About Forward/Reverse Programmable controllers TMM® xxxx – 3 car-boat

for brushless sensorless motors (Ver. 2.25 and more)

Controllers TMM® xxxx – 3, *car - boat* are outstanding programmable controllers for brushless sensorless motors (BLCD motors). They are manufactured with the use of surface mounting from high-end components and are controlled by a very powerful processor. Controllers are ready for immediate use, no programming necessary. However, if you wish to set some parameters you may do so through a very simple process. These parameters are then saved permanently. The revolution regulation is extremely fine - 1024 steps all the way to the full throttle. The Mega BEC circuit (applies to versions with BEC) is also extremely powerful.

Controllers for higher currents (>40A) are manufactured in two designs. The first one is similar to that of aircraft controllers that is the controller is enclosed in shrinking sleeve with axial wires. The second design features additional ribbed heat sinks on both sides of controller, wires to battery and motor are connected using G3.5 plug connectors in socket 3.5 mm vertically to the controller – this design is much more preferable in term better cooling.

Standard workmanship

Design with additional heat sinks („cube“) for 60A ESC and more

It is possible added water proof protective coating for better resistance for humidity or water.

Operating data:

Temperature of the environment:	0°C to 40°C	**Number of regulation steps:**	1024 / full throttle
Motor controlling:	PWM 8 kHz	**Max. rpm for 2 poles motor:**	150 000 rpm

Control signal: positive pulses 1,5 ± 0,5 ms, period 10 ÷ 30 ms
User set parameters brake on – off / NiCd, NiMH or Li-Ion, Li-Pol batteries / min and max throttle positions
Automatically set parameters number and quality of cells, controlling signal from transmitter, motor timing
MEGA BEC: **5V / max. 4,0 A** (power losses 5W continuous, 10W / 10 sec., 15W / 5 sec., max. 20W, see graph)
Suitable for motors: Mega AC, Model Motors, MP JET, PJS, Überall model, Hacker, Kontronik, LRK, Plettenberg, etc.

TMM®	1210-3	1810-3L	2512-3	4012-3	6012-3	8012-3	12012-3	16016-3
Dimensions (with external capacitor) [mm]:	25×22×6	40×26×6	44×26×6	55×32×6	67×30×14	67×30×14	67×30×17	67×30×20
Dimensions for „cube“ version [mm]:	--	--	--	--	70×33×23	70×33×23	70×33×28	70×33×28
No. of feeding **NiCd / NiMH** cells:	6 – 10	**4** – 10	6 – 12	6 – 12	6 – 12	6 – 12	6 – 12	6 – 16
No. of feeding **Li-Ion / Li-Pol** cells:	2 – 3	2 – 3	2 – 4	2 – 4	2 – 4	2 – 4	2 – 4	2 – 5
Model:	MEGA BEC	MEGA BEC+	MEGA BEC+	MEGA BEC+	MEGA BEC+	MEGA BEC+	MEGA BEC+	MEGA BEC+ ***)**
Max. current (for full throttle):	12 A	18 A	25 A	40 A	60 A	80 A	120 A	160 A
Max. current for 5 sec.:	15 A	23 A	30 A	50 A	70 A	100 A	150 A	200 A
On-state switch resistance at 25 °C:	2×6,3 mΩ	2×4,0 mΩ	2×3,9 mΩ	2×1,3 mΩ	2×1,0 mΩ	2×0,67 mΩ	2×0,44 mΩ	2×0,33 mΩ
Power conductors cross-section:	0,5 mm^2	1,0 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2	2,5 mm^2	4 mm^2	4 mm^2
JR gold connector, cables:	0,15 mm^2	0,25 mm^2	0,25 mm^2	0,25 mm^2	0,25 mm^2	0,25 mm^2	0,25 mm^2	0,15 mm^2
Weight **incl. all conductors:**	9 g	17 g	20 g	31 g	55 g	57 g	83 g	91 g
Weight **without power conductors:**		6 g	10 g	10 g	17 g	40 g	42 g	52 g
Weight of **„cube“** version:	--	--	--	--	TBD	TBD	TBD	86 g

***) For 16016-3 controller is possible use BEC up to 12 cells (up to 4 Lipol), i.e. up to ca 17V. It is need use external battery for receiver and servos when is use higher voltage and take out the central core of the servo cable connector for disconnect BEC.**

Protective and safety mechanisms of TMM® controllers:

Accumulators are protected in three ways. Firstly, due to the use of automatic current fuse (**ACF**) the current overload of accumulators (and their possible damage) even at crisis points can be avoided. Secondly, the used system of intelligent power reduce (**IPR)** always ensures through measurements of number of cells, voltage, currents, accumulator condition and calculations an optimal point of starting continuous reduction of motor performance (it is applied when accumulators become heavily discharged) so that accumulator cells do not get extremely discharged. This, not mentioning other advantages, reduces the possibility of reversal of poles of lower cells.

This system at the same time **enables retaining defined energy for BEC (perfect RPC)** in controllers that have BEC which is of great significance for flying models (a crash due to running out of energy for receiver and servos can be avoided) Thirdly, it is the automatic current reduce (ACR) due to which a drop in voltage for BEC under extremely big current load (for every given controller) while motor starts does not occur.

Controller may be operated in 2 different modes – car or boat.

If you choice „car“ mode, you can connect „braking lights“ to controller (extra brightness red LED), this LEDs lights when is braking.

All programming is done thought transmitter and receiver with which the controller will run. After programming the data will be saved (until possible next programming) and the controller must be switched off. After switching it on again it is ready to fly. If after switching on, the throttle stick is not in the **neutral** position the controller waits for it to get there (safety precaution) – if the throttle is in its **neutral** position you may start immediately.

Description of parameters in the programming mode:

Parameter A – mode choice: "CAR" mode for cars, "BOAT" mode for boats

CAR mode: If the car is at standstill, then by moving the throttle from neutral the car will go backward or forwards. If the car is moving then by moving the throttle backwards the car will brake. The brake is proportional, that means the further the throttle is from neural the more intensive the brake is. The intensity of braking in the max throttle position may be set in parameter "B". When braking the car will stop, and not start moving backwards until you move the throttle to neutral and then again backwards.
BOAT mode: in this mode the parameter „B" sets the speed in which the motor revolutions are reduced from maximum to the full stop. The direction of motor revolutions is reversed immediately upon moving the throttle the opposite way. The speed of slowing down and starting up is set in parameters „B" and „C".

Parameter B – brake:
– deceleration:
CAR mode: enables to set 5 grades of intensity of proportional brake in the max throttle position. Set according to your needs.
BOAT mode: enables to set the speed of deceleration in 5 grades, Set according to your needs.

Parameter C – acceleration: enables to set acceleration (acceleration speed of motor) in 5 steps. Set according to your needs.

Parameter D – timing: here you may choose (and experiment with) 5 different timings. The six possibility is automatic timing which is strongly recommended because it ensures optimal setting and maximal efficiency. While using the definite values of timing and higher timing you may rise the motor revolution or the twisting moment a bit but always at the expense of lowering the efficiency. If you wish to have higher revolutions it is better to use different motor or more cells because lower efficiency cannot be made up for. High value of timing may in unsuitable combination with some motors damage the controller!
Motor with high inductance: setup timing 5° or 10°, automatic timing cannot be optimal.

Parameter E – controller behavior when batteries are getting low: This parameters sets the controllers behavior at moment when the voltage on discharging curve of batteries gets to the point when controller starts to preserve the remaining energy for BEC. You may set continuous motor revolutions reduction or an immediate cut off (with the possibility of start when you lower the throttle to neutral). This depends on pilots customs. Both behaviors are quite alike regarding the residual energy.

Race mode: In race mode, the motor will be stopped when voltage of batteries drops below 5V, number of cells, their condition or current is not taken into consideration. After throttling down to neutral, the operation may be resumed. This mode is quite harsh on accumulators, particularly for those with more cells !!! Current fuse is disabled (that means it does not check maximal current !!!), the thermal fuse is set to 105°C. Warranty does not apply to a possible damage of controller when operating under this mode.

Parameter F – battery: choice of the battery type, NiCd, NiMH or Li-Ion, Li-Pol

Parameter G – range of the neutral zone: There exists a zone evaluated by the controller as „the neutral". Here the motor is not fed, the brakes are or are not applied automatically, in case of an overcharge normal operating mode is resumed. This parameter may be changed according to your needs and requirements in the extent of ca 3 up to 20% of the full deflection of the throttle stick. The zone which is too narrow may be not evaluated reliably and the one which is too wide narrows the zone of stepless control.

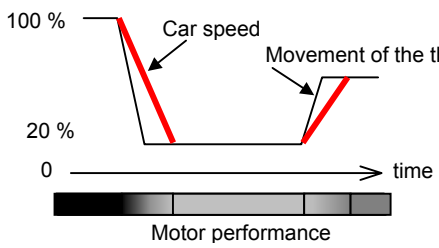
Parameter H – automatic correction of the neutral after each switching-on: If this parameter is not switched on, the position of the neutral is evaluated exactly according to the setup within the scope of basic programming. If this parameter is switched on, the correction to the throttle stick current neutral position is carried out after each controller switch-on. It can be used in such cases as are those when you easily (and unintentionally) move the trim thus changing the centre of the neutral. There is no need to carry out the basic programming again - upon the following switch-on of the controller the position of the neutral is set automatically. When switching the controller on, pay heed to the following - the transmitter must already be switched on and the throttle stick moved to the neutral position.

Parameter I – Freewheel: Operation without the switched on freewheel can be compared to a common car with an engaged gear. If you throttle down, the car gets braked to the value of a throttle stick new position. If you quickly move the throttle stick to the neutral position, the car finishes running due to inertia as if you were driving a common car without the engaged gear. If the freewheel is switched on, the motor gets disconnected (and does not brake) on each quicker dropping the throttle to a lower value (of course incl. the neutral); the motor gets disconnected until the car due to inertia slows down to the speed corresponding to the throttle stick new position. Then the motor gets fed again. Actually it is an electronic analogy of mechanical freewheels. The electronic analogy directly affects the motor and thus all driven axles. Operation with a switched on freewheel is suitable for roads and races, while with a switched off freewheel it is suitable for off-road (in the „car" mode only).

Note:

Set on your transmitter the biggest possible size of deflections, the control will be finer.
If you do not wish to use a full performance of the motor (in some direction), reduce the size of deflections (only after programming !!) on your transmitter; as a result, max. motor revolutions will be not achieved even if the throttle stick is moved into a full deflection position.

Operation without the freewheel



Operation with the freewheel