary of terms

BEC **B**attery **E**liminator **C**ircuit
This circuit replaces a extra Battery needed for the receiver and connected servos, by generating a fixed voltage from the drive battery.

ESC **E**lectronic **S**peed **C**ontroller
This is a unit to control the speed and direction of a DC motor.

LED **L**ight **E**mmitting **D**iode
A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. Benefits of LEDs are low power requirement and long life. Disadvantages is the more complicated wiring, compared to a classic bulb, it has a polarity and a resistor is needed to limit the current.

Scalebus The Scalebus is a development of **SGS electronic** to connect controllers and modules to compose solutions for complex RC models.

SBus The Sbus has been introduced by **Futaba** to simplify the wiring between RC Receivers and servos / esc.

SBus The SBus was introduced by the company **Futaba** to simplify the wiring between receiver and servos/controllers. This is especially useful for models with many controllers.

IBus The IBus was introduced by the company **Flysky** to simplify the wiring between receiver and servos/controllers. This is especially useful for models with many controllers.

SUMD The SUMD sum signal has been introduced by the company **Graupner** to simplify the wiring between receiver and servos/controllers. This is especially useful for models with many controllers.

Abbre-vation	meaning	explanation
Stick	**S**tick	Stick not self centering
StickS	**S**tick **S**elfcentering	self centering Stick
TSMS	**T**hree **S**tage **M**omentary **S**witch	self centering momentary switch with three stages
TSS	**T**hree **S**tage **S**witch	switch with three stages
Pot	**Pot**entiometer	linear- or rotary knob
PotC	**Pot**entiometer with **C**enter key	linear- or rotary knob with a center key

Table 4: Abbrevation for the manipulators in the transmitter housing

6 Technical data

Rated motor current (per motor)	100 amps up to 30s: 150 amps
Supply voltage drive	12V to 36V
Supply voltage servo input	3.3V to 8.0V
PWM frequency	16kHz
Typical maximum power dissipation	22W
Typical voltage drop in power stage	0.15V
Dimensions (height without connectors)	165 × 105 × 17mm
distance screws row	154mm
Screw spacing	35mm
Bore diameter	5.2mm
Software version	02.01.20

7 Important

This equipment described above has been tested and inspected for quality and function. And it is intended for installation and use only as described above. This equipment does not contain any user serviceable parts. The supplier accepts no responsibility, financially or otherwise, for damages caused by use or misuse of the equipment described above. The equipment must be protected from exposure to water to prevent short circuit. Do not open the equipment or attempt to change function, wiring, or documentation in any way. Do not connect to incorrect voltage or reverse the battery polarity. Do not use in a careless or abusive fashion around persons or property. Do not attempt to repair. Any legitimate use, e.g. Installation in a model makes the user responsible to ensure that the operating instructions and non-liability agreement are provided to the purchaser of the module described above.

Do operate the device only in the permissible operating conditions. Do not make any changes to the controller through. The device shall not be exposed to splashing water or rain (causing a short circuit).

7.1 Warning

Due to choking hazard caused by small parts that may be swallowed, this product is not suitable for children under 6 years of age.

7.2 Environmental protection

For defective devices, repair is possible in many cases. Please contact us. If you do decide to dispose of the device, you will be making a contribution to environmental protection if you return the device to a municipal collection point for recycling. Electronic devices do not belong in household waste.

7.3 Address

SGS electronic
Zeppelinstraße 36
47638 Straelen
Germany / Europe

7.4 Contact

Web	www.sgs-electronic.de
Email	info@sgs-electronic.de

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WEEE-Reg.-Nr.:	DE 90290947

7.5 Document date

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7.6 Documentation

We reserve the right to make updates, changes or additions to the information and data provided.

The documentation that accompanies your product applies.

Please note that documents obtained later via download may not correspond to the status of your module.