Programmable controllers TMM® xxxx - 3 *advanced line* for brushless sensorless motors *(Ver. 2.48 and more)*

Controllers TMM® xxxx – 3 ***advanced line*** 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. The power components of the controller together with thick aluminum cooling plates are placed only on one side of controller for better heat removal (that means no inner boards with power components).

Thanks to the high-tech TMM® technology of MGM compro controllers feature number of outstanding properties which considerably eliminate the possibility of unwanted damage or destroy of motor, the batteries and the controller itself. Controllers also ensure the maximal efficiency with different kinds of motors.

Maximum attention is paid to development which is in continuous progress. To make our newest knowledge available to our customers the upgrade of SW is free (only shipping costs are charged).

The quality of products is under constant supervision in manufacture. Every controller goes through numerous tests. The final test of each controller is done under the controller's full load.

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.

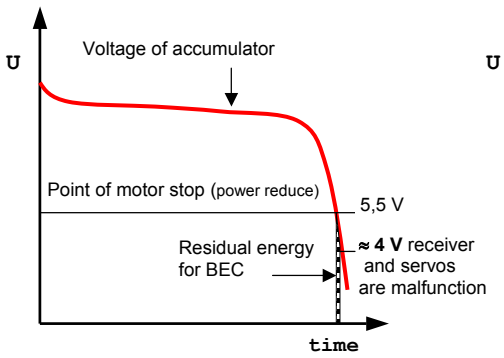
This system at the same time **enables retaining defined energy for BEC (perfect RPC)** in controllers that have BEC which is of great significance for flying models (a crash due to running out of energy for receiver and servos can be avoided) Thirdly, it is the automatic current reduce (ACR) due to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

The controllers efficiently **mask interference and drop-outs** up to 1,5 sec. When long-lasting drop-outs or interference occur the controller slowly reduces motor revolutions. After the signal is resumed the controller continuously gets to the requested power. Without the proper signal from the transmitter (e.g. transmitter is turned off), the motor neither jerks nor runs but is at standstill.

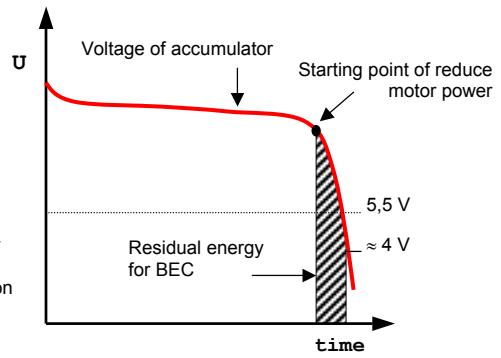
Thermal fuse of the controller is set to 90°C when performance is reduced to ca 60% After switching on, the temperature above 70°C is monitored; if the temperature is higher the controller does not start. New start is possible only after the controller temperature falls. Take notice that the controller warms up not only due to losses on switching transistor but also due to loss on BEC.

Intelligent power reduce (IPR) and retaining enough energy for BEC (RPC)

a) standard controllers



b) TMM controllers



The controller's behavior at the point of exhausted batteries (or closely before that) is very significant from both the controlling point of view and economical use of remaining energy point of view.

When switching (reducing power) the motor off at solid boundary **(a)** there is only very little energy remaining for BEC, particularly for 8 or more cells in accu pack. The better accumulators are used the less energy (time) is left to land (standard ESC).

Comparing to this, TMM **(b)** ensures the remaining energy to be big enough; it is also possible to modify its size in some types (bigger for gliders). This energy is certainly insignificant as long as duration of running the motor is concerned, but it is very significant for feeding BEC.

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

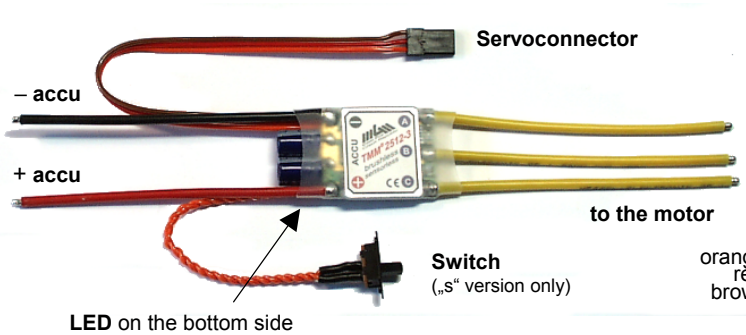
Control signal:	positive pulses 1,5 ± 0,5 ms, period 10 ÷ 30 ms
User set parameters	brake on – off / NiCd, NiMH or Li-Ion, Li-Pol batteries / min and max throttle positions
Automatically set parameters	number and quality of cells, controlling signal from transmitter, motor timing
MEGA BEC:	**5V / max. 4,0 A** (power losses 5W continuous, 10W / 40 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®	**0810-3L**	**0810-3**	**1210-3**	**1812-3**	**2512-3**	**4012-3**	**4016-3**	**4016-3 BEC**
Dimensions (with external capacitor) **[mm]:**	25×22×6	25×22×6	25×22×6	40×26×6	44×26×6	55×32×6	58×32×6	58×32×6
No. of feeding NiCd/NiMH cells:	**4*)** to 10	6 to 10	6 to 10	6 to 12	6 to 12	6 to 12	7 to 16	7 to 16
No. of feeding Li-Ion / Li-Pol cells:	2 to 3	2 to 3	2 to 3	2 to 4	2 to 4	2 to 4	3 to 5	3 to 5
Model:	BEC	BEC	BEC	BEC	BEC	BEC	OPTO	**BEC****)**
Max. current (for full throttle):	8 A	8 A	12 A	18 A	25 A	40 A	40 A	40 A
Max. current for 5 sec.:	10 A	10 A	15 A	23 A	30 A	50 A	50 A	50 A
On-state switch resistance at 25 °C:	2×8,6 mΩ	2×9,3 mΩ	2×6,3 mΩ	2×4,6 mΩ	2×3,9 mΩ	2×1,3 mΩ	2×1,3 mΩ	2×1,3 mΩ
Power conductors lenth/cross-section:	0,5 mm^2	0,5 mm^2	0,5 mm^2	1,0 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2	2,5 mm^2
JR gold connector, cables:	0,15 mm^2	0,15 mm^2	0,15 mm^2	0,25 mm^2	0,25 mm^2	0,25 mm^2	0,15 mm^2	0,25 mm^2
Weight incl. all conductors ("s" version):	9 (11) g	9 (11) g	9 (11) g	17 (19) g	20 (22) g	31 (33) g	31 (33) g	31 (33) g
Weight without power conductors ("s" ver.):	6 (8) g	6 (8) g	6 (8) g	10 (12) g	10 (12) g	17 (19) g	17 (19) g	17 (19) g

*) **Note:** Controllers may be used also with 4 NiCd / NiMH cells which is requested by some modelers. However, feeding with such low voltage does not bring any big advantages (except possibly in some special cases). Proportionally bigger currents will be needed for keeping the same power. Losses grow with current squared (I^2) therefore it is less favorable from the energetic point of view than feeding with more cells (and lower needed current). Moreover, it is not possible to ensure the stable BEC voltage of 5V which however does not interfere with many receivers and servos. When feeding from 4 and 5 cells the permitted limit currents are lowered 20%.

**) This type have BEC. BEC voltage is automaticaly off for battery voltage higher then 17V (12 cells). You cannot take out the central core of the servo cable connector for disconnect BEC.

The appearance and operating data may be changed without prior notice



properly insulated.

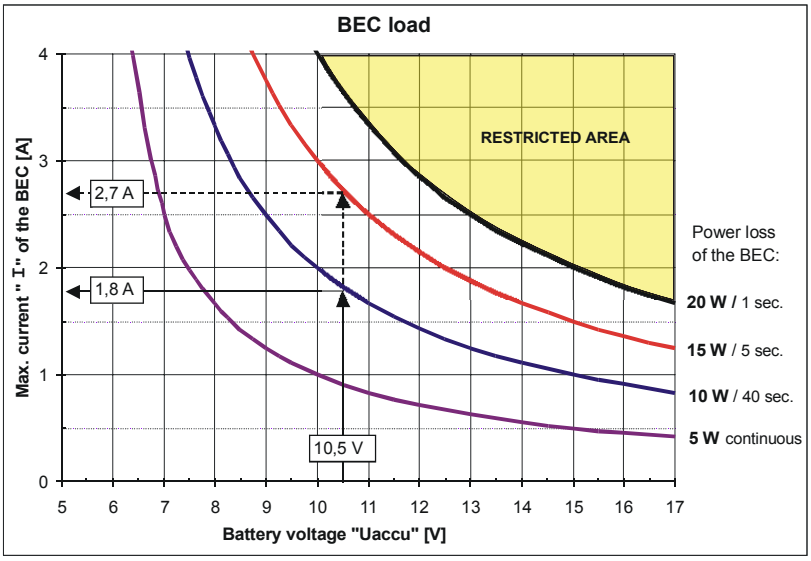
Note:
(for BEC versions only !)
If you need to feed the receiver or servos from some other source carefully take out the central core of the servo cable connector. The taken out core of this conductor must be

MEGA BEC: controllers up to 12 cells are equipped with BEC. The BEC can hold peak currents up to 4A and loss power loads which are significantly big but has its limits. It may not exceed 20W. It is possible to determine for example current which may be drawn from BEC under given load and voltage and also find out for how long from the graph. The power losses of the BEC warm the controller up. It is necessary to remove the generated heat by airflow. If the BEC is loaded with the power loss >5W pauses for cooling are necessary so that the average power loss is ≤ 5W.

Power loss of BEC: (Uaccu – 5V) × current I

Example: (see graph) if voltage of batteries is 10,5V it is possible to draw current of 1,8A continuously for 40s when the power loss of BEC is 10W. If the load would only take 5 sec. the power loss may be 15W and it is possible to draw current up to 2,7A.

When exceeding the maximal limits of current or power losses, BEC may be destroyed and the model may be uncontrollable !
Please, notice that servos loaded with the control surfaces (rudder, ailerons etc.) in the air draw many times more current than when you move them on the ground !

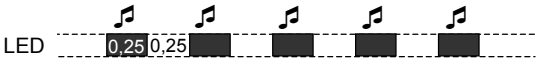


Instructions for use:

- Opposite piece of the connector, which is on your accumulators, should be soldered to the leading-in conductors to the accumulator. Use only quality golden plated kinds. We recommend the MP JET 1.8mm,2.5mm or 3.5mm depending on the type of controller and current; or Schulze 3,5mm connectors (they are not interchangeable); or golden plated connectors ∅ 4 or 2mm. The MP JET connectors have considerable smaller contact resistance. We recommend to put socket on the "-" wire *(black wire)* of the controller and the plug on the "+" wire *(red wire)*.
- Use power conductors as short as possible – it is better for minimum weight and for minimum interference. Receiver and antenna should be placed as far as possible from the controller, the batteries and power leads.
- **NOTICE, reversal of poles on wires to the batteries will destroy the controller !**
- The leads to the motor *(yellow wires marked "A", "B", "C")* should be soldered directly to the motor or it is also possible to use the connectors mentioned above. If you decide to use connectors, this time solder sockets to the controller leads !
  Short cut of these wires together (when batteries are connected) or short cut of these wires to the feeding voltage results in damage or destroy of the controller !
- After the connectors are soldered it is necessary to isolate them, for example with heat shrinking sleeve ! (the connectors on pictures are without isolation sleeve for better clearness)
- If you need the motor to run in an opposite direction, swap any two motor phases.
- **It is necessary to cool the controller in operation with flowing air. Do not prevent the cooling air to get to the controller (eg. by packing it in foam).**
- The controller informs of overload and overheating acoustically (motor beeping) and also through LED.
- The switch of the controller is connected in such way that even if it gets damaged the BEC will be still functioning.
  The controller is switched on by TURNING OFF the switch (applies to "s" version with switch) or by connecting batteries (applies to versions without switch).
- **Do not switch off or disconnect the controller from batteries when motor runs or when it is still turning – that may lead to damage or destroyed of controller !!!**

Error messages (the controller must be switched off to correct error, then switched on again):

- throttle stick was moved the opposite way then it is supposed to (the trhtolle stick was not in the min or max position at the beginning, and after beep it was moved to the max or min position to which …. the throttle was closer and not the other (correct way)
- low size of deflection of the throttle stick on the transmitter – you must shorten the size of deflection on transmitter
- overstep max. throttle position 0,5 and 2,5 ms – you must shorten the size of deflection
- switching on the controller with turned off transmitter



Numbers gives the approximate length of beep in seconds

- starting an overheated controller
- overheating of controller during operation (only LED blinks, motor does not beep, …….. the power is reduced to 60%)

- more or less cells than specified ……

- current overload
  (resumes operation after dropping throttle to zero, it is not necessary to switch …….. the controller off in this case)

- signal drop out for long time ……

The controller is defaultly set in "BASIC" mode (I). In this mode, it is not necessary to program – you may start flying immediately (similar as the SMM range or TMM xxe-3ph). Upon each switch on of the controller, the throttle position determines whether the brake is set on or off. The min and max throttle positions are automatically set at this movement. Disadvantage of this mode is the necessity to repeat the procedure mentioned above upon each switch on of the controller. All other parameters are automatically set by the controller or are defaultly set.

In case the "BASIC" mode does not suit you, you may set some parameters which will then be saved permanently even after the controller is switched off. Other parameters, such as number of cells, their quality, etc. will the controller determine automatically itself, some are defaultly set. See also the "Programming" part of this manual. **(II)**

(I) Operation in the BASIC mode:

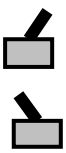
Starting with the brake in Basic mode:

1. **switch the transmitter on**
2. throttle down (min. throttle)
3. **turn the controller on**
4. 1 × BEEP
5. full throttle (max. throttle)
6. 2 × BEEP
7. throttle down (min. throttle)
8. 1 × BEEP
9. **you may start**

NOTE :
If in the starting position  of the throttle stick (min position), 2 × BEEP can be heard, change the norm of deflection of the throttle stick on the transmitter.

Starting without the brake in the basic mode:

1. **switch the transmitter on**
2. full throttle (max. throttle)
3. **zapnout regulátor**
4. 2 × BEEP
5. throttle down up to 10 sec. (min. throttle)
6. 1 × BEEP
7. **you may start**



If in the starting position  of the throttle stick (max position), 1 × BEEP can be heard, change the norm of deflection of the throttle stick on the transmitter.

(II) PROGRAMMING and operation:

All programming is done thought transmitter and receiver with which the controller will run. After programming the data will be saved together with the min and max throttle positions (until possible next programming). It is necessary to switch the controller off afterwards to end the programming. When the controller is programmed it is ready for use immediately after switch on**. If after switching on, the throttle stick is not in the min position the controller waits for it to get there (safety precaution) – if the throttle is in its min position you may take off immediately.**

Description of parameters in the programming mode:

Parameter A – mode choice: enables to set "Basic" mode option or user set parameters option
Parameter B – brake: enables to set the brake off and the strength of brake (intensity of braking) in 5 steps. Set according to your needs.
Parameter C – type of cells: enables to set battery type which will use, Set according to your needs.

How to program the desired "value" in parameter you are setting (basic procedure in each parameter)**:**

Move the throttle to ½ throttle, green LED will be switched off 2× (twice) and motor beeps 2×. Move throttle back to min position, green LED will be switched off once and motor beeps once. Repeat this procedure (½ throttle – min throttle) as many times as is the number of parameter (according to the table) you wish to set. **For example:** for setting the **number 2** in parameter "B" (light brake) repeat the whole procedure (½ throttle –min throttle) **2×** (you certainly have to be in parameter "B").

The programming of each parameter will be finished when you move the throttle from min position to the full throttle – green LED will be turned off 3× and motor will beep 3×, then move the throttle back to min position, Green LED will be turned off 1× and motor will beep once – the parameter is programmed to the value you have chosen and saved **(this sequence is marked as "ENTER")**. This also automatically gets you to next parameter. After the last programmed parameter the controller must be turned off.

If you do not wish to change some parameter (you wish to preserve its last value) you directly set full throttle when programming it (no ½ throttle – minimum procedure, but directly ENTER). The parameter value stay as it was before and the controller will get to the next parameter programming. The exception to this is the "A" parameter.

The programming itself:

1) Turn the transmitter on **with throttle stick in max position !**
2) Turn on **the controller.** After 10 seconds ***(++)*** the controller will beep 3× and LED will blink and stay turned on. Now you have 3 seconds to move the throttle back to zero. If in this time limit you do not put the throttle in min position the programming process will end and the controller will be turned off. Its next operation is possible after turning it off with the switch and then turning on with switch (disconnecting and connecting of batteries).
   If you put the throttle to zero in this time limit, the motor will beep 1× and the green LED will be turned off 1×. Now you are in the programming mode and may start to program parameters according to the procedure described above.
   (++) If before this programming the "BASIC" mode was set, the motor will beep 2× after switching on the controller, do not take care of this and wait for the 3× beeps.
3) **Parameter A – mode choice: parameter setting or "BASIC" mode**
   a) you do not wish to program and you wish to use the initial setting, "BASIC" mode:
   Move the throttle to ½ throttle position, green LED will be turned off 2× and the motor will be beep 2×. Move throttle back to min position, green LED turned of 1× and motor will beep 1x. Repeat this procedure 3×. This choice will be confirmed by moving the throttle from min to full position – green LED will be turned off 3× and motor will beep 3×. then move back to min position and LED will be turned off 1× and motor will beep 1×. The default setting is set and min and max positions of throttle are saved. Now turn the controller off. The "Basic" mode is set.

   b) You wish to program and set the controller according to your criteria:
   Move the throttle directly to full throttle as if you wanted to skip the parameter. Green LED will blink 3× and motor will beep 3×. Move the throttle back to min position, green LED will be turned off once and motor will beep. Now you will set parameter "B" .
4) **parameter "B" – brake:**
   set according to the "How to program the desired "value" in parameter you are setting" (see above) set the desired value and move to next parameter by "Enter" sequence – also described above
5) **parameter "C" – type of cells:**
   set according to the "How to program the desired "value" in parameter you are setting" (see above) set the desired value
   By sequence „ENTER" (set full throttle – back to min. throttle) you terminate programming. **Turn controller off !**

Parameter	Value of parameter →	0	1	2	3	4	5	6
1	Mode choice	Parameters setup			**„BASIC mode"**			
2	Brake	next parameter	Brake off	light	**medium**	high	hard	extra hard
3	Type of cells	next parameter	**NiCd / NiMH**	Li-Ion, Li-Pol 2 cells	Li-Ion, Li-Pol 3 cells	Li-Ion, Li-Pol 4 cells	Li-Ion, Li-Pol 5 cells	

Notice: - Default setting is **bold and underlined**
- „next parameter" means skipping to the next parameter by directly setting „ full throttle" in the parameter (the skipped parameter will not be changed)

WARNING:

You risk destroying the controller for:

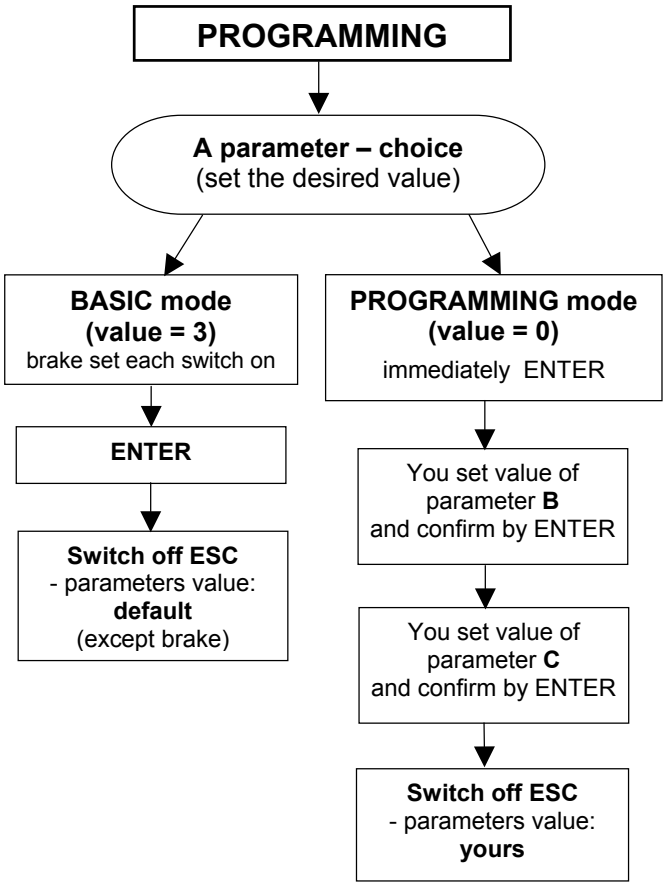
- connecting more battery cells to the controller than the max. number specified in the technical data
- reversing connections to the accumulator
- shortcutting of wires to motor when batteries are connected
- changing motor and accumulator outlets
- overloading of the BEC with bigger currents or bigger power loss than is specified in technical data
- water in the controller (except for „hydro" versions")
- metal objects in the controller (screwdrivers, wires, etc.)
- disconnecting the controller from batteries or turning off the controller while motor is running (or still turning)

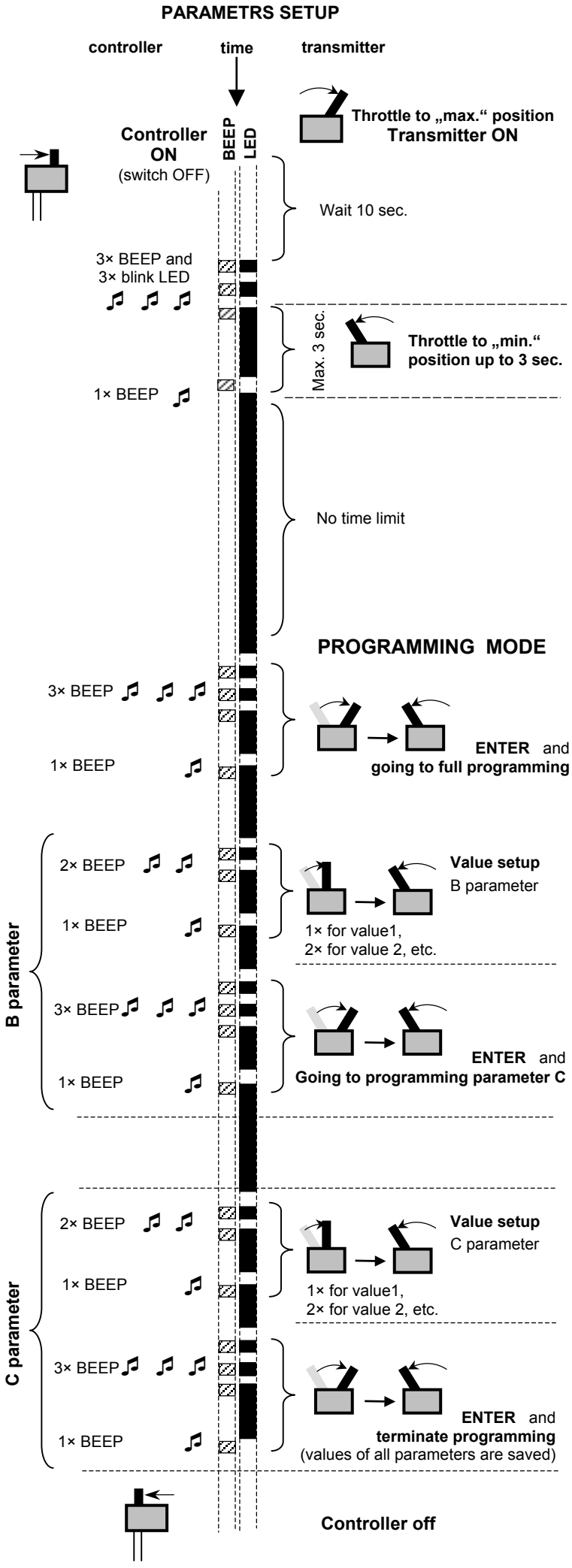
SECURITY WARNING:

Always disconnect the accumulators when not operating the model !!! Small current consumption occurs even when controller is switched off. Do not leave model with connected accumulators unattended ! Do not charge batteries when connected to the controller ! If the controller is connected to batteries do not stay in the reach of the propeller even when the controller is switched off ! Please notice that running motor with propeller is very dangerous !

Development, manufacture, servis:
MGM compro, Ing. G. Dvorský,
Sv. Čecha 593, 760 01 Zlín, Czech Republic
Tel.:+420 577 001 350, fax:+420 577 001 348
E-mail: mgm@mgm-compro.cz
Info: www.mgm-compro.com

PROGRAMMING TMM xxxx – 3





Legend: