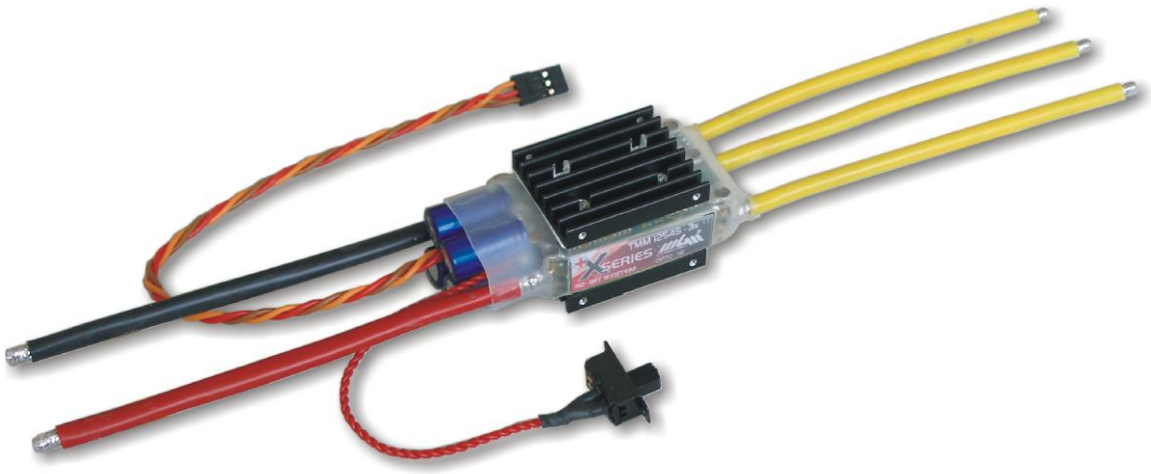
X-SERIES V7



Programmable brushless controllers for all types of models

Operating Manual

Development, manufacture, service:
MGM compro, Ing. G. Dvorský
Sv. Čecha 593, 760 01 Zlín, Czech Republic

Tel.: +420 577 001 350
E-mail: mgm@mgm-compro.cz
Info: www.mgm-compro.com

Programmable "brushless“ controllers for all types of models
TMM® xxxx – 3 X-series V7 *(Version 7.xx)*

TMM® xxxx – 3 X-series V7 range Controllers are outstanding, fully programmable controllers of the highest quality for "brushless“ sensorless and sensor motors (BLCD motors) for models of cars, boats, submarines, airplanes, helicopters etc. They feature both uni-directional as well as bidirectional operation, and are manufactured in numerous modifications and variants - see below for an over-view.
These controllers built up on their predeceasing Z-series controller range. They are already a 7th generation of brushless controllers. Compared to E-series and Z-series, these new controllers offer many new features, possibilities and also significant changes. The well-proven methods of control and outstanding features from the previous series are certainly retained in these newest controller series.

To enable our customers to exploit the newest developments and satisfy new requirements, SW update of the PC programs as well as the firmware update of the controller can be carried out by the customer himself/herself though the internet at any time.

New features of the X-series controllers:

- new - The controllers use new and very powerful **32 bit processors**, which have enough throughput to satisfy all requirements and demands. That is also one of the reasons that these controllers have features and possibilities not achievable with simple controllers using 8-bit or even 16-bit processors.
- new - Controllers offer up to 400A / 63V (= 15 Lipol), that is **up to 25kW**! *(controller 63V / 250A and 400A have their own separate user manual)*
- new - Choice of the model type (**airplane, car, boat, helicopter – all in one**) depends only on your controller settings, and both unidirectional as well as bidirectional operation is enabled (except for heli)
- new - Controllers have **4 memory banks** for parameter settings → choice of one of the 4 preset models is thus very easy
- new - **Internal Black Box** (logging device) is integrated into the controller (no additional cables needed, no additional cost)
- new - **the controllers can make use of „back data channel“** (telemetry) - real time telemetric data transfer from the model) **of some RC sets** (such as **TWIN** by **MZK servis**) and can therefore send all the measured values to the transmitter in real time (to a display unit connected to the transmitter)
- new - Controllers making use of the back channel have **two servocables** (one for control of the controller, second for the data transmission to the receiver) - it is also a great advantage that feeding of the receiver and servos is doubled in this case → **higher safety and smaller losses** on the resistors of the servocable and its connector
- new - Very clear indication of different states of the controller using 4 LED 
- new - When connected to PC, both saved data as well as warning and error notifications are transferred from the controller to the PC
- new - Controller can send all the measured (logged) values into PC in real time (§NA)
- new - It is possible to reduce power for both reverse as well as forward gear (current reduction to preset value)
- new - Powerful switched **S-BEC**, with choice of **5V** and **6V** or **5V, 6V, 7V and 8V (version HV-BEC),** currents up to **6A**
- new - For controllers up to 35V (i.e. up to 8 Lipol cells) is possible to choose **BEC** or optical coupling **(OPTO version)** in order
- new - Parallel to BEC is possible connect battery → significantly increase safety and reliability all RC system
- new - Extremely fine **throttle step 2048 values** (steps)
- new - Very high maximal motor revolutions (up to **250 000 rpm** for a 2 pole motor)
- new - **Automatic sensor setting** when sensor motors are connected → the problematic "phasing" of sensors and phases on motor is therefore not needed, the sensor position is also optimized; it is possible to connect also other motors not just those recommended by EFRA
- new - Sensor motor controllers (marking **SE**) you can run with sensorless motors also – necessary only set correct motor type to parameters

Further advantages X-series controllers:

- very transparent and easy settings of parameters using PC with Windows (XP, Vista, 7)
- you can update the controller with a newer firmware yourself from our website www.mgm-compro.com, using your **PC**, **USBCOM_4** module and **CC_11** cable. This new feature is very useful and favorable. Controller may have additional features that were not available at the time of purchase. You may have actual version at all times. The same components will be used to set parameters and read-out of data from the controller.
- controllers also support motors requiring higher working frequency of 32kHz (such as „Tango" motor by Kontronik etc.)
- controllers support **NiCd, NiMH, Lipol, Li-Ion, A123, acid (Pb)** cells and possibly **any other new battery type** (universal settings) which may have not even existed at the time of the controller production
- unmatched protection and management of accumulators Lipol / Li-Ion (*for these cell types this is of a fundamental importance*) as well as A123 cells and NiCd / NiMH
- very smooth starts with sensor as well as sensorless motors
- Possibility to connect brake lights or flashing beacon
- They are standard manufacture in a version with a switch (*in a safe connection – as in all MGM compro controllers, damage of switch does not affect controller)*
- it is possible to choose from several variants and cooling with active cooling and water cooling
- it is possible to choose a variant with enhanced resistance to water and humidity (marked as **WP**) or with a 100% water resistance (marked as **WR**)

Table of content:

Note:

Content…….. all items are available quickly by ***CTRL+ left mouse button***.

blue underlined ….. all like this marking texts in manual quickly jump, by ***CTRL+ left mouse button,*** to corresponding content (cross reference).

In the Manual in „pdf" format on these marking texts standard cursor changed to hand symbol ( ) . In this case only click to ***left mouse button,*** (without ***CTRL***), caused jump to corresponding content (cross reference).

(§NA) …….. parameters or features parking by this symbol are not available in this moment. As soon as will be available, you can download and update new firmware for your controller – please watch information on our web.

In this manual are described general things about this line controllers. Exceptions for each type of model are described in separate chapters or differences are highlights.
Separate chapters are devote to technical specifications and related things.

First steps.

(full sail to start)

First, before you start run controller, make these steps:

- **read** Basic Recommendations
- **solder corresponding connectors**
- **select basic type of model** (car, boat, aircraft or helicopter). This you make by program „***Controller 2***“ or simply by transmitter, see to Memory select
- **connect controller to receiver and battery,** see more Controller's connection.

Now you can start → Start with automatic throttle limits.

- When you want use **sensor motor**, **read first instruction here**: Sensor motor settings

For first tests is not necessary (except sensor motors) set optimal parameters, controller has pre-defined average value of all parameters for basic type of models. For first tests you can use automatic modes (type cells = **Automat 78%**) and Start with Automatic throttle limits.

Of course, optimal behaviors of the controller, or your model, by your images, you achieve only by correct setting and tuning corresponding parameters. For this case is connection to the PC necessary.

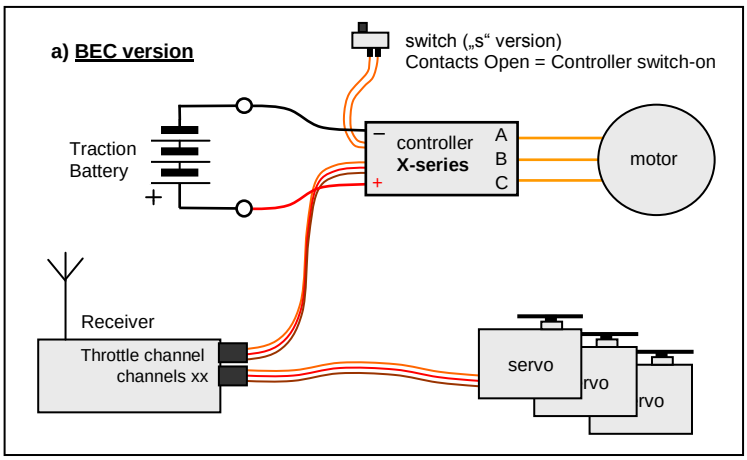
Parameter setting by program „***Controller 2***“ is very simple and intuitive and enable easy and transparent setting all controller features for optimal behavior. If you wish to enjoy all the possibilities of the controller, please refer to the whole manual.
When you set parameters, include throttle limits (= programed), you can start → Start with programed throttle limits.

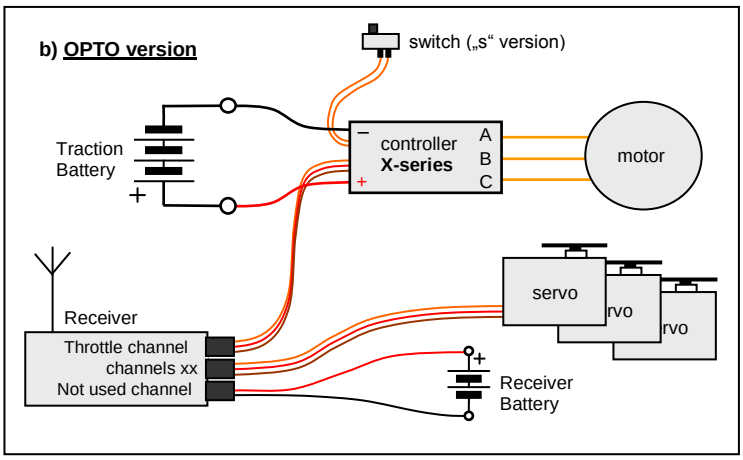
Basic Recommendations.

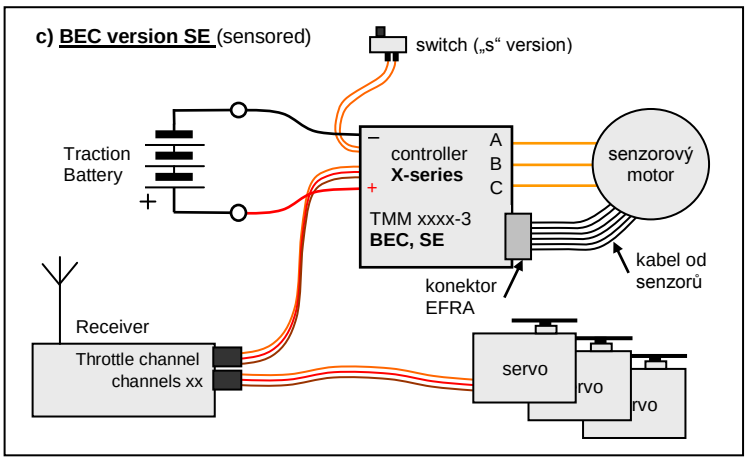
- **!!! Shorten the cables between the battery and the controller as much as possible** (however not under 3 cm, there is a possibility of unsoldering wires from the controller) **! The higher the power and the "faster" the used motor, the more important is this requirement !**
- If you need to prolong the power conductors to batteries (distance between the controller and the batteries > 20 cm), it is necessary to solder additional capacitors (same as in the controller) as close to the controller (to "**+**" and "**–** " conductors of the controller) as possible. The capacitors must be "**very low ESR**", **105°C** with at least double the capacity than those used in the controllers.
  It is strongly discouraged to prolong the overall length of conductors between the battery and the controller above 15 – 20 cm for currents above 80A.
- **!!! Use only quality and well dimensioned connectors for connect battery to the controller !** Very suitable and very reliable connectors are MP JET 2.5 – 3.5 – 5.5 – 6.0 mm, which are dimensioned for currents up to 200 – 300A, see more to file, Be careful when choosing power connectors for batteries and motor! on our www. MP JET connectors feature small transition resistance, small dimensions and very firm connection (they do not come apart themselves as some other types do). We recommend to put the socket on the "**–** " wire *(black wire)* of the controller and the plug on the "**+**" wire *(red wire)*.
  Connectors of „plug" type 4mm, even golden-plated (4mm Gold Plated Bullet Connectors) or connectors of „Dean" type are discouraged for use.
- **!!! NOTICE, reversal of battery poles will reliably destroy the controller !** (The damage however, may not show immediately, but in some later runs !) Therefore we recommend to put the socket on the "**–** " wire *(black wire)* of the controller and the plug on the "**+**" wire *(red wire)* – not the same part for „+" and also „**–**" pole → possibility of reversal input voltage polarity is smaller.
- **Never connect more cells (higher voltage) than is specified in technical data, you can damage controller.**
- When you use more than 4 Lipol cells (more than ca 16V), use „antispark" resistor for first battery connection, see here: Sparking prevent when connect higher voltage.
- 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 circuit 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 !
- **Short circuit motor cables or feeding cables to any other wires** (driving signal, BEC, …) **caused damaging of the controller.**
- Insulate the connectors after soldering, e.g. using heat shrinking sleeve.
- **!!! Using of power supplies for controller feeding is strictly prohibited ! Only battery for feeding is permit.**
- **!!! Do not SWITCH OFF controller or PLUG OFF BATTERY when motor RUN or when it is still turning – that may lead to damage or destroy of the controller !!! This also applies to spontaneous disconnecting of the connector during operation, e.g. by vibrations!!!** This is why connectors should be chosen very carefully – see recommendation above**.**
- **!!! Be careful for using damaged motor or motor overloading, controller damaging is possible.**
- One controller can control only one motor.
- **It is necessary to cool the controller in operation with flowing air. Do not obstruct the access of cooling airflow to the controller, e.g. by packing the controller in foam,** especially when working near its limit parameters or choose types with external coolers (possibly also with a fan).
- It is recommended to measure current drawn from battery with charged battery and full load. **Only clamp Ampermeters using is permitted** (always for DC current, on the battery cables).
  Never use Ampermeter inserted to the circuit (i.e. between battery and controller) **– you can damage controller !**
  It is convenient to use measurements carried out by the controller during the drive and their display using PC. Please remember, that even one additional cog on pinion of the motor significantly increase the drawn currents. With acceleration set faster, currents in the start-up peak rise very fast, and that up to many times of the current in the steady state. It is necessary to do the measurement with the hardest batteries, which you wish to use in the set. This will prevent possible problems with overloading the controller, motor and batteries.
- Receiver and antenna should be placed as far as possible from the controller, the motor, the batteries and power leads.

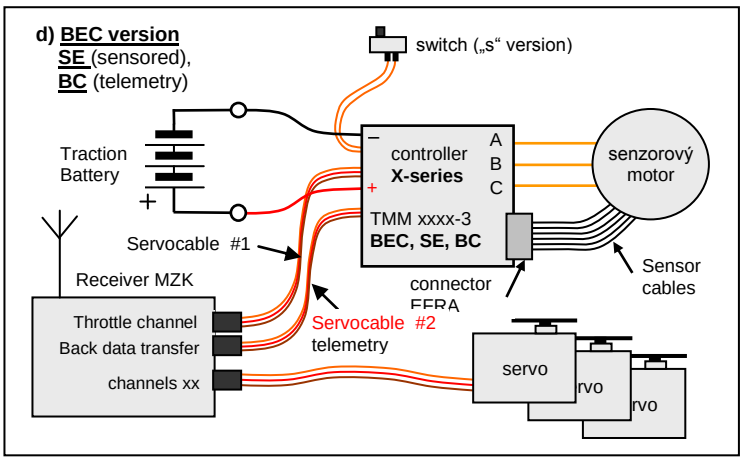
Controller's connection.

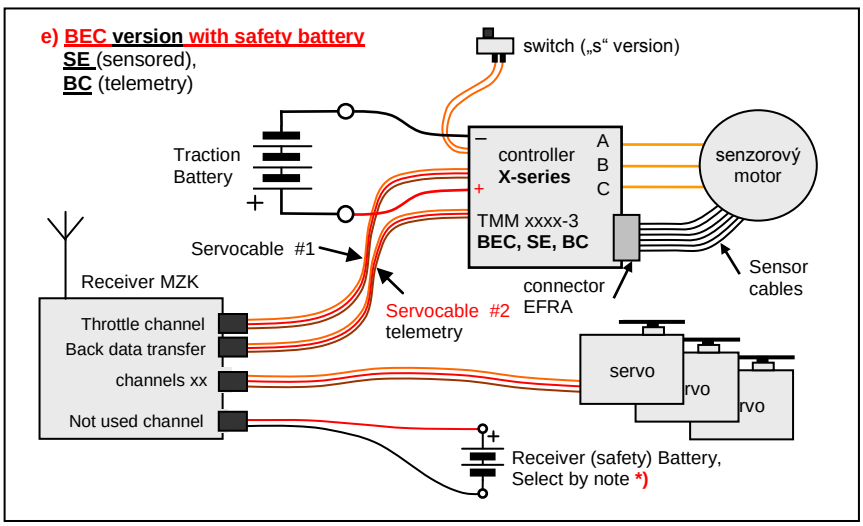
- Receiver and antenna should be placed as far as possible from the motor, controller, the batteries and power leads.
- Controller's servocable #1 connect to the receiver, throttle channel.
- When you use (you have) controller with telemetry (BC version), connect servocable #2 to corresponding channel of receiver.
- For OPTO versions (i.e. without BEC) you must use external supply for receiver and servos (receiver battery, external BEC, …)
- You can connect receiver (safety) battery parallel to BEC for safety increase ***)**, see fig. e)
- When motor rotate to other side than you need, you can swap two motor cables (only for sensorless motors !) or change parameter settings (parameter **Reversal of motor revolution**).
- When you want use sensor motor (SE version of controller), make „Automatic sensor settings" before first start.
- The controller switch is connected safety so that drop-out of BEC voltage is not possible if the switch fails (safe connection).
- Controller is turned-on by open contact of the switch or by connecting the accumulators (applies to versions without the switch).
- When you use more than 4 Lipol cells (more than ca 16V), use „antispark" resistor for first battery connection, see: Sparking prevent when connect higher voltage











Notice:
(only for versions with BEC !!!)

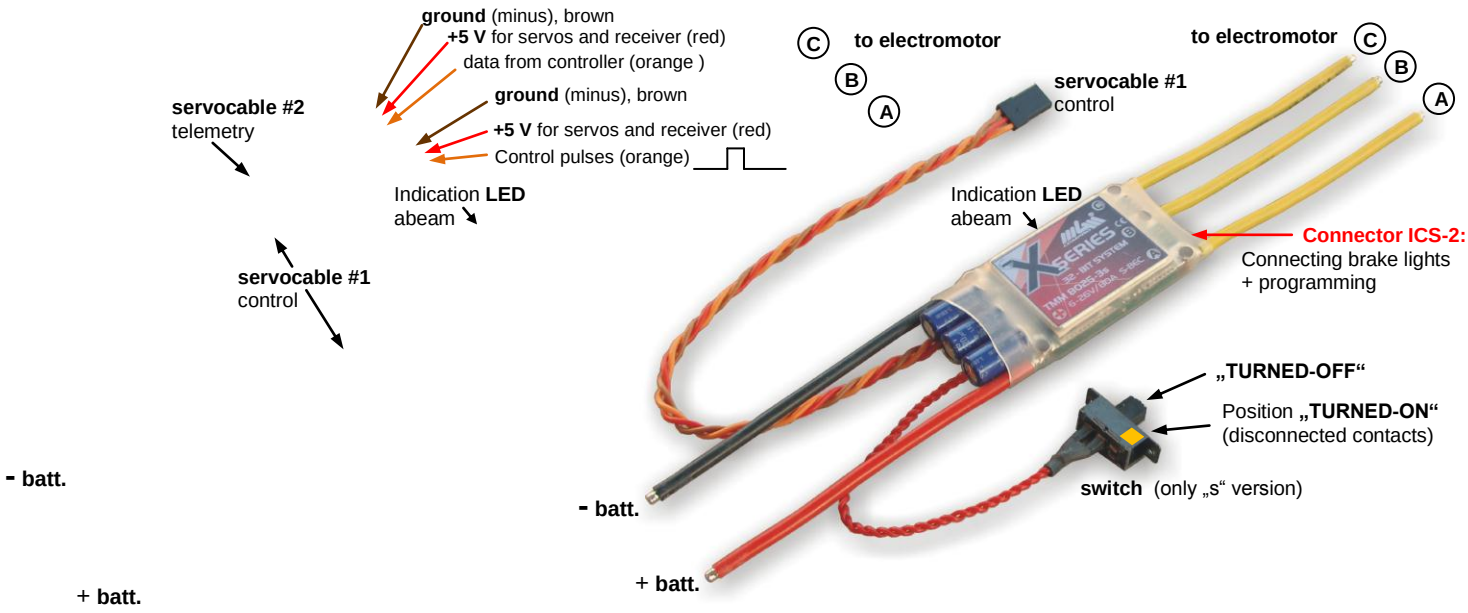
If you need to feed the receiver or servos from some other source than BEC, carefully take out the central core of the servo cable connector (red wire) and insulate it properly **!**

With OPTO versions
DO NOT TAKE OUT the core !!!

***)** for 5V BEC voltage connect 4 Nixx cells
for 6V BEC voltage connect 5 Nixx cells
for 7V BEC voltage connect 2 A123 cells
for 8V BEC voltage connect 2 Lipol / Li-Ion cells

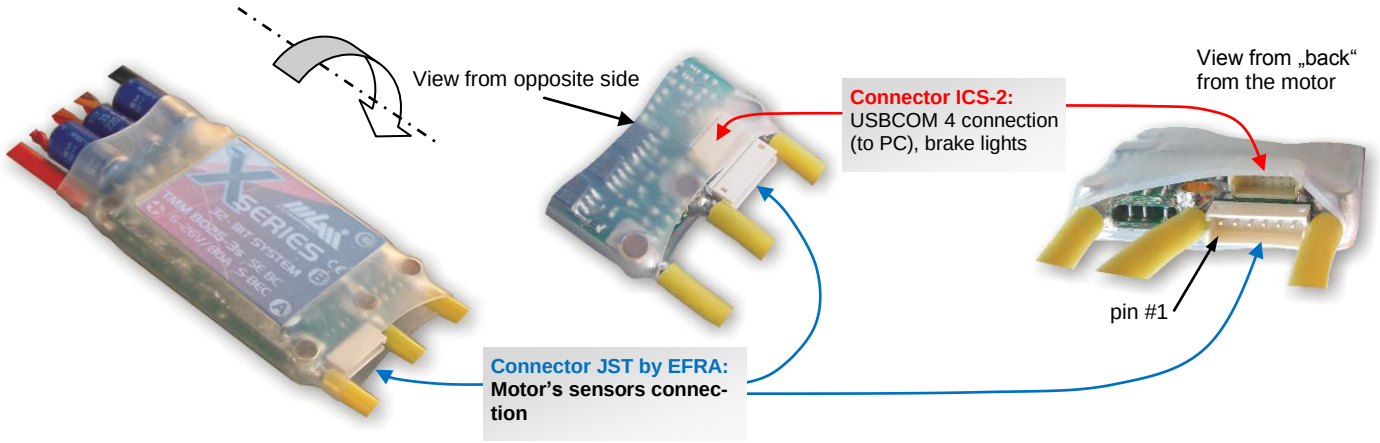
Connect traction battery and switch-on controller first, connect this battery in second step. For switch-off controller disconnect this safety battery first and traction battery disconnect in second step.

Basic description of the controllers.



Controllers version **SE** a **BC** (sensor motors and telemetry), with switch

Basic modification with switch



SECURITY WARNING:

Always disconnect the battery when not operating the model !!! Do not leave model with connected battery unwanted !!! If the controller is connected to batteries do not stay in the area in front of the model ! Rotating screw, propeller or uncontrolled car are very dangerous!!!
Do not charge batteries when connected to the controller! Controller turned off by a switch only, draws small current from the batteries.

- **NOTICE, reversal of battery poles will reliably destroy the controller !** (The damage however, may not show immediately, but in some later runs !) **Damaged controller can caused subsequently damaging of battery, their short circuit and/or eventually fire.**
- **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 the controller, with all adverse effects !**
- **Make sure that the motor is in a good condition. A faulty or damaged motor** (mechanical damages, shortcuts on winding, etc.) **may cause damage or destroy of the controller as well as the feeding cells, with all adverse effects !**
- **Disconnecting the connectors to battery or motor during operation** (motor is turning) **due to faulty or unsuitable connector leads to damage or destroy of the Controller, with all adverse effects !**

Controller states indication, Error messages.

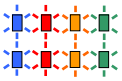
Controller indicate states by 4 LED and also acoustic by motor beeping.

short beep long beeeep melody

In this example blue LED blinking, others lights continuously: 

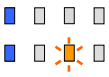
Possible states:

Short blink of all LEDs after switch/on controller (check of LED) ……
Short blink of all LEDs together with beep by motor (BEEP) ……..



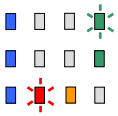
a) correct states (= blue LED lights continuously):

- all is O.K., Controller communicate with the PC ……
- all is O.K., but controller without driving signal (all lost driving signal) …

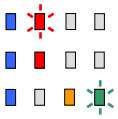


- throttle position STOP (neutral) ……
- all is correct (O.K.), signal is above neutral position……..
- all is correct (O.K.), signal is bellow neutral position……..

- partial throttle forward ……
- full throttle forward (full power)……
- partial brake when run forward ……..
- full brake when run forward ……



- partial throttle backward ……
- full throttle backward (full power)……
- partial brake when run backward ……..
- full brake when run backward ……



- correct finish of pre-set operation ……..

(Automatic sensors settings, set of max. rpm, set of throttle position by transmitter, ….)

When happen some of next states (problems), correct states are not indicated. These not correct states indicated some problem in the system. These states last until switch-off.

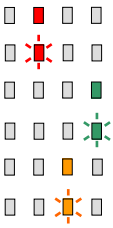
b) special RESET state (=only blue LED blinking):

- necessary switch-off and again switch-on controller……..

(this is not defect, switch-off can be requested absolutely correctly, after some settings !)

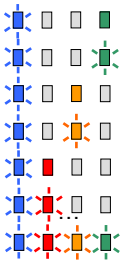
c) limit operational states (=blue LED not lights):

- power is reduced by high controller temperature .. ……..
- motor is switch off by high controller temperature ……..
- power is reduced by battery low voltage ……..
- motor is switch off by battery low voltage ……
- power is reduced by high current peaks ……..
- braking is reduced by high battery internal resistance ……



d) critical and error states (=blue LED blinking + some other LED):

- motor overheating ……..
- destroy or damaged motor… ……..
- battery overheating ……
- switch of by overload (average currents are too high) ……
- BEC overheating ……
- overload / short circuit on the BEC ……..
- damaged HW, call service … ……



e) any LED lights

- input voltage (feeding) lost or bad value ****)** or problem in HW ……..

****)** bad soldered connectors, disconnect battery inside, etc. – measure voltage on the supply cables to the controller (red and black), after main connectors, on the controller side. The most easy by wiretap (inject) by sharp pin or needle and connect voltmeter to these pins.

Basic operational modes – mode select, model select.

a) Aircraft one way (fig. 1): Standard aircraft driving. “STOP” throttle position is identical with “brake” position. Transmitter without lock of STOP position.

b) Aircraft bidirectional (fig. 5, 6): This very special mode for aircrafts enabled, after landing, reverse motor(s) rotation direction and brake on very short runway (or run backward). Transmitter without lock of STOP position and/or with flying modes switch.

c) HELI (one way) (fig. 2): Standard helicopter driving. Transmitter without lock of STOP position and/or with flying modes switch.

d) Boat one way (fig. 1): Backward run is blocked by SW as well as by throttle position. Transmitter without lock of STOP position.

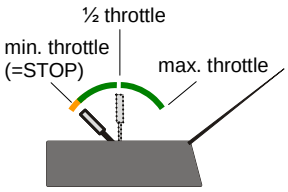
e) Boat one way (fig. 3, 4): Backward run is blocked by SW, throttle moving back from neutral is without effect. Transmitter with lock of STOP pos.

f) Boat bidirectional (fig. 5, 6): Bidirectional driving of boat, transition from one direction of rotation to opposite is instantaneous. Transmitter with lock of STOP position.

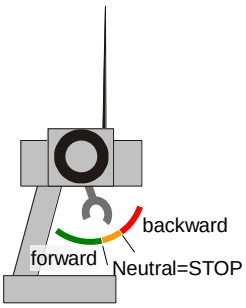
g) Car one way (fig. 7, 8): Backward run is blocked by SW, throttle moving back from neutral activate only brake (at the time brake light is lighting). No possible run backward. Transmitter with lock of STOP position.

h) Car bidirectional (fig. 7, 8): Standard bidirectional car driving, motor pass continually from run to braking (at the time brake light is lighting). Backward run is possible only after stop of model and throttle stick start from neutral position. Transmitter with lock of STOP position.

Transmitter without neutral



Transmitter with neutral



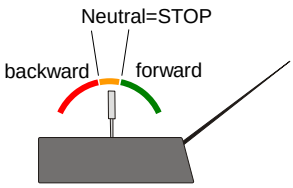


Fig. 1

One way mode:

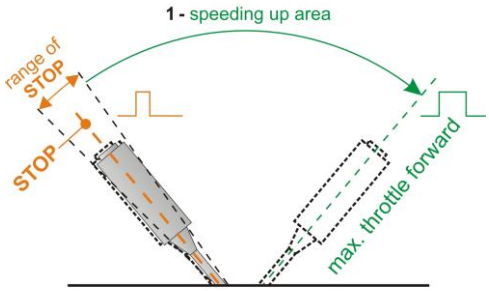


Fig. 2

HELI mode:

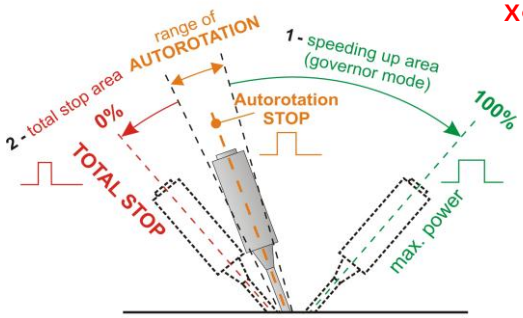


Fig. 3

One way mode:

50:50

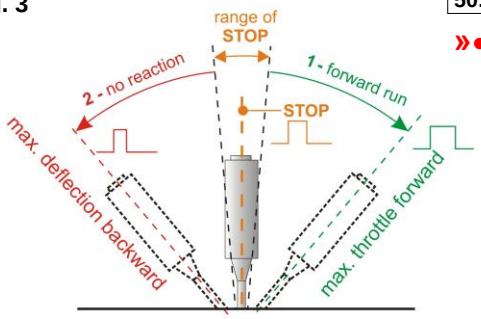


Fig. 4

One way mode:

30:70

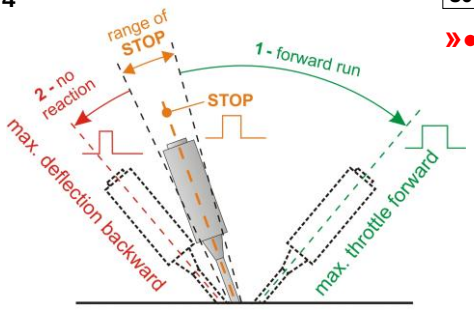


Fig. 5

Bidirectional mode:

50:50

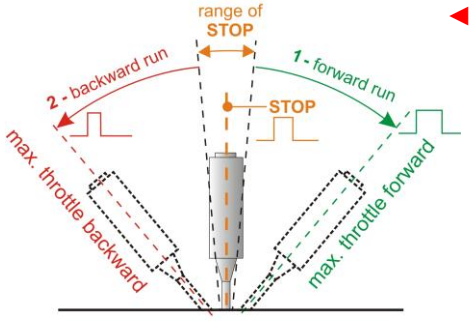


Fig. 6

Bidirectional mode:

30:70

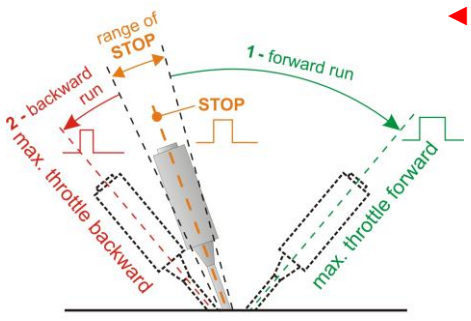
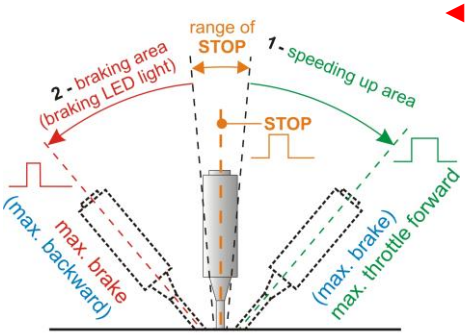


Fig. 7

Bidirectional mode - car (forward):

50:50

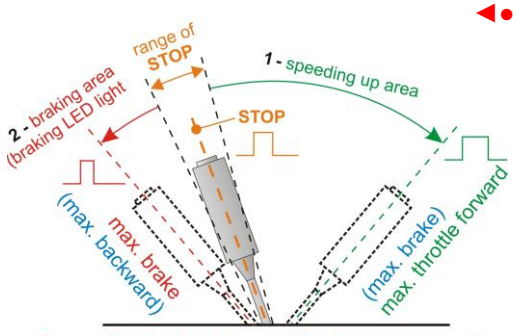


For running backwards everything is exactly

Fig. 8

Bidirectional mode - car (forward):

30:70



For running backwards everything is exactly opposite

Select of Memory Bank and Model Type.

Controller has 4 memory banks for storage parameters for 4 models (or 4 different parameters setting for one model etc.).

First possibility is **basic settings** of parameters, button **"Default basic"**. In this mode are available only basic parameters corresponding with choice model type.
Second possibility **is full parameter settings**, button **"Default advanced"** for experts. In this mode are available all parameters and you can use all controllers possibilities (options).

In basic settings are model types assign to memory banks (wired-in).
Simultaneously are predefined parameters (default values) for these models – therefore is possible use controller immediately.

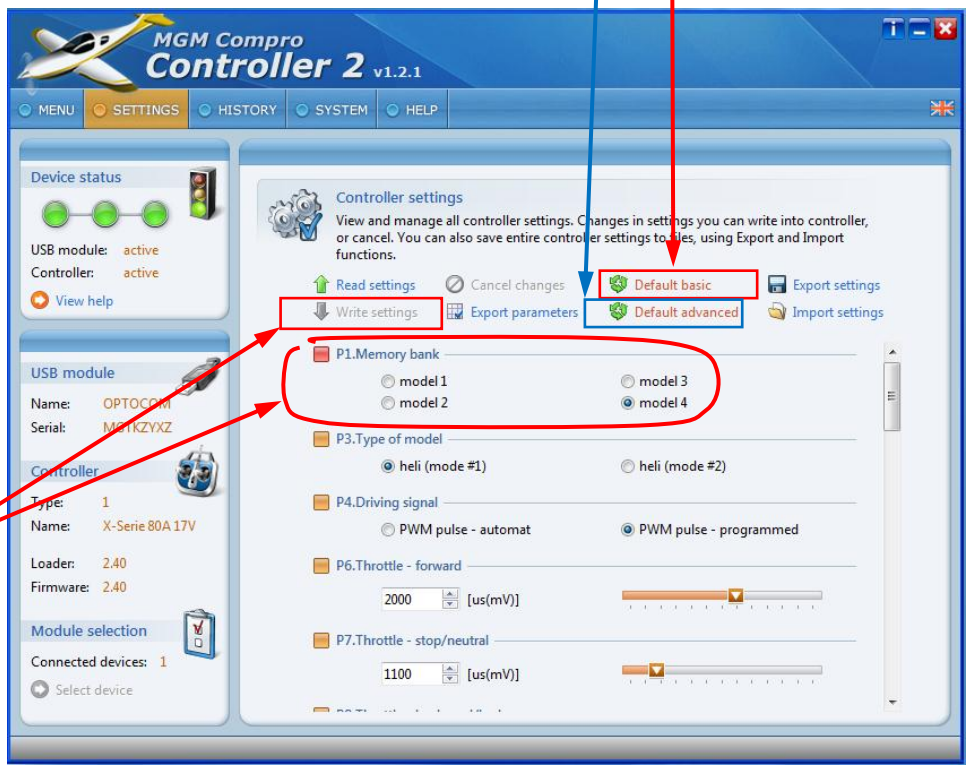
- memory #1 (model 1) = car bidirectional
- memory #2 (model 2) = boat bidirectional
- memory #3 (model 3) = aircraft one way
- memory #4 (model 4) = helicopter

From the production is pre-set select of memory #1

Nevertheless you can any time change settings of parameters in these memory banks, by your own request and needs.

When you choice "**Default advanced**" settings, model types assigning is broken – it means you can redefine parameters and its values in all banks, for example, to one model type, even to aircraft. Also all parameters are available.

select memory bank in program ***Controller 2*** and write by button „**Write setting**" (available when change some parameter)



IMPORTANT:

Change of content of selected memory bank (i.e. parameters values) is possible make only by PC!
To change the "Default basic" to "Default advanced" (and vice versa) are set to all parameters default values !

When you want change some parameter(s), **necessary first select memory bank in program** „***Controller 2***" in which you want make changes. After this selection you can change all parameters by your needs and after pushing button "**Write setting**" will be these new values of changed parameters write to selected memory banks.
All changes of any parameter are related to selected memory bank.

Note: **No possible make this process in reversal order, i.e. no possible change parameter first and after this select memory bank !**

Programming of the parameters.

With respect to possibility of settings is necessary programming controllers **X-series** range only by PC with operating system Microsoft (**Windows XP**, **Vista** or **Windows 7**) and **USBCOM_4** module with s cable **CC_11**. In your PC must be installed and run program „***Controller 2***". Installation instruction is in manual „Installing and running of program Controller 2".

In the **Basic settings** are available only red marked parameters.
If you want (need) change additional parameters, necessary switch to **Advanced settings**.

Parameters setting by user, including default values for all memory banks (type of models):

parameter		range		step	Model #1	Model #2	Model #3	Model #4
					Default settings	Default settings	Default settings	Default settings
P1	**Memory bank**	1	4	H	#1	#2	#3	#4
P2	**Controller mode**			H	**Bidirectional**	**Bidirectional**	One way	One way
P3	**Type of model**			H	**Car**	**Boat**	**Aircraft**	**Heli mode #1**
P69	**Type of driving**			H	PWM	PWM	PWM	**Const. rpm**
P4	**Driving signal**			H	**Automat**	**Automat**	**Automat**	**Programmed**
P33	**Settings from transmitter**				Allowed	Allowed	Allowed	Allowed
	Throttle position							
P6	**Full throttle Forward**	1,6 ms	2,3 ms	1µs	**2,0 ms**	**2,0 ms**	**2,0 ms**	**2,0 ms**
P7	**STOP / Neutral**	1,0 ms	1,7 ms	1µs	**1,5 ms**	**1,5 ms**	**1,0 ms**	**Stop 1,0 ms**
P8	**Full throttle Backward / (Full Brake)**	0,7 ms	1,4 ms	1µs	**1,0 ms**	**1,0 ms**	**(1,0 ms)**	**(1,0 ms)**
P12	**Neutral range** (STOP position)	5%	25%	1%	15%	15%	5%	5%
P14	**Telemetry**			H	No	No	No	No
P71	**Internal Black Box record period**	10 ms	100 ms	H	100 ms	100 ms	100 ms	100 ms
P16	**Acceleration** (also from autorotation position for HELI)	0,1 sec.	60 sec.	0,1	**0,5 sec.**	**0,5 sec.**	**0,5 sec.**	**0,5 sec.**
P17	**Acceleration from total stop (HELI)**	0,1 sec.	60 sec.	1	--	--	--	**20 sec.**
P18	**Deceleration**	0,1 sec.	60 sec.	0,1	0,5 sec	0,5 sec	0,5 sec	0,5 sec
P19	**Current limit** (% of nominal current)	10%	100%	1A	100%	100%]	100%	100%
P20	**Power reduction backward** (% of P19)	10%	100%	1%	100%	100%	--	--
P21	**Freewheel**			H	**Yes**	Yes	Yes	Yes
P22	**Brake**	0%	100%	1%	**30%**	--	--	--
P23	**Brake in Neutral position (STOP)**	0%	100%	1%	**0%**	--	**30%**	--
P25	**Brake start time (ramp)**	0 sec.	60 sec.	0,1	0,2s	0,2s	0,2s	0,2s
P26	**Brake start time for Neutral**	0 sec.	60 sec.	0,1	0,5s	0,5s	0,5s	0,5s
P53	**„Reversing or Brake" Point**	0	200	1	10	10	--	--
P38	**Masking time after signal lost**	0	60 sec.	10 ms	0,5 sec	0,5 sec	0,5 sec	0,5 sec
P39	**Brake intensity after signal lost**	0%	100%	1%	50%	50%	50%	50%
P40	**BEC voltage** (depend on type)	5V	6V / 8V	1V	**5V**	**5V**	**5V**	**5V**
P42	**Controller feeding**			H	**Automat 78%**	**Automat 78%**	**Automat 78%**	**Automat 78%**
P43	**Number of cells**	1	250	1	**1**	**1**	**1**	**1**
P78	**Battery capacity**	0,1	250	0,1	0,1	0,1	0,1	0,1
P44	**Switch-off voltage for UNI**	0,1V	60V	0,1V	**0,1**	**0,1**	**0,1**	**0,1**
P77	**Early warning** voltage / cell	0,1V	60V	0,1V	0,1	0,1	0,1	**0,1**
P45	**Behavior when battery empty**			H	Power reduction	Power reduction	Power reduction	Power reduction
P29	**Battery temperature sensor**			H	Unwatched	Unwatched	Unwatched	Unwatched
P75	**Calibration of Battery temp. sensor**			H	No	No	No	No
P32	**Battery temperature limit**	40°	70°	°C	55°C	55°C	55°C	55°C
P46	**Motor type** (+Automatic sensor setting)			H	**Sensorless**	**Sensorless**	**Sensorless**	**Sensorless**
P47	**Number of poles of motor**	2	60	2	**2**	**2**	**2**	**2**
P51	**Motor driving PWM frequency**	8 kHz	32 kHz	H	8 kHz	8 kHz	8 kHz	8 kHz
P54	**Reversal of motor revolution**			H	**No**	**No**	**No**	**No**
P52	**Motor timing**	0°	30°	1°	**0°**	**0°**	**0°**	**0°**
P50	**Rpm Limit** /rev. 3rd throttle (mode #2)	--	250.000	10	250.000	250.000	250.000	**2.500**
P73	**Revolution 1st** throttle (Heli mode #2)	--	250.000	10	--	--	--	**1.500**
P74	**Revolution 2nd** throttle (Heli mode #2)	--	250.000	10	--	--	--	**2.000**
P28	**Motor temperature sensor**			H	Unwatched	Unwatched	Unwatched	Unwatched
P76	**Calibration of Motor temp. sensor**			H	No	No	No	No
P31	**Motor temperature limit**	60°	150°	°C	90°C	90°C	90°C	90°C
P48	**Mechanical gear X:1**	1:	6.000	XX.xx	**1.00**	1.00	1.00	**1.00**
P49	**Wheel (tires) diameter in [mm]**	1	1.000	1mm	**50**	--	--	--

Legend: **H** - choice from discrete values

Keep in mind default (company) settings of parameters represent only average values. These values are usable as "starting values" for starting of system (model) testing. In most cases will be necessary many parameters change and adapt for the best behavior of the controller - respectively of your model – by your images and requests.

Note: When your requests on parameter range or parameter type, or some other features, don´t realize these standard specification, contact ***MGM compro*** company please.

Parameters description.

In this chapter are described all parameters, include parameters which are hidden for basic settings (Default basic).

P1: Memory bank – memory choice (choice of pre-defined parameters)

This special parameter makes possible choice of one of four pre-defined settings. Default parameters are defined for these type of models:

- (#1)car bidirectional
- (#2)boat bidirectional
- (#3)aircraft one way
- (#4)helicopter mode #1, constant revolution

Nevertheless you can change these parameters (in each memory bank) in any time by your request and needs, for example *aerobatic* (#1), *glide* (#2), *model F5B-1* (#3), *model F5B-2* (#4), etc. **However this is possible only in Advanced settings mode.** In Basic settings mode is possible change only red marked parameters.
You can change all parameters by memory bank select, very quickly and easy. Choice of concrete memory bank you can make by program ***Controller 2*** or by transmitter (any time). Detail description you find in chapter „**Memory choice**“ .

P2: Controller mode

- One way
- Bidirectional

Except helicopters you can choice one way or bidirectional running.

P3: Type of model

- car
- boat
- aircraft
- helicopter **mode #1** – any constant revolution (governor) or PWM driving (set by P69) by throttle position
- helicopter **mode #2** – preset constant revolution (governor), three values

Together with parameter „**P2**“ you can set one way or bidirectional running for select type of model.
Together with parameter „**P69**“ you can set “constant revolution mode”, not only for HELI modes.

»●▶ Car one way mode:
Car may run only forward – when move throttle stick rearward (from neutral position), only brake is activate – car never run backward.

◀●▶ Car bidirectional mode:
Car can run forward as well as backward.
If the car is standing, moving the throttle stick from neutral either forward or backward, will make it start up in the respective direction (forward or backward). If the car is already moving, and you move the throttle stick in the opposite direction, it will start braking. The brake is proportional that is the further the throttle stick from neutral, the more intensive is the brake. The maximal intensity of brake (in the maximal position) may be set in parameter „P22 - brake “. During braking, even after the car stops it will stay that way and will not start up in the opposite direction. Therefore, if you are braking and wish to move in the opposite direction, it is necessary, after stopping, to first move the throttle stick to neutral and then towards the desired direction. Then will the car move in the desired (opposite) direction (after moving the throttle from neutral forward/backward). Connected brake lights are lit up during braking.

X●▶ Boat one way mode:
Boat may run only forward – when move throttle stick rearward (from neutral position), nothing happened, motor stop – no brake, no run.

◀●▶ Boat bidirectional mode:
Boat may run forward as well as backward. Transition from one direction is opposite, with speeds of deceleration and acceleration set in parameters „**P18 - deceleration**“ and „**P16 - acceleration**“. Function is symmetrical for both directions.

X●▶ Aircraft one way mode:
Throttle stick moving to forward motor start run. When moved to STOP position, motor stops and brake with set intensity („**P23 – brake in Neutral (i.e. STOP) position**“) or only stops, without brake, when parameter set to 0 – fig. 1 on the page 8.

◀●▶ Aircraft bidirectional mode (!):
With this special mode is possible reverse motor rotation direction (i.e. also direction of thrust) and is possible very strongly brake (after landing) – fig. 5 and 6 on the page 8. It is possible use transmitter with Neutral throttle position. More safety is using transmitter without Neutral throttle position with change of flying modes by switch (as for helicopters).

X●▶ Helicopter (one way mode)**:**
Motor speed (i.e. rotor rpm) controlling is possible by throttle stick, include autorotation position, total stop, constant rpm (governor mode) in range 50 – 85% of maximal set rpm, fig. 2 on page 8. Controlling is also possible by switches of flying modes, depend on your practice.

P69: Type of driving

- motor PWM
- constant revolution (speed), governor

PWM:
Linear throttle – motor PWM characteristic – standard motor driving.

Constant revolution:
controller hold settled revolution on the output shaft, not depend on voltage and / or mechanical load.
For details see „Maximal revolution of …“ a „HELI modes“.

P4: Driving signal

- automatic – (throttle limits is necessary set for each turning on controller)
- programmed – (controller use saved learned throttle limits)

This parameter coheres with next parameters P6, P7 and P8. This mode is advantageous because you do not have to set or program anything even when you change the transmitter setting (on channel throttle) or use different transmitter or receiver. The disadvantage is that you have to show the controller the throttle limits after each turn on of the controller by moving the throttle forwards and backwards, respectively minimal and maximal throttle.
In most cases is better when controller remember real throttle limits. Necessary set this parameter to “Programed” and learn real throttle limits by way description for next parameters (P6, P7, P8)

P33: Settings from transmitter

- `forbidden` – blocks of unwanted rewriting of throttle limits (blocks "learning" of these values)
- `allowed` – permits learning of throttle limits (rewriting of parameters P6, P7, P8) from transmitter

P6, P7, P8: Throttle limits *(values in µs (microseconds))*

- `Full throttle Forward`
- `STOP (Neutral)`
- `Full throttle Backward (Full brake)`

For correct controller reaction (by your image) is necessary unify throttle range (limits) of your transmitter with range throttle limits in your controller. **When you change the transmitter or the range of the throttle, or you change the receiver, you have to set the limits again.** This setting (unify) is possible make by these ways:

a) Set controller's throttle limits to concrete values by program Controller 2 (or let set default values). Change transmitter throttle limits by transmitter settings (neutral position, end points of throttle stick deflections) with controller settings – with this step help you controller's indication LEDs – exactly show current throttle position.

b) Controller learns real throttle limits directly by steps description in chapter „Throttle limits settings" (without PC connection).

P12: Neutral range (wide of STOP position) *(values in %)*

This parameter relate with previous parameters – this is area is interpret by controller as zone in which motor stop (not running).
Too narrow zone may not be reliably evaluated, too wide zone narrows the area of throttle regulation. With some types of transmitters, loosening of throttle potentiometer occurs during operation, which causes different position of neutral for transitions from „throttle forward" and different from „throttle backward". This mechanical shortcoming must be eliminated by either setting a significantly higher value of this parameter or even better by fastening the fastening nut of the throttle potentiometer.
When you set too wide zone, all is working correctly, but lost part of regulation range → lower gentle of regulation step.

P14: Telemetry

- `off`
- `Open TWIN (MZK)`

Controller can send data (internal measured values) through receiver, by "back data channel" some of 2,4 GHz RC equipment (as TWIN from MZK servis), to display connected to the transmitter, in real time. This bring many interesting possibilities, as well as increasing reliability and safety of models operations (you know battery voltage in real time, … and you can react immediately to real situation).

Transferring data to transmitter side:

- main (traction) battery voltage (respectively voltage of lower cell)
- main battery current
- temperature of the battery (when is measured)
- rpm of the motor
- motor temperature (if measured)
- controller temperature
- BEC voltage
- BEC current
- BEC temperature

P71: Internal BlackBox record period, writing rate *(10 ms and 100 ms)*

Standard writing speed is 100 ms/record. Average values (during this time) are saved with this period. Record time is ca 12 minutes. In case higher writing speed (10 ms/record), is averaging time shorter (lower samples for average value), quick details are better view, but record time is 10x shorter.

To internal BlackBox (data logger) are saved many data, for details see chapter "Internal Black Box".

P16: Acceleration *(value in seconds)*

Time necessary for increase rpm from zero to full value when move throttle from „STOP" (neutral) position (cars, boats or aircrafts) and from „Autorotation" position of the helicopters.

Car / Boat / Aircraft - set speed of starting of stopped motor from 0 to 100% of power
Helicopter - set speed of starting of stopped motor (**rotor always running** !) from 0 to 100% of power (from „Autorotation" position)

P17: Acceleration from TOTAL STOP position (only helicopters) *(value in seconds)*

Helicopter - set speed of starting of stopped motor and also **stopped rotor** from 0 to 100% of power from „Total STOP" position

P18: Deceleration *(value in seconds)*

Time necessary for decrease rpm from full value to zero (100% to 0) when move throttle from full throttle position to STOP. This is important mainly when going from full throttle forward to full throttle backwards (and vice-versa). That is, motor decelerates to zero with the set speed and then accelerates to the other direction with the speed set in parameter " **P16**" - acceleration.
If **Freewheel** parameter („**P21**") is set, deceleration is not so strong.

P19: Current limit *(value in %)*
This parameter set top value of average motor current (in all cases equal or smaller than nominal controller current). Parameter is defined as % from nominal current. **Apply for both directions.** Acceleration current peaks are tolerated. (P19=100% is without reduction)

P20: Power reduction backward *(value in %)*
This parameter reduce max. power for backward direction. Acceleration current peaks are tolerated. Parameter is defined as **% from P19** (100% is without reduction)

Example: for controller with **nominal current 160A** (for example 16026-3)
P19=70%, i.e. current will be reduced to 70% from 160A, i.e. **to 112A** (value is valid for both direction)
P20 = 50%, i.e. current backward will be reduced to 50% of P19 (from 112A), i.e. will be reduced **to 56A** (only for backward rotation)
P20 = 100%, i.e. current backward will be not additionally reduced. Reduction will be the same as forward direction (112A)

P21: Freewheel

- No (off)
- Yes (on)

Car - Operation without a switched on freewheel can be compared to operation of a regular car with an engaged gear. If you throttle down, the motor is braking the car to the new value of the throttle stick position. If you quickly move the throttle stick to the neutral position, the car coasts due to momentum as if driving a regular car without engaged gear. If the freewheel is switched on, dropping the throttle stick to a lower value (and even to neutral) disconnects the motor (which then does not brake) until the car does not lower its speed due to momentum to the new value set by the throttle. From then on the motor is connected again. It is an electronic analogy to mechanical freewheels. This electronic analogy however affects directly the motor and thus all driven axles. The operation with a switched on freewheel is suitable for road riding and races, while switched off freewheel is suitable for riding in terrain (off-road). Set according to your needs and custom practice. For details see chapter Freewheel.

Aircraft / Boat / Helicopter
- With these model settings behavior is similar, but not so strong.

P22: Brake (for cars only) *(value in %)*
Cars - enables to set the maximal force of proportional brake in the maximal deflection of the throttle stick (braking intensity) + possibility "no brake" (suitable for models with mechanical brake). Set according to your needs. If you wish automatically brake also in neutral, set parameter „**P23**", Brake in Neutral. Fig. 7 and 8, page 8. Function is symmetrical for both directions.

P23: Brake in Neutral - in STOP position (for cars and aircrafts only) *(value in %)*
Car - If you wish to automatically brake when the throttle stick is in Neutral position (STOP position), you may set the intensity of braking. If you do not wish to brake when in Neutral, set „0" to this parameter (do not brake when STOP position).
Increase braking force is possible any time by moving throttle stick to opposite direction (to max. brake position by **P22 setting**).
Aircraft - Parameter set braking intensity in STOP position of the throttle + not brake possibility.
Boat - setting of this parameter is without effect.
Helicopter - setting of this parameter is without effect.

P25: Brake start time (ramp) *(value in seconds)*
Define speed of activation of braking (speed of "actuate brake pedal").

P26: Brake start time for Neutral (ramp for Neutral) *(value in seconds)*
Define speed of activation of automatic braking in Neutral position.

P53: „Reversing or Brake" Point (for cars only) *(relative dimensionless value)*
Car - This point set moment (or better speed of run) for which is not activate brake when move throttle to max. brake position – and activate run to other direction. This is state when car is near to zero speed or stop and controller analyze this speed as "stopped".
When run on plain field, profitable is set the smallest value of this parameter.
Another situation is when you braking during run down from hill – is possible that minimal speed (for full brake) is higher than nearly zero and controller cannot start run backward. Car is going too quickly and always (i.e. when move throttle from STOP position backward) is activate only brake. In this situation help set higher value of this parameter → hereafter is possible start reverse run (backward) also in situation when car speed is not near to zero.

P38: Masking time after signal lost *(value in seconds)*
Masking of short driving signal lost. Parameter define time for which is mask signal lost and keep last correct value of throttle position (i.e. also power value). After the lapse of this time controller start reduce power (motor rpm), with or without brake. Intensity of braking in this situation is set in next parameter **P39**.

P39: Brake intensity after signal lost *(value in %)*
Set brake intensity when lost driving signal, after adjusted masking time (P38) from 0% (not brake) to 100% of max. brake..

P40: BEC voltage

- +5V
- +6V
- +7V (only for HV BEC version)
- +8V (only for HV BEC version)

Set of BEC voltage, 5V or 6V for standard S-BEC. Controllers with „HV-BEC" can set 5V, 6V and also 7V and 8V, suitable for RC systems with feeding from 2 Lipol or A123 cells.

P42: Controller feeding (Type of cells / switching-off voltage)

Parameter set type of cells, include standard switch-off voltage. Monitoring each cell is possible select for some type of cells.
Also is possible set switch-off voltage as 78% of value in moment of connection battery.
Next possibility is selection of "universal cell" (UNI), when is possible set any value – this choice includes so much as type of cell, also cells which are not available in moment of controller production.

- `Automat 78%` – switch-off / power reducing for voltage drop to 78% of initial battery voltage
- `Lipol (3,2V)` – switch-off / power reducing for voltage drop to 3,2V / cell
- `Lipol, monitors each cell` – switch-off / power reducing for voltage drop to 3,2V / cell, necessary ext. module
- `A123 (2,5V)` – switch-off / power reducing for voltage drop to 2,5V / cell
- `A123, monitors each cell` – switch-off / power reducing for voltage drop to 2,5V / cell, necessary ext. module
- `Nixx (0,8V)` – switch-off / power reducing for voltage drop to 0,8V / cell
- `Pb (1,8V)` – switch-off / power reducing for voltage drop to 1,8V / cell
- `UNI universal value` – switch-off / power reducing for voltage drop to set value
- `UNI, monitors each cell` – switch-off / power reducing for voltage drop to set value (necessary external module except 40063 controller)
- `Unwatched battery voltage` – **ATTENTION**, with this setting you can damaged battery !!! (battery must be monitored by some external equipment)

P43: Number of cells

Set used number of cells for **Lipol**, **A123**, **Nixx**, **Pb** and **UNI** battery.
Not operate for **Automat 78%** and **Not monitored** …. – in these two cases is parameter afield .

P78: Battery capacity *(value in Ah)*

This enables possibility watch, in real time, discharging main battery in the model by "back data transfer" via Telemetry – as "fuel tank indicator".

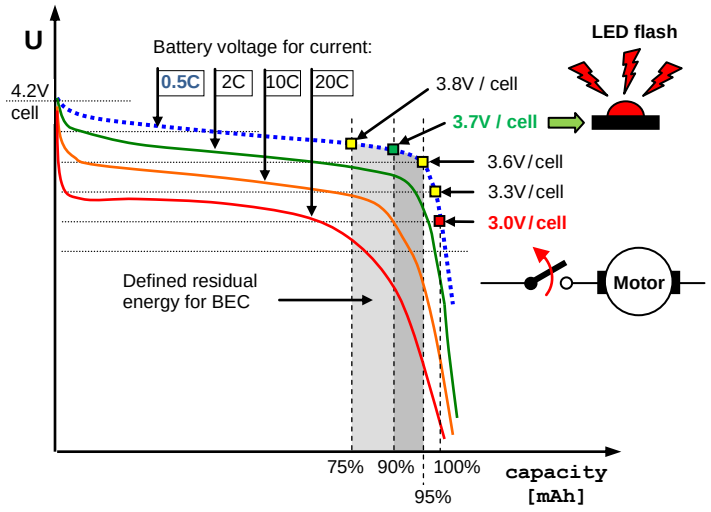
P44: Switch-off voltage for UNI *(value in Volts)*

Set switch-off voltage for one cell for **UNI** battery.

P77: Early warning *(value in Volt / cell)*

Defines voltage (for one cell) for which is activate indication by external indication equipment (super brightness LED, etc.), connected via ICS-2.
In case correct settings you achieve, that coming discharging of the battery is indicate with enough advance for correct landing. Please, respect real discharging curves (characteristics) for used battery.

TMM® controllers *MGM compro* – early warning indication



Switching-off voltage set to safety value corresponding with choice battery type (parameter P42, P43, P44) – example on the picture have set 3.0 V/ cell for Lipol, red point on blue dotted discharging curve (start value for limitation of motor power).

Early warning voltage set to corresponding value with requested residual energy – example on picture have set **3.7 V/ cell**, green point on blue dotted discharging curve. Please, always respect discharging characteristics of used battery, see to values on battery producer datasheet. Always use discharging curve for lower current (lowest "C" rate), blue dotted curve for example on the picture. Residual energy is in this sample ca 10%.

In regard of unique feature of ***MGM compro*** controllers (recomputation of terminal battery voltage to its internal voltage), is this voltage (≈ residual energy) almost independent on internal battery resistance as well as on real battery discharging current, see „Protective and safety mechanism ….".

We recommend this set voltage (≈ residual energy) check by one discharging cycle on the ground (not during real flight) and verify real value of residual energy, and eventually make little correction by real result.

Profitable can be association with each cell monitoring, by possibility of setting of parameter P42, Controller feeding.

Note: Some battery types (for example A123) have extremely flat discharging curve or, of even, negative (during discharging voltage increase up). In these special cases is not possible advantage to take early warning possibility.

P45: Behavior when battery empty

- `Switch-off`
- `Switch-off with brake`
- `Power reduction`

In case that controller switched-off motor, it is possible start again (slow) when battery voltage recovered a little, after some time.

P29: Battery temperature sensor

If your controller may measure battery temperature (only OPTO versions), is possible set sensor type:

- `off`
- `Si diode`
- `10k NTC`
- `KTY81-210`

When sensor is not connected, set „off".

P75: Calibration of Battery temperature sensor *(value in °C)*

For easy changing of temperature sensor you can make any time its calibration. For calibration necessary set value of current environment temperature (in which is battery temperature sensor) by program Controller 2. Write to controller. Controller turns-off and again turns-on. If all operation did correctly, controller normally start and you can flight (run). In case some problem controller indicates this situation on internal LEDs.
This calibration procedure you can combine with other parameters settings as well as with motor temperature sensor calibration (if used), see parameter P76, motor temperature sensor calibration.
Attention – for each memory bank necessary make separately (advantage of possible another type of sensors for another settings).

P32: Battery temperature limit *(value in °C)*

If your controller may measure battery temperature and you have connect some of defined sensors, you can set temperature value for which is motor switch-off with 50% brake.

P46: Motor type

- Sensorless
- Sensors
- **Sensors – Automatic sensors settings**

Possible is set sensorless as well as sensor motor (SE version only).
Next possibility is „**Automatic sensors settings**" include optimization of sensors position. We recommend make this setting first in case of sensor motor. Partly you eliminate problems with no correct phase and sensors connection, partly you optimize sensors position – this is, at least, very recommendation, therefore sensor can be up to 20°out of optimize position inside some motors (and these not optimal position caused worse efficiency).
Procedure of this setting is described in details in chapter „Automatic sensors settings".

P47: Number of motor poles

This parameter is important for correct computing of mechanical output wheel rpm of the motor. When connect mechanical gear, necessary set also gear ratio in parameter **P48** – necessary for helicopters (for example). Without this value is not possible determine correct rpm.

P51: Motor driving PWM frequency

- Automat
- 8 kHz
- 10 kHz
- 12 kHz
- 14 kHz
- 16 kHz
- 24 kHz
- 32 kHz

Using this parameter you set suitable frequency for motor control (PWM).
If you have a regular motor, set the lower frequency (8 - 12 kHz). If your motor requires higher frequency, set the corresponding value (for example Tango by Kontronik need 32kHz, no recommend use lower value, etc.) Mostly, these types called ironless motors. Higher frequency of motor control means higher switching losses of the controller and the controller is heated up more. This leads to higher cooling demands; eventually it is also necessary to proportionally reduce maximal power (current) of the controller.
Next occasion for higher frequency select (for example 24 kHz) can be audible whistling of some motors under runs.

P54: reversal of motor revolution (basic rotation direction)

- No
- Yes

This parameters sets the desired direction of motor revolutions without having to swap two motor cables, when the motor is turning the other way. The same effect as swapping of two motor cables (cables swapping is possible only for sensorless motors).

P52: Motor timing *(value in ° (angle))*

Automatic timing or 0° is recommended settings for most of motors. We recommend this setting also in cases when motor producers recommend some concrete angel, for example 10° (this is necessary for some other controllers, not MGM compro).
Automatic timing cannot be the best for some sensorless motors working on the border of its power possibility – they can lose synchronization (as for example AXI 53xx for highest power). In these cases is possible set higher timing 10 – 25°, this can little bit help. However, in these cases, better is used another motor or sensor motor.

P73: Revolution 1st throttle *(value in rpm)* **(only for HELI mode #2)**

This parameter set revolution of flight mode ≡1 for throttle position in range between 1,2 – 1,46 ms. Controller indicate this range by **lights yellow LED**.

P74: Revolution 2nd throttle *(value in rpm)* **(only for HELI mode #2)**

This parameter set revolution of flight mode ≡2 for throttle position in range between 1,46 – 1,73 ms. Controller indicate this range by **blinking yellow LED**.

P50: Revolution limit / Revolution 3rd throttle for HELI mode #2 *(value in rpm)*

This parameter make possible monitored (and not exceed) set maximal mechanical rpm (for example helicopter's rotor rpm). This setting is important also for running with constant rpm (governor mode). Value is possible set directly (as number) in program „***Controller 2***", more in chapter "Maximal revolution of ….".
Max. rpm value not may exceed 250.000 for 2-poles motor, in any combination of number of motor poles and gear ratio.
In HELI mode #2 this parameter set revolution of flight mode ≡3 for throttle position in range between 1,73 – 2.0 ms (resp. up to 2.3 ms). Controller indicate this range by lights **green LED**.

P28: Motor temperature sensor

Available for sensor motors only.

- off
- Si diode
- 10k NTC (by EFRA recommendation)
- KTY81-210

When sensor is not connected, set “off”.

P76: Calibration of Battery temperature sensor *(value in °C)*

For easy changing of temperature sensor you can make any time its calibration. For calibration necessary set value of current environment temperature (in which is motor temperature sensor) by program Controller 2. Write to controller. Controller turns-off and again turns-on. If all operation did correctly, controller normally start and you can flight (run). In case some problem controller indicates this situation on internal LEDs.
This calibration procedure you can combine with other parameters settings as well as with battery temperature sensor calibration (if used), see parameter P75, battery temperature sensor calibration.
Attention – for each memory bank necessary make separately (advantage of possible another type of sensors for another settings).

P31: Motor temperature limit *(value in °C)*

If your controller may measure motor temperature (only sensor motor types, marked SE) and you have connect some of defined sensors, you can set temperature value for which is motor switch-off with 50% brake.

P48: Mechanical gear

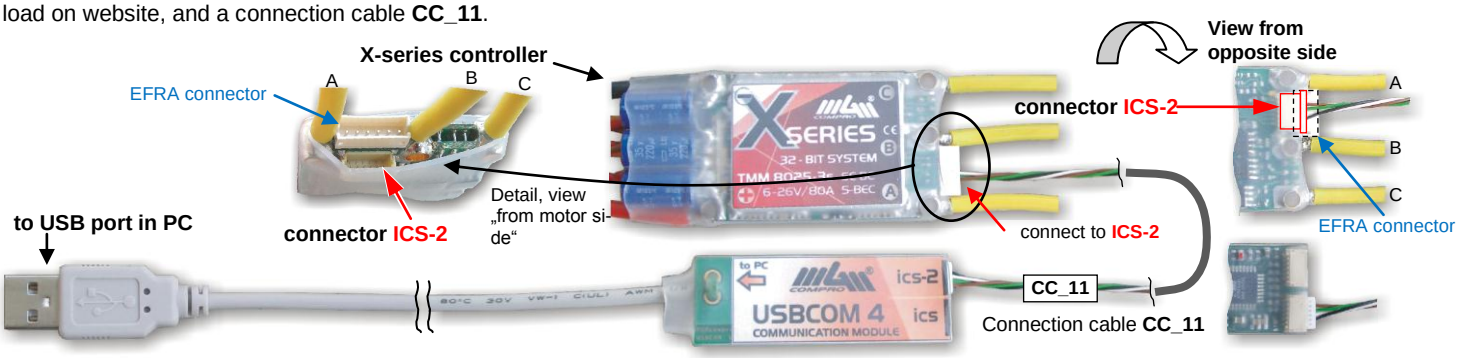
This parameter define general rate1:X between output motor wheel and mechanical machine output (for example rate of tooth of pinion and main cog-wheel for helicopters). Important for correct settings of real mechanical rpm (of the helicopters rotor, cars wheel etc.).

P49: Wheel diameter, tires diameter **(for cars only)** *(value in mm)*

Car - necessary for correct displaying of car speed (km/hour), set value directly in program Controller 2.

Parameters setting / Data reading from controller.

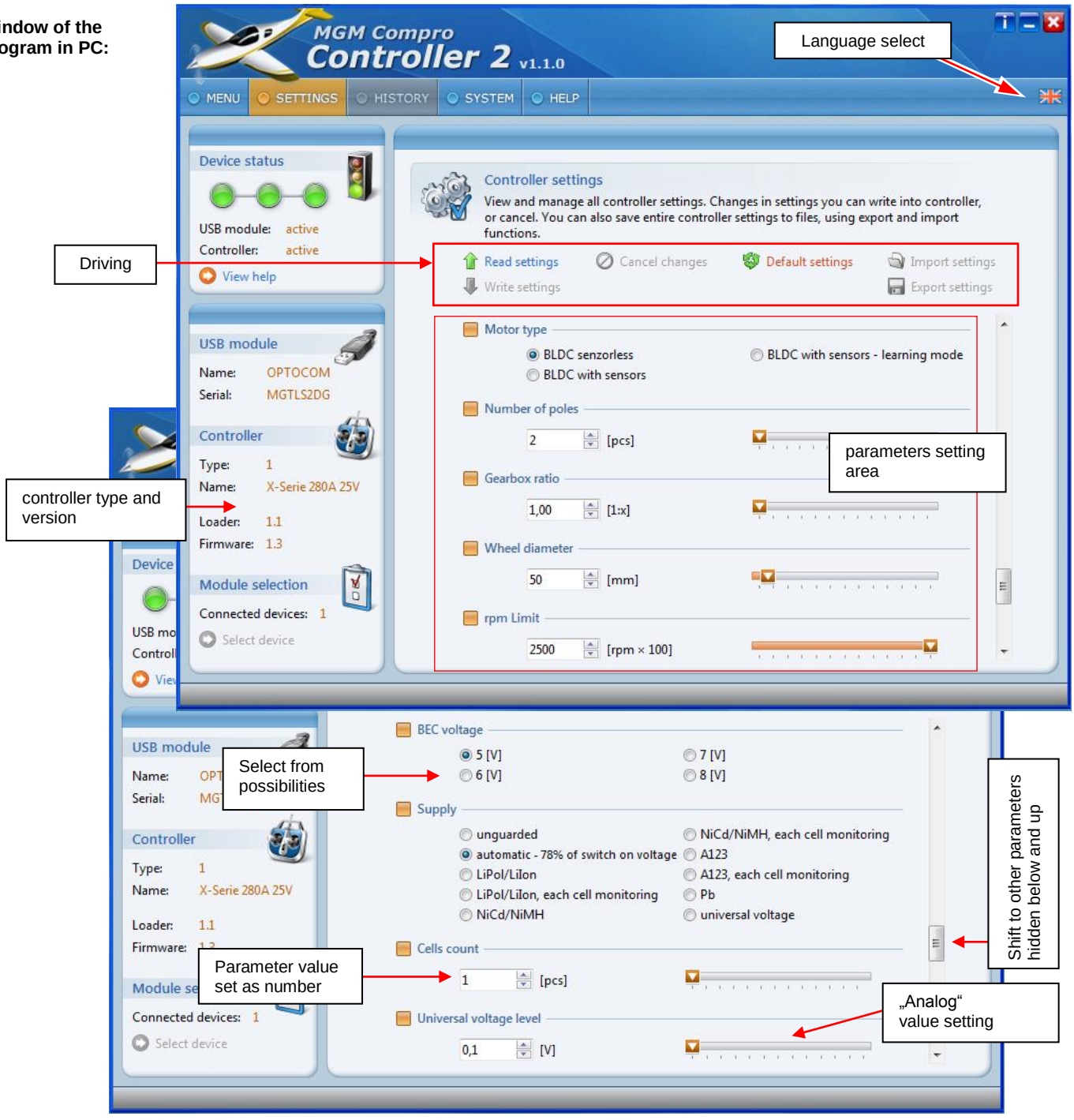
If you wish to program the controller using PC or read out some values from the controller, it is necessary to connect the controller with your PC using **USBCOM 4** module, program „***Controller 2***“ which is supplied together with the communication module and available for download on website, and a connection cable **CC_11**.



1) start program ***Controller 2***
2) connect **USBCOM 4** module to USB port of your PC and connect with controller by **CC_11** cable (cable CC_11 is connected to **ICS-2** marking connectors, in both equipment)
3) turn on controller by connect to suitable battery (and turn-on switch for version with switch)
4) you can communicate with controller now, read data, change parameters value, write changes parameters etc.

Don´t forget select memory bank first, change parameters after this. Before switch-off write parameters by button “Write setting”.

Window of the program in PC:



Internal Black Box (flying recorder)

For correct using of controller's Black Box, set requested value for „Record period" (P71). You can choice more quickly record with more details but shorter record (each 10 ms, i.e. 100× per second, record time ca 1,2 minutes) or slower and longer record (each 100 ms, i.e. 10× per second, record time ca 12 minutes).

Don´t remember set correct number of motor poles for correct rpm value, respectively also gear ratio and tires diameter for correct computing of car speed.

Current version record first 12 minutes of flying (run) resp. 1,2 minutes for quick record. Record automatically stopped after this time. Record start when throttle is moved from STOP position after controller turn-on.
In the future will be possible switch record also for last 12minutes of flying (run).

When you want read recorded data, necessary connect Controller to PC and start program Controller 2.
Choice button „**History**" and push „**Read history**".
Data harvested from controller are displayed on the graph continuously. Graph is possible zoomed, moved, change displayed parameters etc., as well as you can export data to file in Excel format (xls) format. Each parameter can be assign to left or right axis (different automatic scale). Graph can displayed maximal 9 different parameters in time.

Data saved during record to internal Black Box:

a) - time
b) - main (traction) battery voltage
c) - current (from traction battery)
d) - motor rpm (or better rpm of output shaft, i.e. mechanical rpm on the gear output)
e) - controller temperature
f) - BEC voltage (in case controller isn´t OPTO version)
g) - BEC current (in case controller isn´t OPTO version)
h) - BEC temperature (in case controller isn´t OPTO version)
i) - input driving signal (throttle)
j) - controller's input power
k) - car speed (only for cars)
l) - motor temperature (in case motor temperature sensor is connected)
m) - traction battery temperature (in case battery temperature sensor is connected)
n) - motor PWM in % (output power in %)
– this information give you very good image about reserves of your power unit in constant speed modes (if is unit on the limits of possibilities or reserves are enough); 100% is maximum

Also state information are stored:

1) – constant rpm active (governor)
2) – cruise control active
3) – under voltage
4) – over current
5) – controller over heating
6) – motor over heating
7) – battery over heating

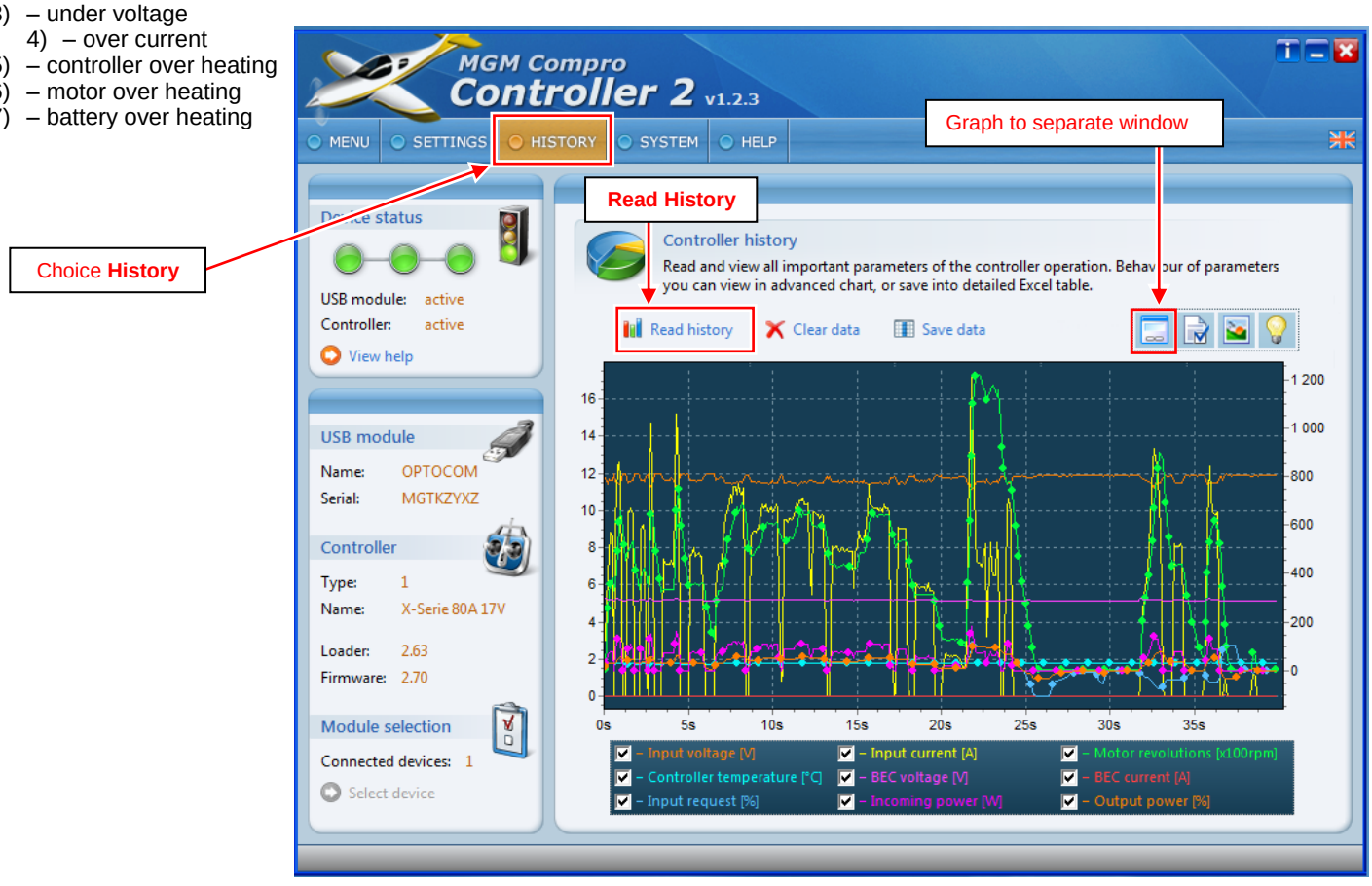
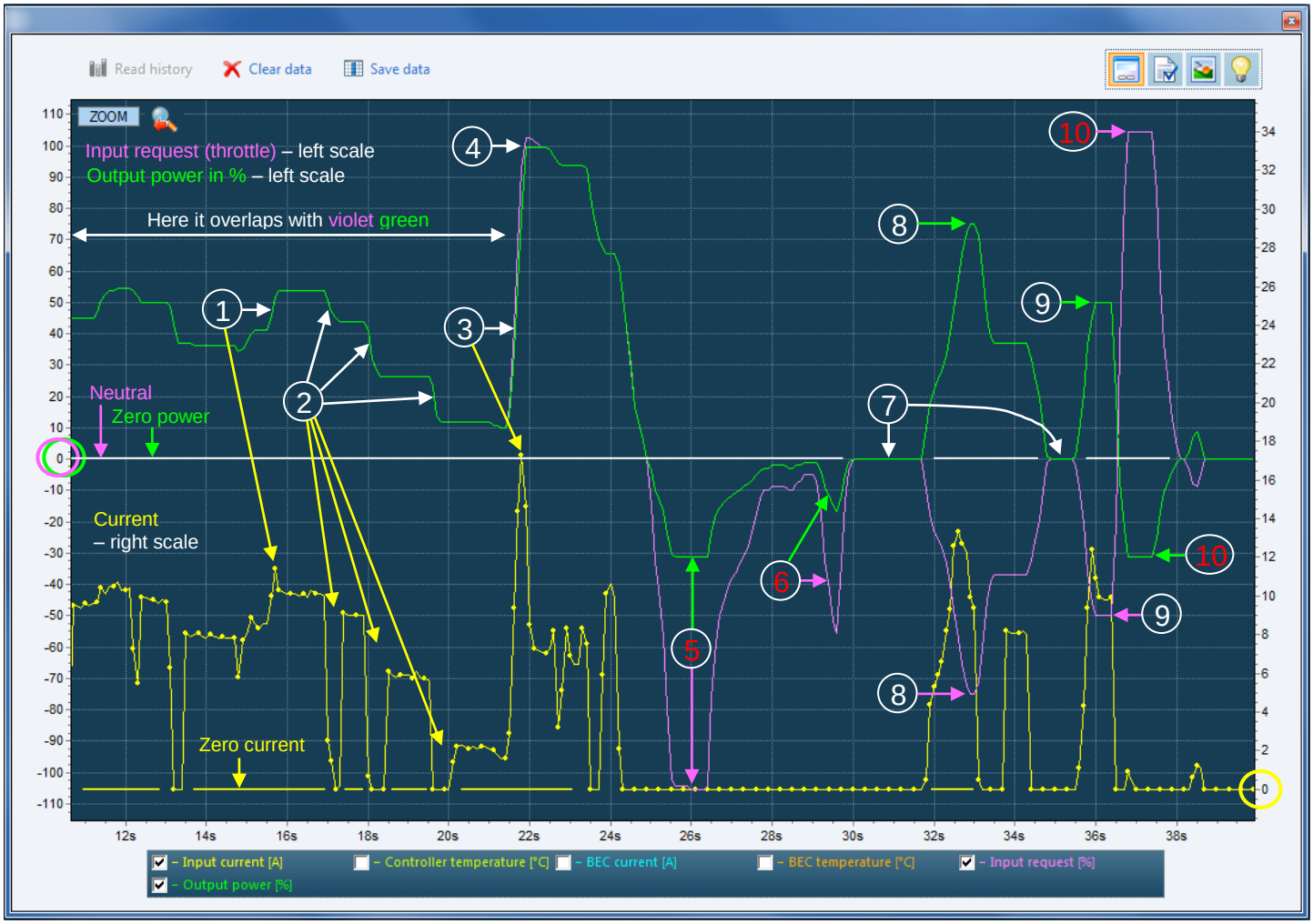



Chart settings
Help
Select parameters you wish to display in the chart. You can select curve color and curve placement in the chart, color scheme and many more.
Parameter selection
Curve settings
Chart appearance
Color
Parameter name
Chart axe
Input voltage [V]
Input current [A]
Motor revolutions [x100rpm]
Controller temperature [°C]
BEC voltage [V]
BEC current [A]
BEC temperature [°C]
left
right
Selected: 7/9
Close
Left axe curve
Right axe curve
Show curve points
Colour point
Point shape:
square
circle
Automatic axe range
Chart color scheme
bright
dark
Show grid in chart
Read History
Read history
Clear data
Save data
Export to Excel file
Setting the properties of curves, assigning to the left or right scale, appearance chart
A new area selected to zoom
– Input voltage [V]
– Input current [A]
– Motor revolutions [x100rpm]
– Controller temperature [°C]
– BEC voltage [V]
– BEC current [A]
– BEC temperature [°C]
– Input request [%]
– Output power [%]
ZOOM
The left vertical axis (scale)
„Switch-on“ and „switch-off“ selected variables
The right vertical axis (scale)
Time axis
Enlarged selected area

Evaluation (interpretation) parts of the record:
For greater clarity, the color and scale are changed to images on the previous page.
Here is shows a throttle (input command), the output power in % and current from about 11 to 40 second.



1 partial acceleration (from +42% to +54%) - output power practically follows the input command is a small current peak
2 throttle defend – current decreases during the reduction of power (rpm) to zero (freewheel on)
3 aggressive acceleration (from +10% to +100% (**4**)) - output power (motor PWM) goes to 100%, current peak is strong
5 full brake (input command is **-100%**) – output power goes into negative numbers, the brake is 30% (depending on settings) – battery current is zero
6 partial brake (input command is **-55%**) - output power goes into negative numbers, the brake is about 18%
7 neutral – output power is zero
8 ride backward, partial throttle (input command is -75%) - power goes to positive numbers, current flows
9 ride backward, partial throttle (input command is -50%) - power goes to positive numbers, current flows
10 full brake when driving backward (input command is +100%) - output power goes into negative numbers, the brake is 30% (according to parameters settings) – output power is zero

Note: negative currents flowing to the battery **under braking** are not displayed (shows zero current). It is displayed as "negative" output power in % only.

Throttle limits setting.

For correct controller reaction (by your image) is necessary unify throttle range (limits) of your transmitter with range throttle limits in your controller.
This setting (unify) is possible make by these ways:

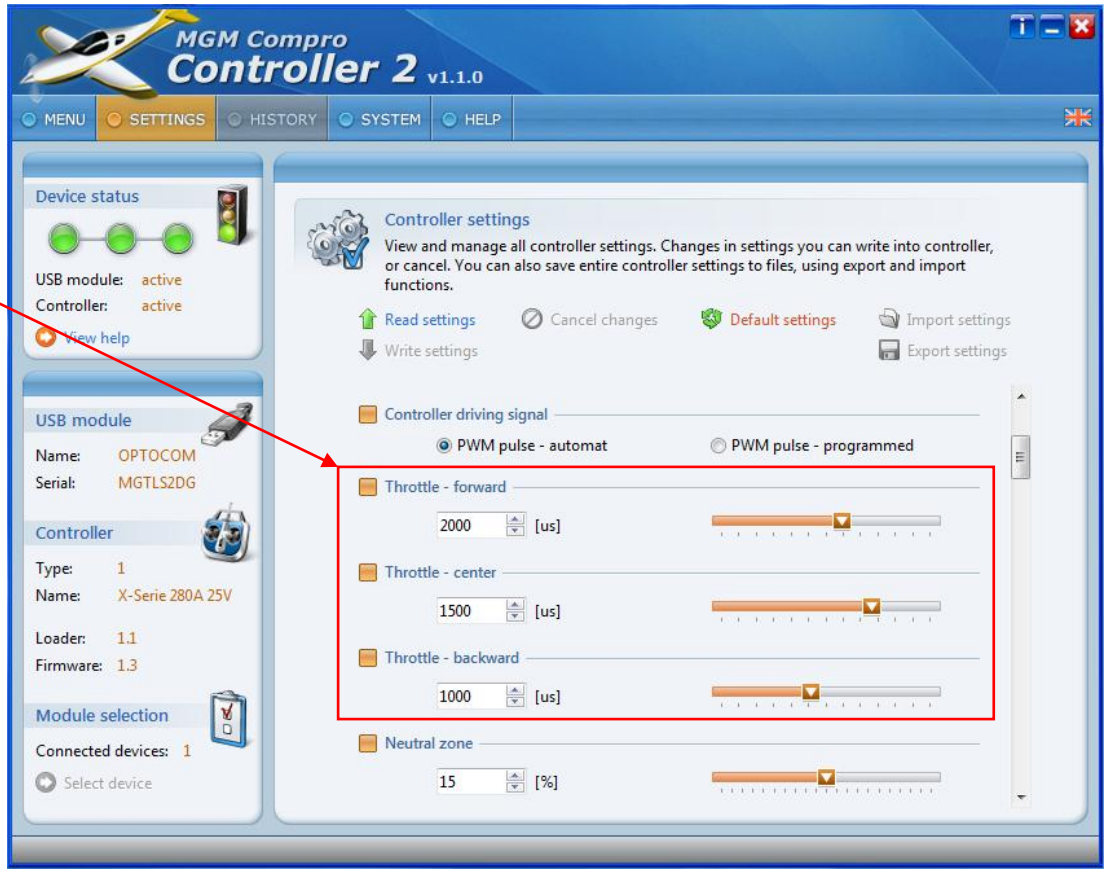
I. In the parameter **P4** (Driving signal) is set „**Automatic**“ (default setting). In this case controller **don´t remembers** throttle limits and necessary learn real these values after each turn on of controller again.
This case is description in details on the chapter „**Start with automatic throttle limits**“.

II. In the parameter **P4** (Driving signal) is set „**Programmed**“. In this case controller **remembers** throttle limits. Necessary learn these real values once – this procedure is describe in the next paragraph „**Programmed**“.
When you change the transmitter or the range of the throttle, or you change the receiver, you have to set the limits again.

Programmed:

Controller remembers throttle limits of your transmitter. Setting is possible make by these ways:

a) by program „*Controller 2*“ and setting of your transmitter: directly set values for neutral, max. throttle forward and max. throttle backward in these fields (or stay default values)



Subsequently is necessary set, by transmitter setting, position of the Neutral and max. deflections for forward and backward throttle position. Controller's LEDs indication significantly helps you with setting correct values in your transmitter.

Note: for transmitters without Neutral position set both values (Neutral and Full throttle backward) to the same value by program Controller 2.

1) turn on transmitter with throttle stick on STOP (neutral) position, turn on receiver. Controller is connection to throttle channel.
2) turn on controller, wait for **blue LED** continuous light (not depend on other LEDs) ……
3) change of Neutral position setting (STOP) in your transmitter that **yellow LED** also continuous light (not blinking) ……
4) move throttle stick to full throttle forward and set your transmitter for continuous light (not blinking) of **green LED** ……
5) when you have transmitter with neutral position, move throttle to max. throttle backward (max. brake) and set your …. transmitter for continuous light (not blinking) of **red LED**

Now in your transmitter are set the same throttle limits (deflections) as values in your controller.

For better orientation of marking that which throttle position, see to pictures in chapter “Basic operational modes”.

---

b) by transmitter – preferred procedure. Corresponding values inside controller you set with transmitter help. Procedure is described in next chapter „**Throttle limits setting by transmitter**“.

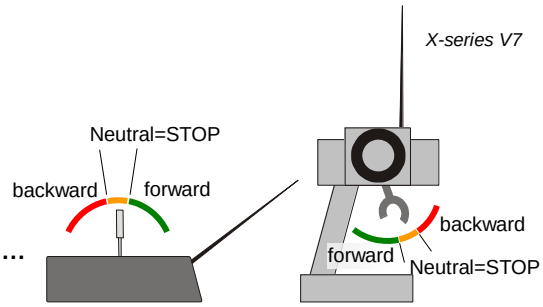
Correct throttle limits is possible set by this procedure whenever, without PC, after each transmitter change, change of throttle range of transmitter or receiver change. Necessary condition is setting of parameter “Driving signal” to “Programmed”.

c) Settings for helicopters is described in chapter “**HELI modes**”.

Throttle limits setting by transmitter.

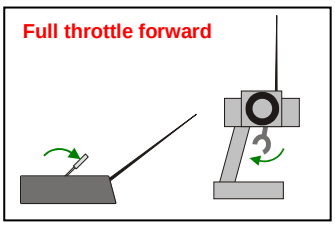
(parameter P33, "Settings from transmitter" must be "Allowed")

In the parameter P4, „**Driving signal**" is set "**Programmed**".

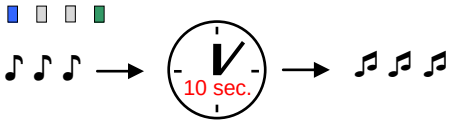


α) Transmitters with NEUTRAL (with lock of STOP position): .....

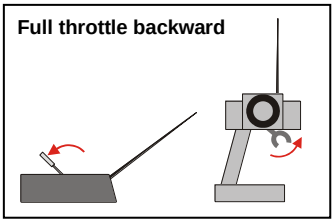
1) Turn on transmitter with throttle in position „**full throttle forward**".
Turn on receiver, controller connected to throttle channel of receiver.



2) Controller short beep 3× by motor, **blue LED** and **green LED** lights.
After 10 seconds controller 3× long beeeps.

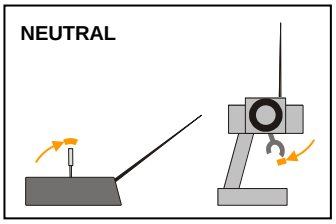


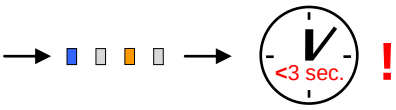
3) You now have **3 seconds** to move the throttle to max. throttle backwards (=full brake).
If in this time limit you do not move the throttle the programming process will finished and the controller will be turned off. Its next operation is possible after switching off and then turning it on again



4) If you start moving throttle in this time limit 3 sec. to max. throttle backward position, controller lights **red LED** and after stop in outer position (max. throttle backward) 2× long beeeps.

5) Controller lights **yellow LED** (challenge to moving to STOP position). You have now **3 second** for moving throttle to Neutral position (=STOP).

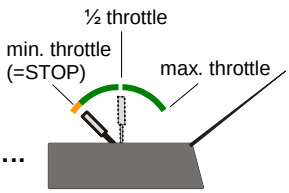




6) Controller confirm correct finishing of this operation by 1× blink together by **red LED**, **yellow LED** and **green LED** and play melody.

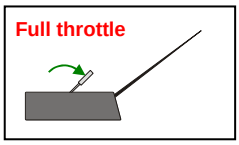
7) Controller starts blinking by **blue LED** (others LEDs not light) → necessary switch-off controller. Throttle limits of your controller corresponding with throttle limits of your transmitter and controller remember these values.

Throttle limits corresponding with transmit-

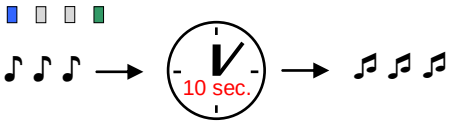


β) Transmitters without NEUTRAL (without lock of STOP position): .....

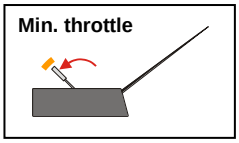
1) Turn on transmitter with throttle in position „**full throttle**". Turn on receiver, controller connected to throttle channel of receiver.



2) Controller short beep 3× by motor, **blue LED** and **green LED** lights. After 10 seconds controller 3× long beeeps.

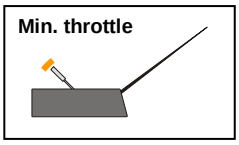


3) You now have **3 seconds** to move the throttle to min. throttle (=STOP)
If in this time limit you do not move the throttle the programming process will finished and the controller will be turned off. Its next operation is possible after switching off and then turning it on again.



4) If you start moving throttle in this time limit 3 sec. to min. throttle position, controller lights **red LED** and after stop in outer position (min. throttle) 2× long beeeps.

5) Controller lights **yellow LED** (challenge to moving to STOP position). You have now **3 second** for moving throttle to STOP position.



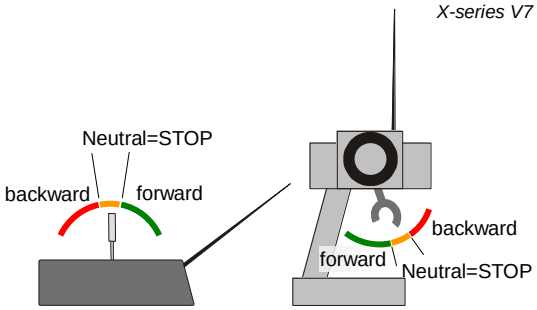
6) Controller confirm correct finishing of this operation by 1× blink together by **red LED**, **yellow LED**, **green LED** and play melody.

7) Controller starts blinking by **blue LED** (others LEDs not light) → necessary switch-off controller. Throttle limits of your controller corresponding with throttle limits of your transmitter and controller remember these values.

Throttle limits corresponding with transmit-

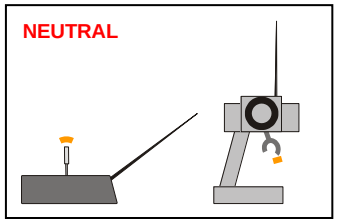
Start with automatic throttle limits.

In the parameter P4, „**Driving signal**" is set „**Automatic**", this is also default setting.

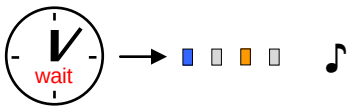


α) Transmitters with NEUTRAL (with lock of STOP position) .....

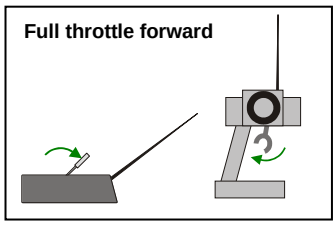
1) Turn on transmitter with throttle stick on STOP (neutral) position, turn on receiver. Controller is connection to throttle channel.



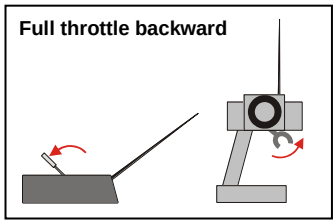
2) Turn on controller, wait for **blue LED** + **yellow LED** continuous lights + 1× short beep .....



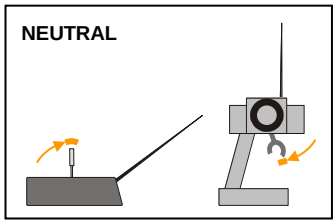
3) Controller alternately light **yellow LED** and **green LED** → challenge to moving throttle stick from "neutral" to "full throttle forward" position. After finishing of motion light **green LED** + 3× short beep



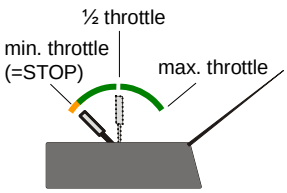
4) Controller alternately light **green LED** and **red LED** → challenge to moving throttle stick from "full throttle forward" position to "full throttle backward" position. After finishing of motion light **red LED** + 2× short beep.



5) Controller alternately light **red LED** and **yellow LED** → challenge to moving throttle stick from "full throttle backward" position to "neutral" position. After finishing of motion light **yellow LED** + 2× short beep + play melody.

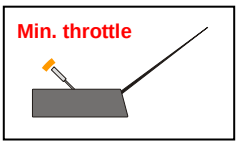


6) You can start now.

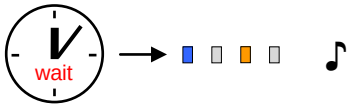


β) Transmitters without NEUTRAL (without lock of STOP position) .....

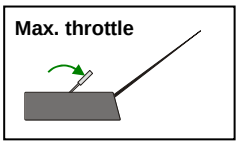
1) Turn on transmitter with throttle stick on Min. throttle position (STOP), turn on receiver. Controller is connection to throttle channel.

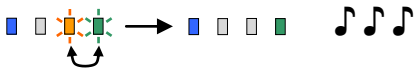


2) Turn on controller, wait for **blue LED** + **yellow LED** continuous lights + 1× short beep ....

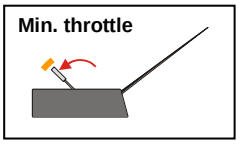


3) Controller alternately light **yellow LED** and **green LED** → challenge to moving throttle stick from "neutral" to "full throttle forward" position. After finishing of motion light **green LED** + 3× short beep.

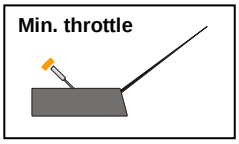




4) Controller alternately light **green LED** and **red LED** → challenge to moving throttle stick from "full throttle" position to "Min. throttle" position. After finishing of motion light **red LED** + 2× short beep



5) Stay on this position, min. throttle (STOP) at least 3 seconds, controller light **yellow LED** + play melody

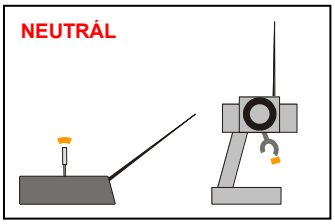


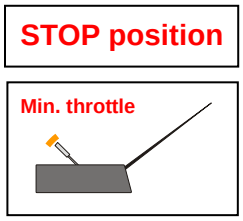
6) You can start now.

Start with programmed throttle limits.

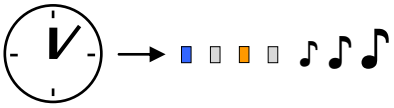
In the parameter P4, „**Driving signal**" is set "**Programmed**". Controller remembers set throttle limits.

1) Turn on transmitter with throttle stick on **STOP** (neutral) position, turn on receiver. Controller is connection to throttle channel.
   = **neutral** for transmitters with neutral
   = **min. throttle** for transmitters without neutral





2) Turn on controller, wait for **blue LED** + **yellow LED** continuous lights + melody ……..

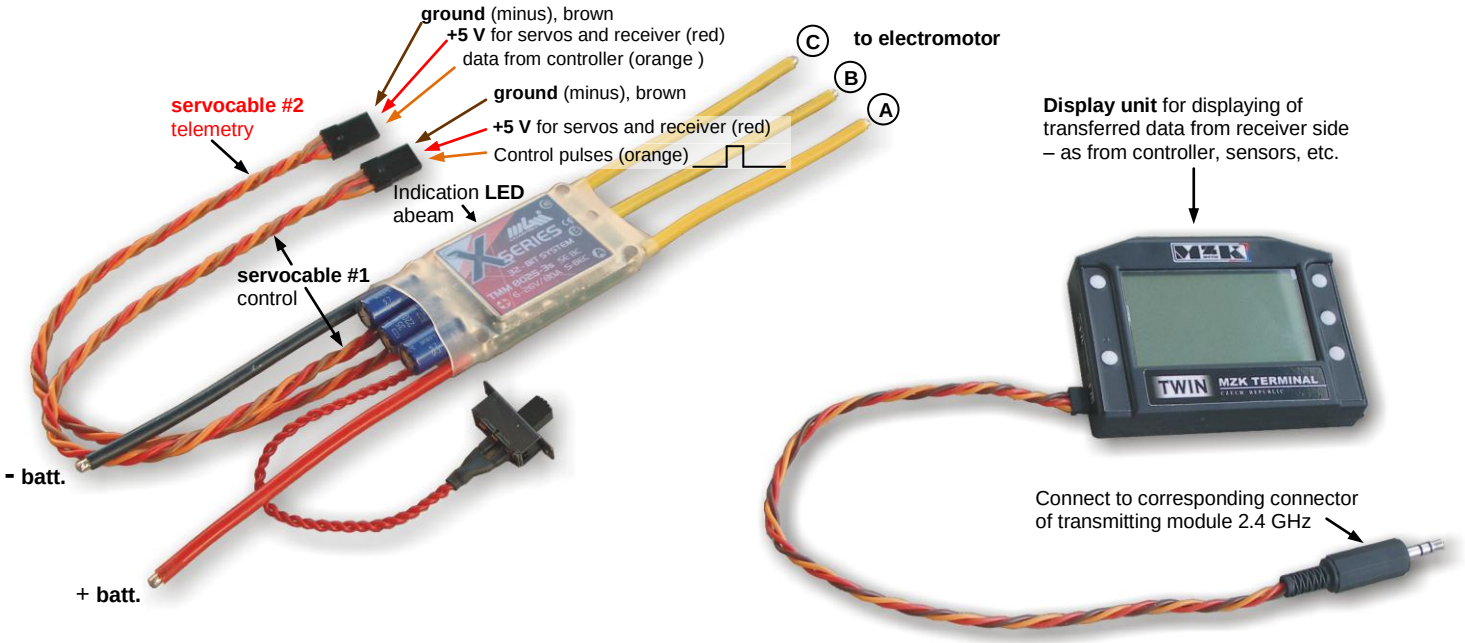


3) You can start now.

Back data transfer, telemetry (only for controllers marking „BC").

Controllers with „**BC**" modification has not only general servocable **#**1, but also servocable #2. This cable transfer data from the controller to receiver (and receiver transfer these data subsequently to transmitter side). This servocable #2 is connected to corresponding channel of receiver (for details see manual of receiver).
Advantage is also boost of BEC wires – this cable transfer within data also BEC voltage to receiver → increase reliability as well as current rating of the BEC (smaller conduction losses on the wires and connectors).

Necessary set corresponding data format, in parameter „**telemetry**" by program „***Controller 2***" (as for example **TWIN** for receivers and RC equipments of **MZK servis** company, etc.)
Display unit, which displayed transferred data, connect to transmitting module 2,4GHz of your transmitter.
For connection and set receiver, transmitting module and display unit follow instruction for these components.



Transferred data from the controller to display unit:

- traction battery voltage
- current from traction battery
- motor rpm
- temperature of the controller
- battery capacity

Sensor motors and controllers („SE“ marking).

Sensor motors (BLDC motors with sensors) can have, generally, various connectors for sensors. When your motor matches EFRA specification, situation is simpler.

When your motor has with EFRA specification connector or not or you are not 100% sure that sensor connector matches EFRA specifications or you are not sure which wires is “A”, which “B” etc., necessary make „Automatic sensor setting” first ! This means before any tests – first start with sensor motor must be make always in “Automatic sensor setting” mode ! Otherwise, risk destruction or damage of the controller.

Nevertheless, this (Automatic sensor setting) is very advantageous make in all cases, i.e. also for EFRA compatible motors – some of them have sensors not in optimal positions – and needless losses rise from this. **Automatic sensor setting** eliminates this imperfection and optimizes sensors setting also for these motors.

When you change motor, make this setting again.

IMPORTANT: When motor rotate to other side than you need, necessary change rotation direction ONLY by controller setting, in parameter P54, “Reversal of motor revolution”. No permit swap two motor wires (phases) as for sensorless motor !!!

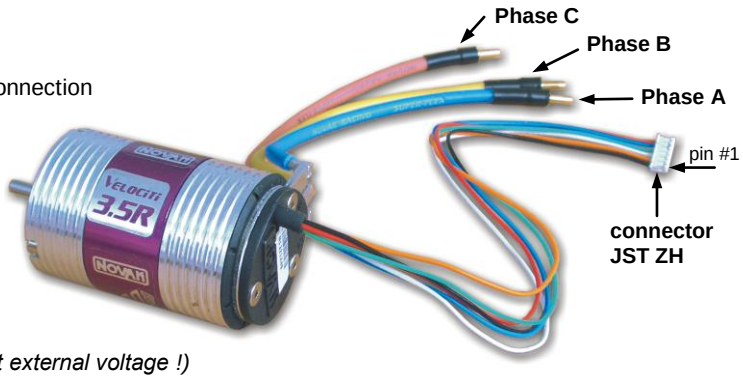
In all cases is necessary observe all pin specification, as show in follow figure:

SENSOR MOTORS:
Sensor motor according to **EFRA** specification**:**

- must have 6-pin JST ZH connector model ZHR-6 or equivalent, marked as SZH-002TP0.5 26-28 awg. for sensors and heat sensor connection

Pins specification of this connector:

Pin #1 – black wire, ground potential (minus)
Pin #2 – orange wire, sensor phase C
Pin #3 – white wire, sensor phase B
Pin #4 – green wire, sensor phase A
Pin #5 – blue wire, motor temperature sensing, *10 kΩ NTC*
(other end of sensor is on ground potential, pin #1)
Pin #6 – red wire, sensors feeding, *+5.0 V ± 10%.*
(supply voltage for sensors provide controller, don´t connect external voltage !)



Example: Motor by NOVAK, Velocity 3.5R Brushless Motor

- power wires are marked A, B, C – connect to phases of controller, with the same name.
A for phase A
B for phase B
C for phase C

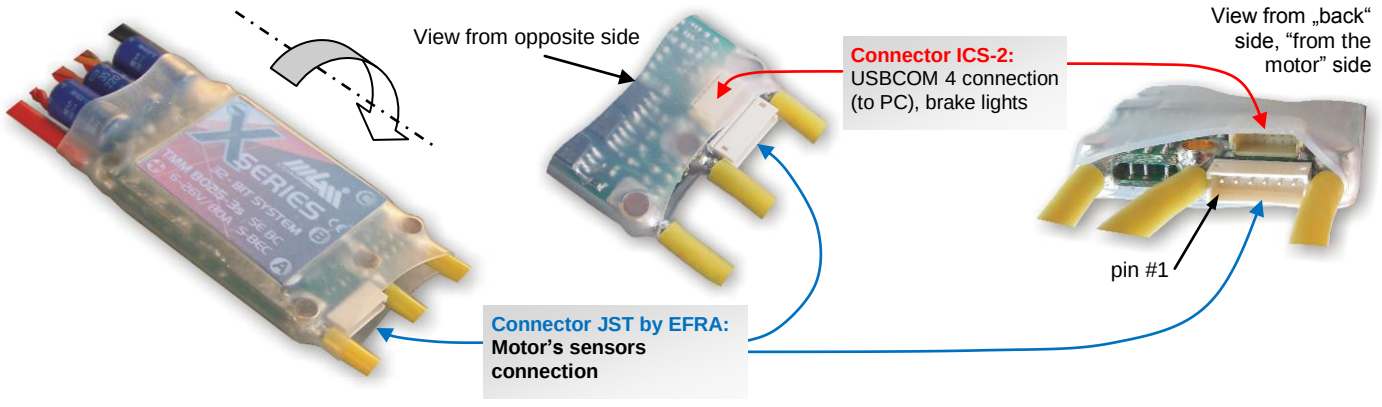
Sensor supply wires (pin #1 and pin #6) and temperature sensor wire (pin #5) no possible change ! Connection of Sensor outputs for phases (pin #2, pin #3, pin #4) aren´t so strict – this can be connect in other order, providing that you make Automatic sensor setting first.

Automatic sensor setting procedure.

This setting is necessary make on the not loaded motor – i.e. without propeller or pinion for gear !

1) connect motor to controller, include sensor cable, connect to PC and turn on controller.
2) in program „***Controller 2***“ set parameter P46, **Motor type** to „**Sensor motor – Automatic sensor setting**“
3) write this setting to controller by button „**Write setting**“
4) turn off controller (USBCOM 4 is possible disconnect)
5) turn on transmitter
6) when controller is not connected to receiver, connect now, to throttle channel (for OPTO version also turn on receiver supply)
7) turn on controller again, if you don´t set throttle limits (= you have automatic limits), must go through the initial setup limits procedure, i.e. until state of lighting **blue LED** and **yellow LED** (throttle in Neutral position) ……..…….....
8) move throttle stick to full throttle forward, controller start run motor and automatically stop ……..... or
9) LED indicate correct finishing of this operation by **blinking of blue LED** ……..
(in case of some problem start **blinking all LEDs** ……)
10) if you don´t see LEDs (controller is somewhere inside model) you can check correct finishing of this procedure by this way:
move throttle stick back to STOP position and try increase throttle again → motor must not start run now
11) switch-off controller, sensors position and phase are correct and optimize, after correct finishing procedure controller automatically switch **Motor type** parameter to “**sensors**” – you can check this also by read data via program ***Controller 2.***
12) when you turn on controller now, working with sensors – you can connect load to motor (propeller, pinion, ..)

When procedure finishes not correctly, checks connectors, sensor connections, and start procedure again.



Maximal revolution of the rotor Settings.

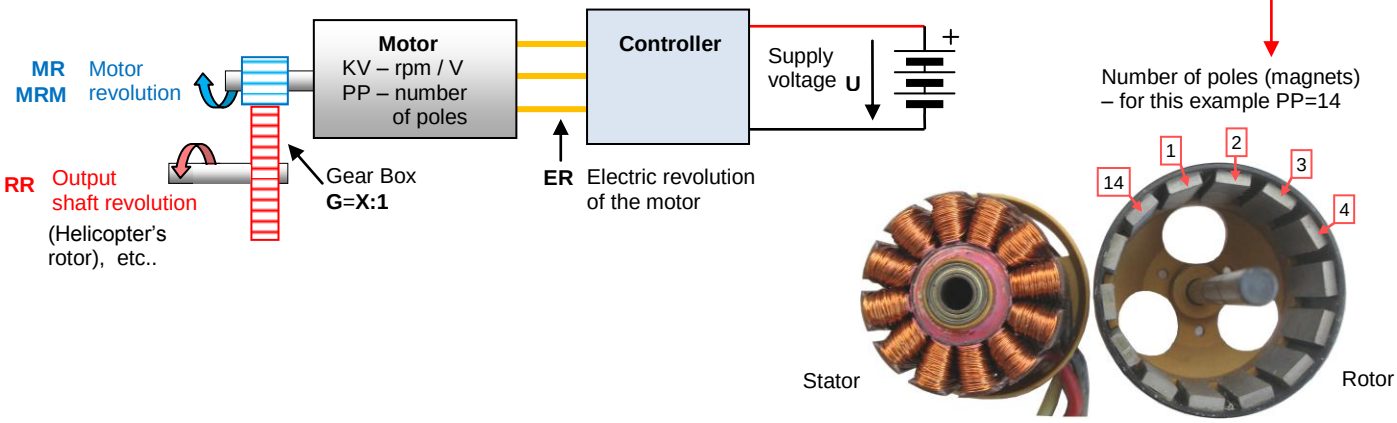
(For HELI mode #2 also 3rd throttle settings)

For setting of Maximal revolution of unloaded motor (view from the motor, not mechanics of the system) necessary make following steps:

Set these parameters values by program ***Controller 2*** (obligatory data):

Parameter P50 – **max. requested rpm limit** (on the gear output), **RR**
Parameter P47 **– number of motor poles** **PP** (determined every correct motor producer or you can count magnets, see picture)
Parameter P48 **– gear ratio of gearbox** **G**

By these steps you have set maximal revolution. This settings is also revolution of 3rd throttle (flight mode ≡3) for HELI mode #2.



We recommend make checking, if controller range of rpm (electric) is sufficient as well as if motor choice is correct:

"Electric revolution" of the motor is the same as mechanical revolution only for 2-poles motor. Motors with higher number of poles have electric revolution (which must generate controller) proportionally higher (4 poles motor 2x, 6 poles motor 3x, etc.). Controller cannot work with higher revolution than specified in Technical data (for HBC controllers 250.000 rpm).

ER = RR x G x PP/2 (electric revolution)

where: RR – requested mechanical revolution on the output shaft (for example helicopter's rotor, etc.) [rpm / V]
G – gear ratio of gearbox
PP – number of poles of the motor

Result must be < **250.000** rpm. In case of result is higher value, necessary lower gear ratio or use motor with lower number of poles.

Example:
requested mechanical revolution on the output shaft **RR** = **2.000** rpm.
gear ratio is 10 tooth of pinion, 50 tooth of main shaft, i.e. **G** = 50/10 = **5**
number of poles of the motor **P** = **12**

ER = **RR x G x PP/2 = 2000 x 5 x 12/2** = **60.000 rpm**

Result: therefore this value 60.000 < 250.000, controller is suitable for this system.

In next step necessary check motor, if requested output revolution is correct with available voltage.

Requested mechanical revolution of the motor:
MR = RR x G

where: RR – requested mechanical revolution on the output shaft (for example helicopter's rotor) [rpm / V]
G – gear ratio of gearbox

We recommend this revolution no more than **70 - 80%** of **max. available mechanical revolution of the unloaded motor (MRM).** In other case not assurance that system has enough reserve of the power for reliable stabilization of the requested revolution.

Maximal available mechanical revolution of the unloaded motor:
MRM = **KV x U**

where: KV – motor revolution [rpm / V]
U – supply voltage [V]

Example:
requested mechanical revolution on the output shaft **RR** = **2.000** rpm.
gear ratio is 10 tooth of pinion, 50 tooth of main shaft, i.e. **G** = 50/10 = **5**
Motor **KV** = **800 rpm/V**
Max. supply voltage: **(6 x Lipol), i.e. U** = **25,2 V** (charged battery) / **U** = **19,8 V** (discharged battery – last 20% of energy available)

MR = RR x G = 2.000 x 5 = 10.000 rpm
MRM = **KV x U = 800 x 25,2 = 20.160 rpm** (charged battery)
MRM = **KV x U = 800 x 19,8 = 15,840 rpm** (discharged battery)

Result: Therefore requested (MM) 10.000 rpm is lower value than 70 - 80% of max. available revolution (=63%), motor is suitable for this system.

HELI modes.

Another, special indication for HELI modes:

- TOTAL STOP, turn-off.....
- Autorotation .....
- 1st throttle (revolution set by P73 parameter) .....
- 2nd throttle (revolution set by P74 parameter) .....
- 3rd throttle / Max. revolution (revolution set by P50 parameter) .....

IMPORTANT:

Current fuse as well as thermal fuse is disabled in heli modes ! – motor revolutions are not reduced, nor switched off – only indication (external circuit connect to ICS-2) is activated – it is necessary to land immediately. Circuits that watch the voltage of batteries also only activate indication of batteries getting discharged soon, motor revolutions are not reduced, nor is the motor switched off - it is necessary to land immediately.

Before setting HELI modes is necessary first set **maximal revolution of the rotor** (parameter **P50**, see previous page), as well as parameters **P47**, **P48** and for heli mode #2 also parameters **P73** and **P74 !!!** Don´t remember to parameter **P69** (constant rpm).
To obtain smoother revolution settings, revolutions in the range of 50 to 100% of maximal requested revolution are "expand" through the whole throttle range (outside the area of autorotation and STOP).

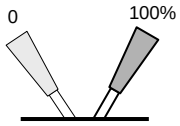
A great advantage of modes with constant revolutions is that revolutions of the motor (or rotor) are held while change of load significantly better than it is possible to do so with throttle and pitch curves on transmitter, and constant revolutions are also held even when drop in voltage occurs (in case enough energy for motor)**.**

Controller may be operates in HELI settings with these different modes:

a) **HELI mode #1**, not stabilized revolution (P3= heli mode #1 + P69= PWM driving)
b) **HELI mode #1**, constant revolution (governor) (P3= heli mode #1 + P69= constant revolution)
c) **HELI mode #2**, constant revolution (governor) (P3= heli mode #2 + P69= constant revolution)

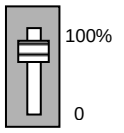
a) HELI mode #1, not stabilized revolution

In this mode, the controller does not hold constant revolutions of the motor – instead, it behaves like aircraft controllers with the exception of fuses and signalization, which are set differently to better suit helicopters' needs. Motor together with controller behaves similarly to glue engine, also setting of transmitter is the same, which means that mix PITCH – THROTTLE (GAS) and their curves are set the same way as if flying with glue engine. Throttle (gas) channel must be assigned to controller (e.g. (CH1 for mc-16/20, CH6 for mc-22, CH3 for FC-18, FC-22 etc.). Throttle curve must be set so that changes in revolutions with change of load would be as small as possible. However, changes in revolutions (decrease) when drop in voltage occurs cannot be compensated in the manner described above.

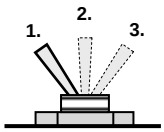


b) HELI mode #1, constant revolution (governor)

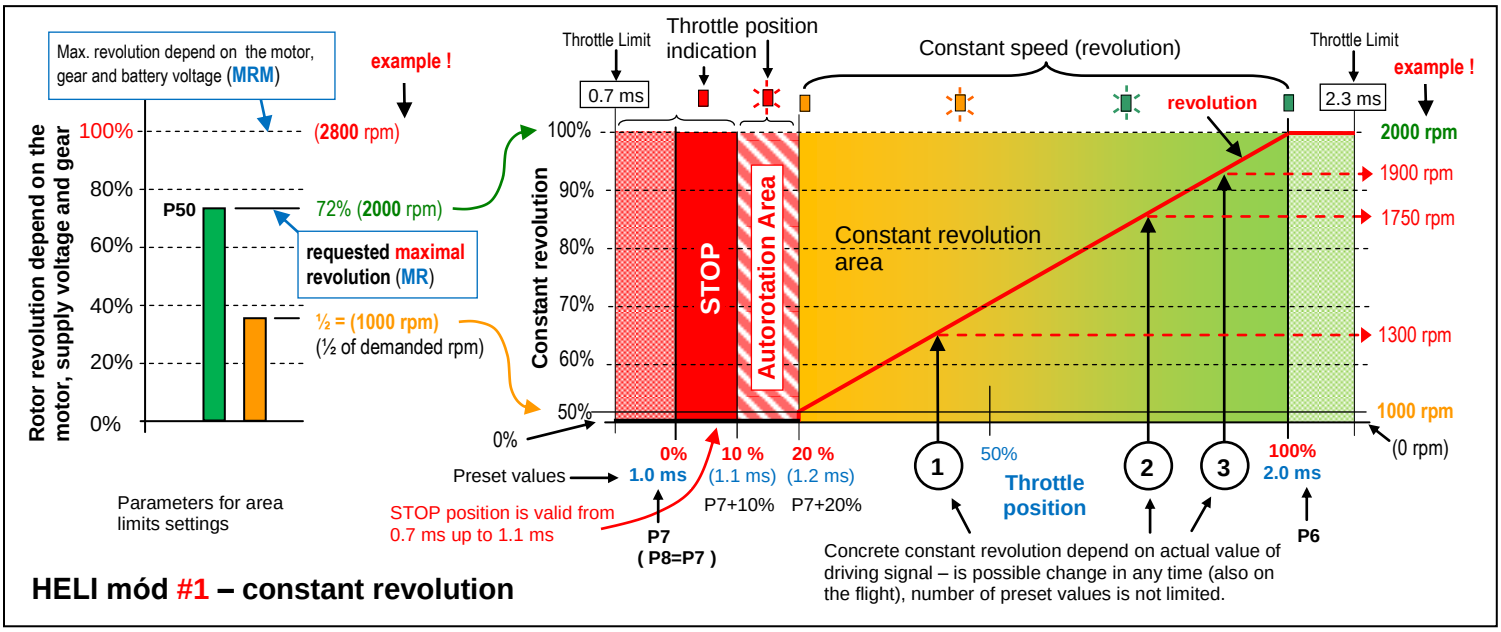
Controller must be assigned to any available (unoccupied) channel (e.g. CH5 for mc-16/20, FC-18), **which is not mixed with pitch !!!**
Throttle value control potentiometer, of that channel is used to easily set constant revolutions that you desire in the range 50 up to 100% **of programmed maximum, parameter P50**, see previous page „ Maximal revolution of rotor settings ", according to the sound, or revolutions meter, etc. Revolution is linear depend on driving signal (throttle position). **Constant revolution can be easy change during flight by your current demand -** just set new desired revolutions using the move throttle stick to new position. As soon as you stop moving the throttle stick, the desired revolutions will be saved immediately and hold afterwards. It is quite similar to a cruise control in car. Constant revolutions are indicated by external LED (continuous light).



Next possibility is flight mode switch. Necessary assign to each position of the switch (or more switches) concrete values of driving signal (=requested revolution) on your transmitter – on the next picture are assign for values 1, 2 and 3 (in ring) concrete revolution (example). Switchover of the switch during flight change revolution to new requested by predefined values (**inside the transmitter !**).
Number of that's how predefined revolutions are not limited by controller , depend only on the transmitter possibility (and his possibilities of switch(es) configuration).



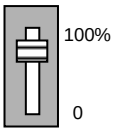
Throttle positions (flight modes) are indicate by controller's LED.



HELI mód #1 – constant revolution

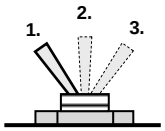
Area limits are predefined. If acceptable for you, you needn´t change this. If these predefined values are not optimal for you, you can change it in corresponding parameters P6, P7. P8 set to value =P7

c) HELI mode #2, constant revolution (governor)



Throttle Potentiometer

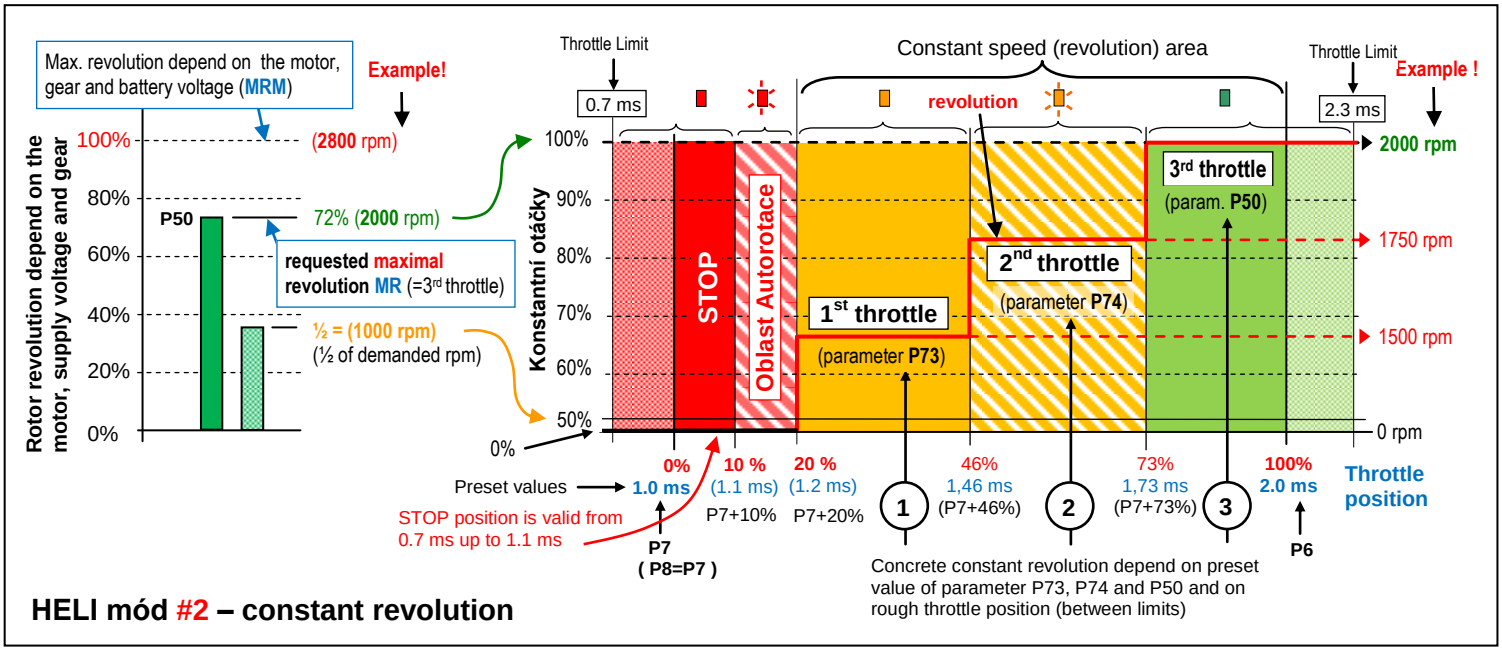
Controller must be assigned to any available (unoccupied) channel (e.g. CH5 for mc-16/20, FC-18), **which is not mixed with pitch !!!**
Throttle value control potentiometer. Constant revolution for flight modes ≡1, ≡2 and ≡3 (i.e. 1st throttle, 2nd throttle and 3rd throttle) are preset in the controller (**value in parameters P73, P74 and P50**). Controller set revolution accordant throttle position inside corresponding area limits. **Preset values** (parameter P73, P74, P50) **is not possible change during flight.** Constant revolutions are indicated by external LED (continuous light).



Flight mode switch

Next possibility is flight mode switch. Necessary assign to each position of the switch (or more switches) concrete values of driving signal (=requested revolution) on your transmitter – on the next picture are assign for values 1, 2 and 3 (in ring) concrete revolution (example). That means, for example, for flight mode ≡2 (2nd throttle) can be driving signal (=throttle position) anywhere between 1,46 ms and 1,78 ms and revolution as always hold on the value preset in parameter P74. Etc. Switchover of the switch during flight change revolution to new requested by predefined values (**inside the controller !**).
Number of that's how predefined revolutions are limited to 3 values.

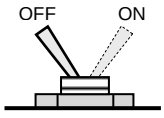
Throttle positions (flight modes) are indicate by controller's LED.



HELI mód #2 – constant revolution

Area limits are predefined. If acceptable for you, you needn´t change this. If these predefined values are not optimal for you, you can change it in corresponding parameters P6, P7. When you change it (from any occasion), area limits for 2nd throttle automatically conforms.

Autorotation:



Autorotation switch

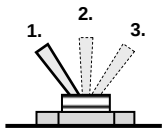
In all described HELI modes is available also special mode „Autorotation". The Startup of motor from this throttle position is significantly quicker (rotor is always running) and is set in parameter P16 (acceleration). This mode is available by throttle moving as well as by switch „Autorotation" (necessary assign to „ON" position of this switch corresponding driving signal between cc 1.1ms and1.2 ms). These values 1.1 and 1.2 ms is possible change indirectly by parameters P7 and P6 (allways P7 + 10% and P7 + 20%, P6 always defined 100% limit).
This state (this mode) is indicate by **blinking of red LED**.

STOP position:

The Startup of motor from this throttle position (STOP) is significantly slower, depend of high centrifugal mass of the rotor and is set in parameter P17 (acceleration from STOP).

Flight mode switch enable choice one of two or three preset values of the rotor revolution. In some manuals marking:

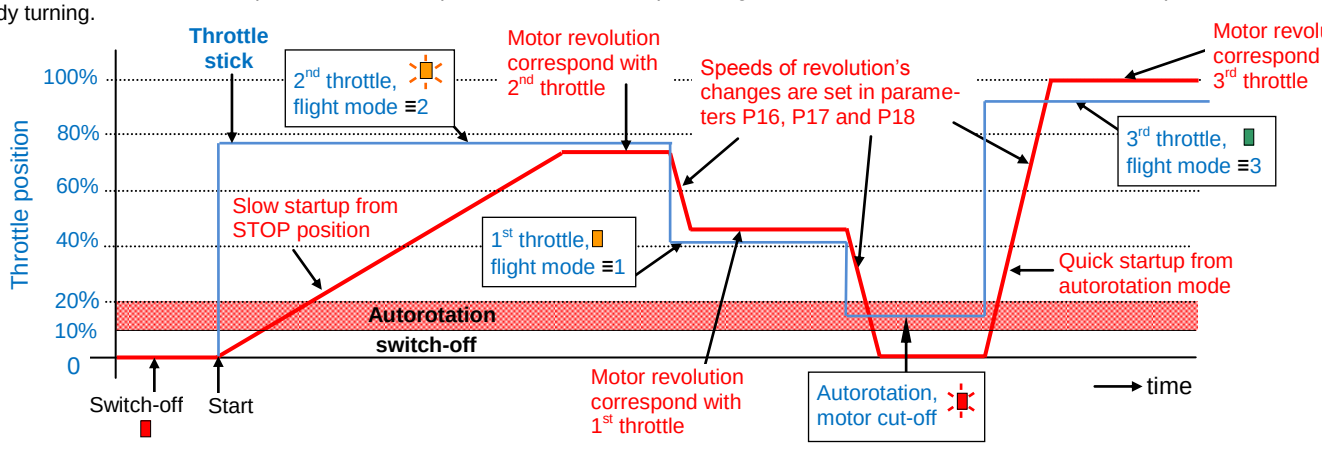
NORMAL	– IDLE UP1	– IDLE UP2	– IDLE UP3	(Robbe - Futaba)
PHASE 1	– PHASE 2	– PHASE 3	– PHASE 4	(Graupner jr)
STOP	– 1. throttle	– 2. throttle	– 3. throttle	(Czech terminology)



Flight mode switch

***First position** of this switch, mostly 0%, enable acceptance of throttle driving in full range 0% up to +100% by throttle stick*

The **Startup** of motor from position 0 (rotor is not turning) is slow so that mechanical parts of helicopter are not exceedingly stressed by big inertial mass. On the other hand, start up from autorotation position is fast – when practicing autorotation there is no time for slow start up, moreover the rotor is already turning.



Technical data. (valid for 25°C environment temperature)

Temperature of the environment: 0°C to 40°C
Motor controlling: PWM: from 8 up to 32 kHz
Number of regulation steps: 2048 / full throttle range
Max. rpm for 2 poles motor: 250 000 rpm

Suitable for motors: **2 to 40 pole motors of classical conception (rotor inside) and also for outrunners (rotor is on the outer side)**
(sensors + sensorless) FreeAir, Hacker, Kontronik, Lehner, Mega AC, Model Motors, MP JET, MVVS, Neu, PJS, Plettenberg, Überall model, etc.

Control signal: Positive pulses 1.5 ± 0,8 ms, period 3 up to 30 ms

S-BEC (switching BEC) : **5V, 6V / 2A cont., 6A max.** (10 sec.), input voltage = 6 up to 35V by type (OPTO versions haven't BEC !)

HV-BEC (switching BEC) : **5V, 6V, 7V, 8V / 2A cont, 6A max.** (10 sec.), input voltage = 6 up to 35V by type (OPTO versions haven't BEC !)

Feeding: **only from batteries**: NiCd, NiMH, Li-Ion, Li-Pol, A123, acid (Pb) or others cells **(using of power supplies is prohibited !)**

Servocables: with JR gold connectors, 0.25mm^2

Weight is defined for basic modification, i.e. **internal cooling plate, shrinking tube, OPTO, input PWM driving** (servocable #1), **without switch**.
In case of use additional parts as external hetasinks, fans, … weight increase :

dimension HT (ribbed heatsink) :	+3,5 mm	+7,5 gram	(single heatsink = 37,5 ×31×5 mm / 11 gram), take off internal cooling plate
dimension HTW (1× water cooler) :	+9 mm	+16,5 gram	(single heatsink = 37,5 ×31×6 mm / 15 gram, pipes Ø 4 / Ø 3, length13 mm)
dimension HTW (2× water cooler) :	+6 mm	+15 gram	
dimension F (fan) :	+10 mm	+10 gram	(30 × 30 × 10 mm / include screws / 10 gram)
switch (with wire) :		+ 2 gram	
servocable #2 - #5 (each one) :		+ 3,2 gram	
S-BEC, HV-BEC :		+ 3 gram	

Dimensions are relate to pictures in chapter "Available versions …."

Note: by shortening of power cables to motor and battery (power supply) weight decrease proportionally

X-series TMM® xxxx-3 V 7.xx	6026-3	8026-3	12026-3	16026-3	28026-3	8017-3LV	16017-3LV
Maximal continuous power:	1,56 kW	2,08 kW	3,12 kW	4,16 kW	7,28 kW	1,36 KW	2,72 kW
Basic dimensions see picture **[mm]**							
Dimension CL (Filtering capacitors) **[mm]:**	Ø 8 × 17	Ø 8 × 17	Ø 10 × 17	Ø 10 × 17	Ø 10 × 17	Ø 8 × 17	Ø 10 × 17
Dimension CT (Controller thickness) **[mm]:**	13	14	17	19	25	14	19
Dimension D (M3 threads distance) **[mm] *):**	--	--	22	24	30	--	24
Weight without power cables:	34 g	36 g	48 g	56 g	82 g	36 g	56 g
Weight with power cables:	47 g	49 g	77 g	91 g	125 g	46 g	91 g
Feeding voltage:	6 – 26 V	6 – 26 V	6 – 26 V	6 – 26 V	6 – 26 V	4.5 – 17 V	4.5 – 17 V
No. of feeding cells NiCd / NiMH:	6 – 18	6 – 18	6 – 18	6 – 18	6 – 18	6 – 12	6 – 12
No. of feeding cells Li-Ion / Li-Pol:	2 – 6	2 – 6	2 – 6	2 – 6	2 – 6	2 – 4	2 – 4
No. of feeding cells A123:	3 – 7	3 – 7	3 – 7	3 – 7	3 – 7	2 – 4	2 – 4
Max. continuous current:	60 A	80 A	120 A	160 A	280 A	80 A	160 A
Peak current for max. 5 seconds:	75 A	100 A	150 A	200 A	340 A	100 A	200 A
On-state FET resistance at 25 °C:	2×0,8 mΩ	2×0,7 mΩ	2×0,4 mΩ	2×0,35 mΩ	2×0,18 mΩ	2×0,55 mΩ	2×0,28 mΩ
Possible modification:	BEC/OPTO	BEC/OPTO	BEC/OPTO	BEC/OPTO	BEC/OPTO	BEC/OPTO	BEC/OPTO
Possible BEC version:	S / HV	S / HV	S / HV	S / HV	S / HV	S	S
Cables cross section to batt. ■■ / motor ■■■):**	2,5/2,5 mm^2	2,5/2,5 mm^2	4/4 mm^2	6/4 mm^2	6/4 mm^2	2,5/2,5 mm^2	6/4 mm^2

X-series TMM® xxxx-3 V 7.xx	7035-3	14035-3	25035-3	6245-3	12545-3	7063-3	14063-3
Maximal continuous power:	2,45 kW	4,90 kW	8,75 kW	1,79 kW	5,62 kW	4,41 KW	8,82 kW
Basic dimensions see picture **[mm]**							
Dimension CL (Filtering capacitors) **[mm]:**	Ø 8 × 17	Ø 10 × 17	Ø 10 × 17	Ø 10 × 31	Ø 10 × 31	Ø 8 × 31	Ø 10 × 31
Dimension CT (Controller thickness) **[mm]:**	14	19	25	19	25	13	17
Dimension D (M3 threads distance) **[mm] *):**	--	24	30	24	30	--	22
Weight without power cables:	36 g	56 g	77 g	51 g	76 g	37 g	63 g
Weight with power cables:	49 g	91 g	120 g	65 g	105 g	51 g	98 g
Feeding voltage:	6 – 35 V	6 – 35 V	6 – 35 V	9 – 45 V	9 – 45 V	9 – 63 V	9 – 63 V
No. of feeding cells NiCd / NiMH:	6 – 24	6 – 24	6 – 24	9 – 32	9 – 32	9 – 44	9 – 44
No. of feeding cells Li-Ion / Li-Pol:	2 – 8	2 – 8	2 – 8	3 – 10	3 – 10	3 – 15	3 – 15
No. of feeding cells A123:	3 – 9	3 – 9	3 – 9	4 – 12	4 – 12	4 – 17	4 – 17
Max. continuous current:	70 A	140 A	250 A	62 A	125 A	70 A	140 A
Peak current for max. 5 seconds:	90 A	180 A	300 A	77 A	155 A	90 A	180 A
On-state FET resistance at 25 °C:	2×1,1 mΩ	2×0,55 mΩ	2×0,28 mΩ	2×1,0 mΩ	2×0,50 mΩ	2×0,65 mΩ	2×0,33 mΩ
Possible modification:	BEC/OPTO	BEC/OPTO	BEC/OPTO	OPTO	OPTO	OPTO	OPTO
Possible BEC version:	S / HV	S / HV	S / HV	--	--	--	--
Cables cross section to batt. ■■ / motor ■■■):**	2,5/2,5 mm^2	6/4 mm^2	6/4 mm^2	2,5/2,5 mm^2	4/4 mm^2	2,5/2,5 mm^2	6/4 mm^2

***) Notice:** possibly also 2×2.5 mm^2 or 2×4.0 mm^2 upon request *The appearance and the technical data may be changed without prior notice.*

„Low voltage versions" of the controllers, marking „**LV**" are suitable for application with low voltage supply (for example. 2x Lipol etc..) and high current consumption, which evoke extremely voltage drops on the internal resistance of the battery as well as on the power cables . Supply voltage can drop up to value around 4.5V.

Important: In case traction battery voltage drops below BEC voltage (not depend if continuous or in motor PWM pulses), not possible provide correct BEC voltage ! and receiver and/or servos must this situation (lower or pulsed BEC voltage) tolerate. Should this bring problem for receiver or servos, necessary supply these components from other source (separate cells for example).

Recommendations: If you use controller for currents higher than ca half of the maximal values, we do recommend intensive cooling by air flow or use of heat sinks (possibly also active cooling using fans or water cooling for boats). This will not only prevent possible overheating of the controller, but you will also gain higher efficiency of the drive unit (cooler controller has lower losses than warm one).

Optional Accessories.

You can specify all these options by your requersts in order:

Switch (s):	all controllers may be ordered with a switch (in a safe design - its damage or destroy does not affect the safety of flight and the model
Heat sinks (coolers):	For more efficient power loss (heat) dissipation, it is possible to optionally mount (from one, or both sides depending on the type of the controller) **outer ribbed heat sinks** (coolers).
Fans:	In case of insufficient cooling air flow it is possible to use heat sinks with fans **FAN 05**, which significantly improve the cooling efficiency – **active cooling**. **Possible order as set FAN 05 separately, with screws, for additional mounting to heat sinks – using of another type is strictly prohibited !!!**
Water cooling:	version with water coolers is available for use in boats.
Hydro version WP:	water and humidity does not get on well with electronics. For significant increase of durability of the controller against humidity and water, it is optionally possible to apply specialty protective cover (marked as **WP**). This however does not mean that the controller with this protection is 100% durable during humidity and water and that it is not necessary to protect it against these negative effects. **The protection does not apply to salt water at all !**
Hydro version WR:	If you need **100% protection** against water, dirt, humidity, necessary choice **WR** modification. Plates with electronics components are fully sealed in special matter, more expensive version. No possible repair ! **The protection does not apply to salt water at all ! For more information see manual "Water protection of RC equipment".**
Sensor motors SE:	all types of controllers may be ordered as „Sensor" – marked as **SE**. These controllers may be connected to sensorless motors as well as sensor motors. In case of sensor motors, types compatible with **EFRA** are recommended. (EFRA Handbook 2007), e.g. motors „**Velocity x.xR Brushless Motor**" by Novak, etc., more see here ».
Back data channel BC:	all types of controllers may be ordered as version with telemetry, with additional servocable for connecting to "back data channel" of receiver some of 2,4 GHz RC equipment, marking **BC.**
BEC, HV BEC, OPTO:	controllers up to 35V is possible order as **OPTO** with isolated input or with switching BEC, **S-BEC** (5V and 6V) or with switching BEC with "high voltage output", **HV-BEC** with output voltage 5V, 6V, 7V and 8V, suitable for RC equipment working with supply voltage up to 8,4V (2×Lipol). **Controllers for higher voltage than 35V are available only as OPTO, without BEC.**
Battery temperature BT: OPTO controllers' version can measure also traction battery temperature (standards with sensor KTY 81-210)	

Controllers marking.

Marking: TMM pppnn-3s / SE / BC / WP / WR / / BEC / HV BEC / OPTO	where „**ppp**" means current (2 – 3 digits), „**nn**" gives voltage (2 digits), „**s**" version with switch **BEC / HV BEC / OPTO** specify version with S-BEC, HV-BEC or without BEC, optically isolated „**SE**" version for sensor motor, „**BC**" version with telemetry, „**WP**" higher durability against humidity and water, „**WR**" 100% durability against water, dirt, …
Example: X-series TMM 7035-3 / OPTO WR	70A, 35V, without switch, sensorless motor only, without telemetry, optically isolated, 100% water resistivity
X-series TMM 14035-3s / BEC SE BC	140A, 35V, with switch, with BEC, sensors and also sensorless motors, with telemetry

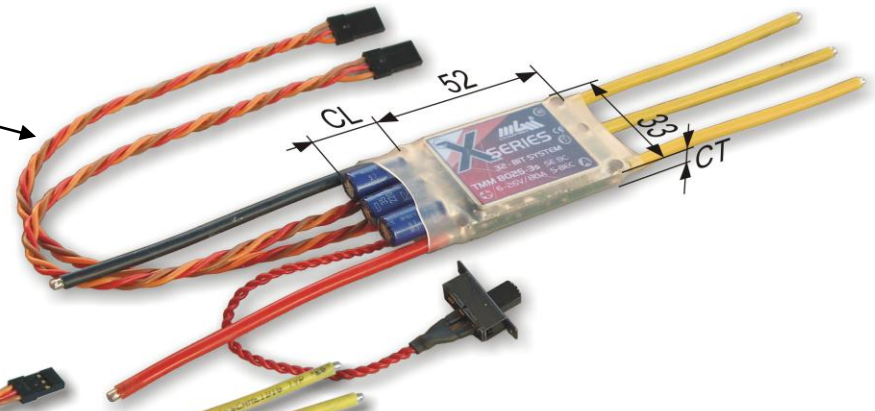
WARNING: You risk damaging or destroying the controller for:

- **connecting more battery cells** to the controller than the max. number specified in the technical data
- reversing voltage connections to supply
- **short circuit of wires to the motor** when the controller is connected to the battery
- **swap of wires** to the motor and the battery
- **overloading of the BEC** with bigger currents or bigger power loss than is specified in the technical data
- dipping the controller in water, or water penetrating to the controller, metal (conductive) objects in the controller (except WR version)
- **feeding the controller from other source** than battery
- **disconnecting the controller** from batteries or turning off the controller or motor disconnect while **motor is running (or still turning)**

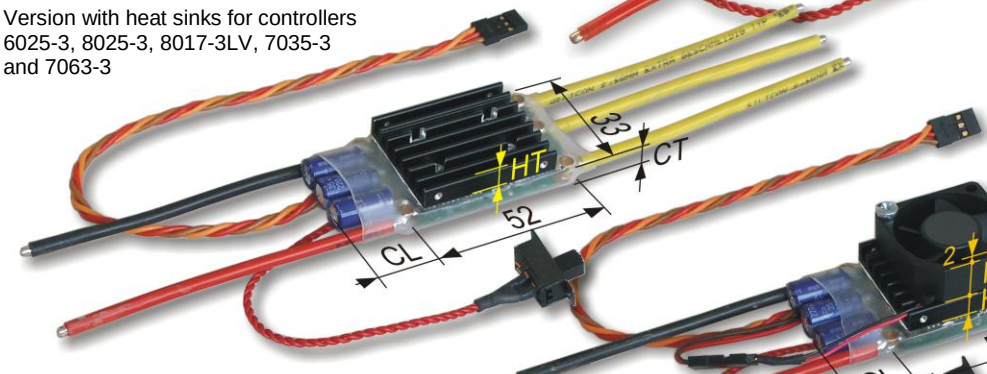
Examples of **WR version** of the controller, with coolers and fans

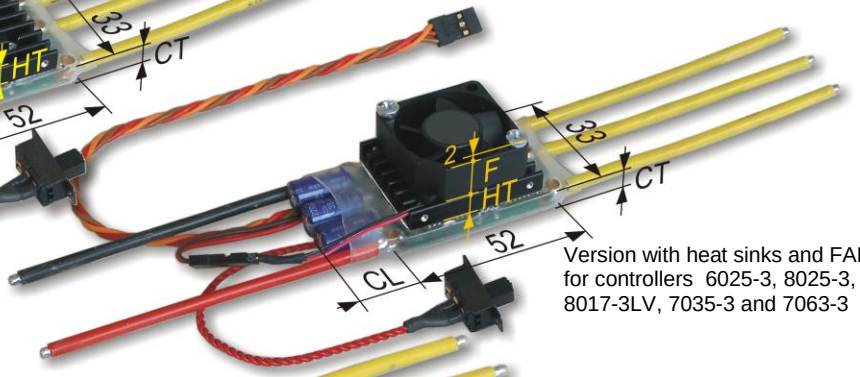
Available versions of X-series V7 controllers.

Regular controller without coolers, with back data channel (telemetry) (BC version) for types: 6025-3, 8025-3, 8017-3LV, 7035-3 and 7063-3



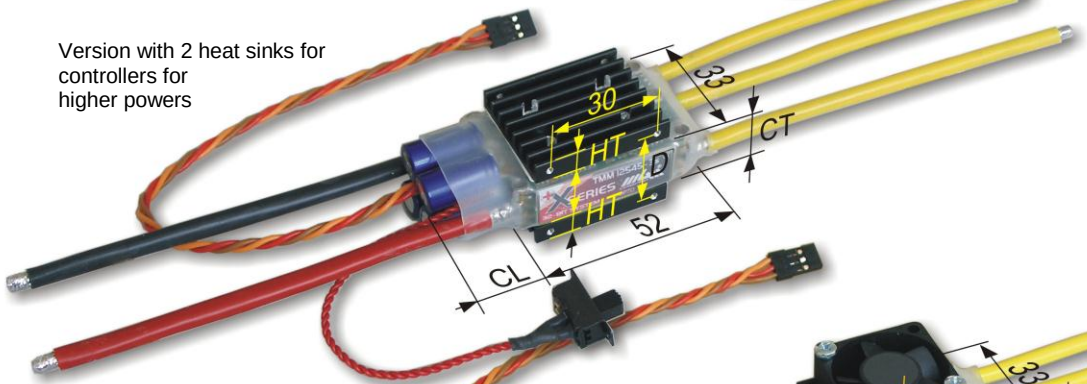
Version with heat sinks for controllers 6025-3, 8025-3, 8017-3LV, 7035-3 and 7063-3

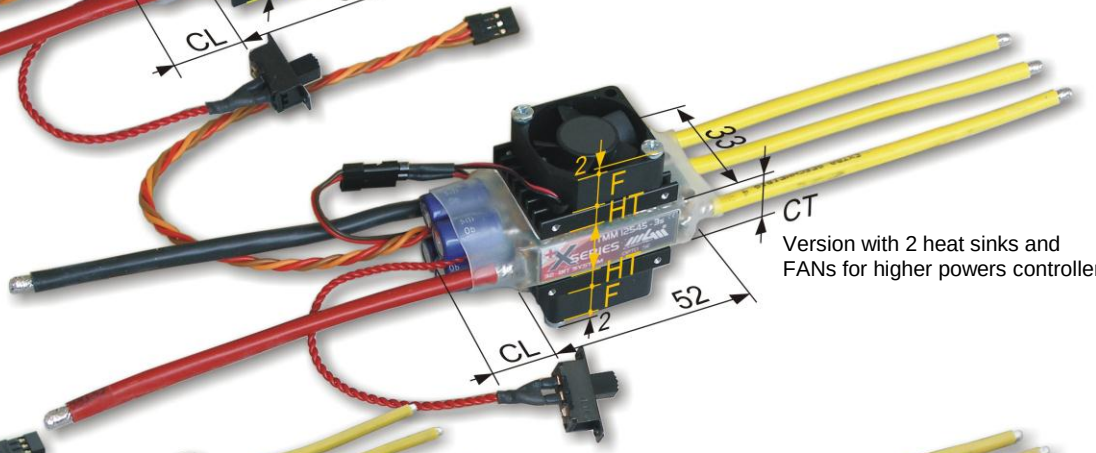




Version with heat sinks and FAN for controllers 6025-3, 8025-3, 8017-3LV, 7035-3 and 7063-3

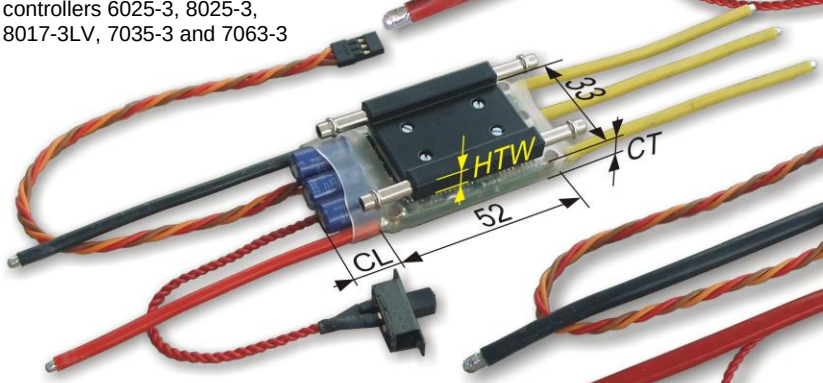
Version with 2 heat sinks for controllers for higher powers

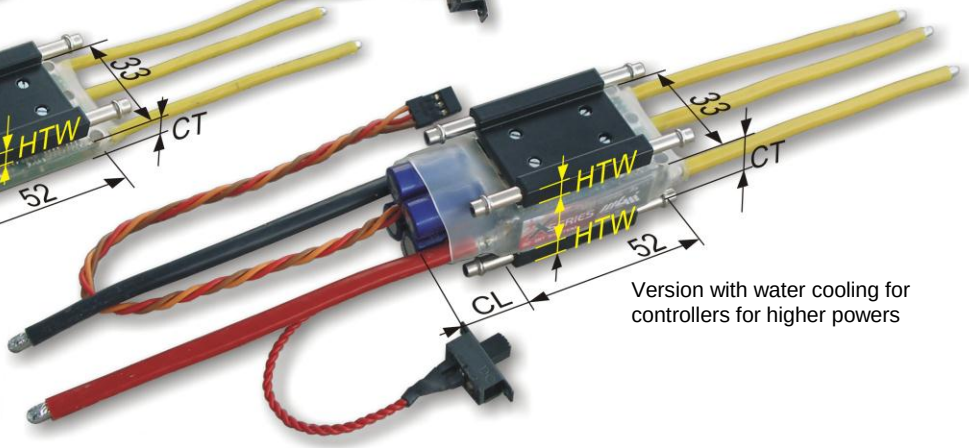




Version with 2 heat sinks and FANs for higher powers controllers

Version with water cooling for controllers 6025-3, 8025-3, 8017-3LV, 7035-3 and 7063-3





Version with water cooling for controllers for higher powers

Switching BEC: S-BEC, HV-BEC.

X-series controllers up to 35V is possible order with switching BEC, **S-BEC** or with switching BEC with "high voltage output", **HV-BEC** with output voltage up to 8V (see Technical data), depend only on your needs and specification.

Advantage of switching BEC is smaller power losses when working with higher input voltages. Disadvantage can be, for older RC equipment, little bit higher value of noise (interferences).
Current rating of BEC declines with higher temperature. BEC current rate is 2A continuously for 25°C and 6A for short time current peak. Short circuit on the BEC output is tolerate some time without damaging.

S-BEC …. suitable for receivers and servos working with voltage 5V and 6V.
HV-BEC .. suitable for receivers and servos working with standard voltage (5 and 6V), as well as with higher voltage 8,4V (2×Lipol). Output voltage is possible set 5V, 6V, 7V and 8V.

Important:
We recommend, for higher safety and higher reliability, connect battery with corresponding capacity parallel to BEC output, see page 5, fig. e) for details. Use next type of cells selection by BEC output voltage:

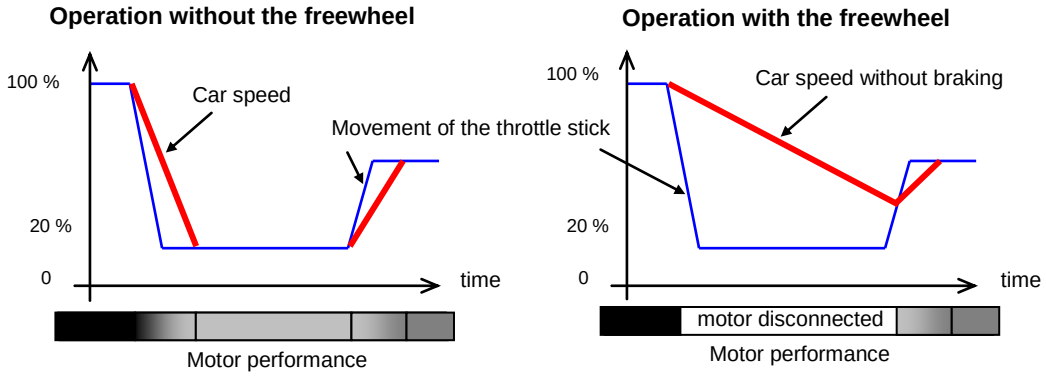
- for BEC = 5V connect 4 Nixx cells,
- for BEC = 6V connect 5 Nixx cells,
- for BEC = 7V connect 2 A123 cells (only for HV-BEC)
- for BEC = 8V connect 2 Lipol cells (only for HV-BEC)

Connect this battery to free channel of receiver or to receiver battery input, see fig. e on page 5.
Connect traction battery and switch-on controller first, connect this battery in second step. For switch-off controller disconnect this safety battery first and traction battery disconnect in second step. Ne depend if you connect this battery directly to receiver or through switch (the best electronic switch).
BEC hold battery almost full charge, therefore when some problem start in electronics or bad contact, wire broken etc., receiver and servos have always supply voltage and you can control your model.

Additional information.

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).



Influence of the battery quality to controller behavior.

If the current peak during loads the battery to such an extent that their voltage is about to drop under ca 4V (for BEC version) or ca 10V for OPTO versions, there automatically is lowered the speed (power) of the onset of revolutions so that voltage does not drop under this limit.
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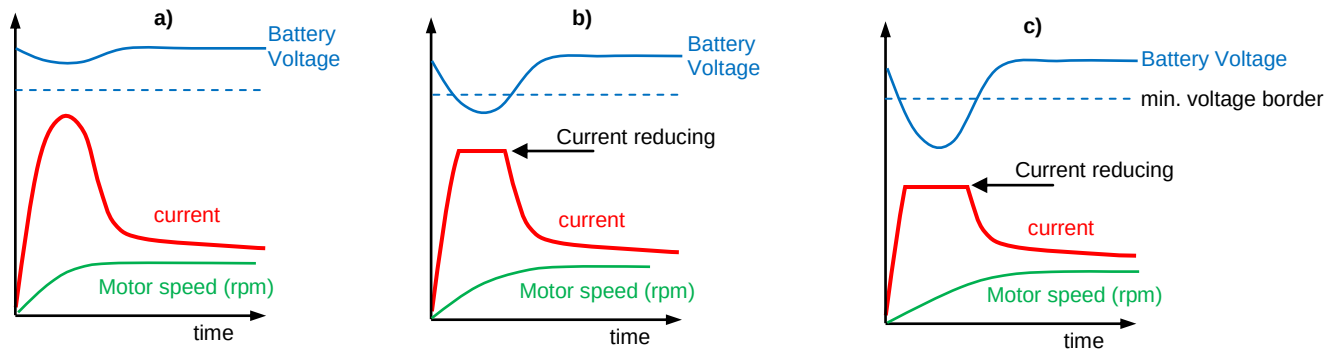


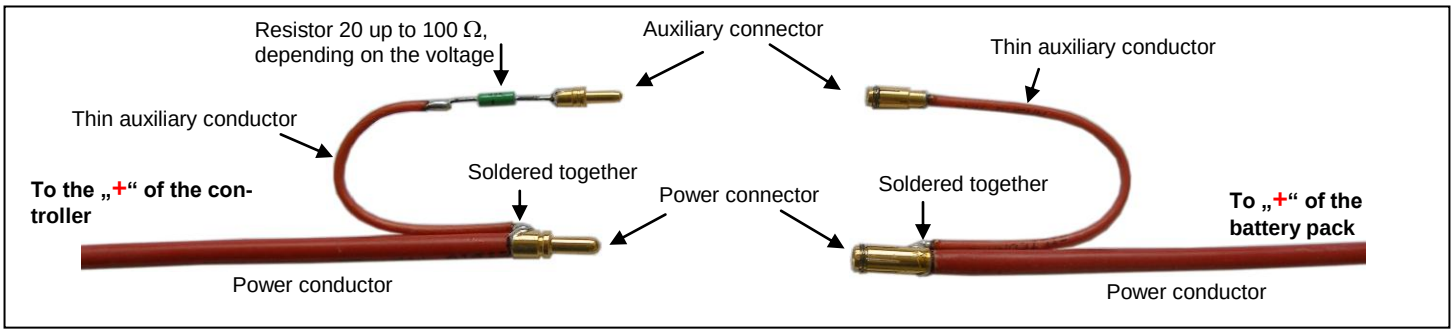
a) Very quality („hard") battery, voltage drop is low under load, not start current reduce process
b) Not so "hard" battery (worse quality) or too high load or too short acceleration time – current is reducing during acceleration so that voltage not dropped under minimum voltage border.
c) Not suitable battery, damaged battery, extremely high load or extremely short acceleration time – current is significantly reducing for hold battery voltage above minimal voltage border.

Sparking prevent when connect higher voltage.

When connecting a Li-xxx pack to the controller, strong sparking commonly occurs. Fast charging of the controller filter capacitors causes this. The higher voltage (higher the cell count), the lower the internal resistance (and the better the quality of the pack). The better the capacitors in the controller and the higher the capacity of the capacitors, the bigger spark occurs. Besides the small shock (due to the sparking), the charging current of the capacitors may be in, extreme cases, so great that damage or destruction of the capacitors occurs.

A simple procedure exists to eliminate sparking when connecting the battery pack. This inexpensive modification eliminates sparking and thus protects the filter capacitors.

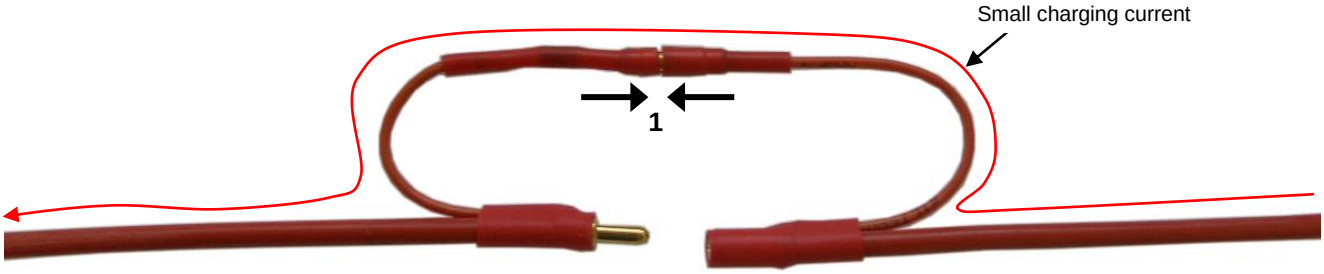
How to connect the positive leg or wire (shown here without insulation):



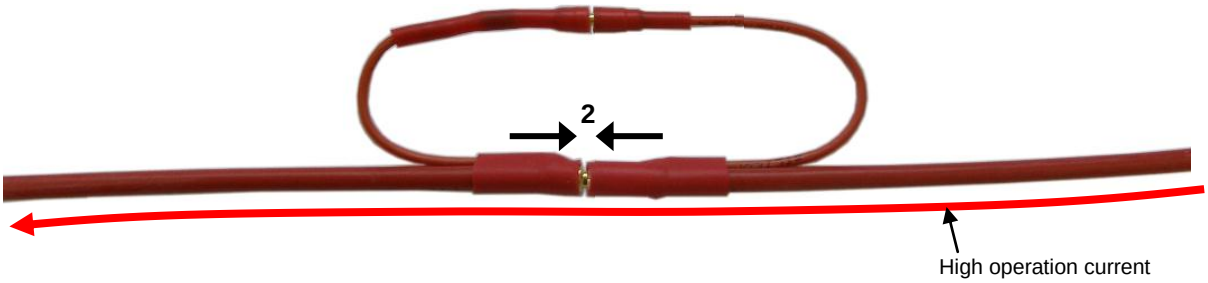
Connectors as well as the resistor are insulated by heat shrink tubing.

How to connect the battery:

1) connect the “**–** “ leg of the battery to the “**–** “ on the controller.
2) in the positive circuit, **first connect the “+” leg of the controller to the auxiliary connector** (to which a resistor with tens of ohms is connected in serial). This will limit the charging current when connecting the wires and will charge the filter capacitors without sparking.



3) now connect the power wires (sparking will not occur). Main current flow is going through this power connector. You may start the motor now.



Note:

There are no special requirements on the auxiliary connector. The current is small (1- 2A) and lasts only for a short time. There are also no requirements on the resistor, any type is sufficient, e.g. metalized 0.6W, size 0207, value between 20 to 100Ω depending on the voltage of the battery pack. However, it is not necessary to use these exact values because of wide variation.
for 4 – 6 Lipol use 20Ω - 40Ω
for 10 Lipol use 50Ω- 100Ω
for 12 up to 15 Lipol use 100Ω

Resistors 22Ω, 47Ω and 100Ω are enclosed.

Protective and safety mechanisms of TMM® controllers.

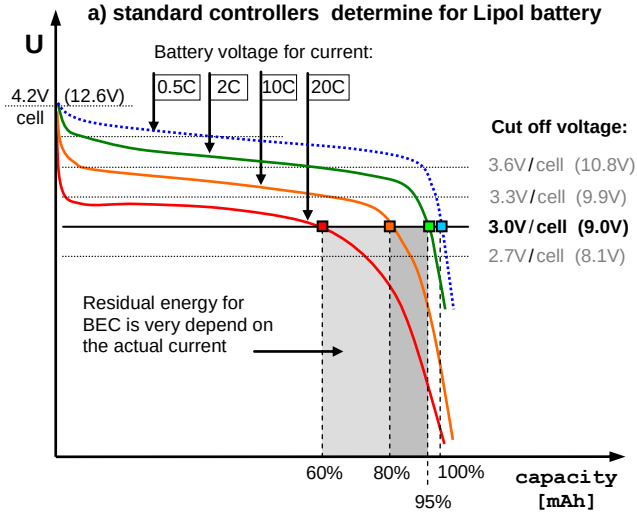
Controllers mask interference and signal losses for up to defined time in parameters. Motor revolutions are gradually reduced for longer lasting signal drop outs or interference. When the signal is restored, the controller goes smoothly back to the required power. Long lasting signal drop out (or its absence) is indicated by LED.
Motor does not start, if the controller does not receive a correct signal from the receiver (e.g. when the transmitter is turned off). It also does not start until the throttle stick is not in „motor turned off" position after switch on – that is in the neutral position for "grip pistols" transmitter type or „minimal throttle" for transmitters without neutral.
Temperature fuse of the controller is set to ca 100°C.
Current fuses of the controller turn the controller off or limit the currents during current overload of the controller. New start, after fuse cut off, is possible after the throttle is moved back to neutral (minimal position for transmitters without neutral).
Circuits monitoring voltage take care of the correct moment for disconnecting the motor when the batteries get discharged – not only that the batteries do not get undercharged but also enough energy is retained for servos after the motor is turned off (when the battery is discharged).

Advantages of these mechanisms for TMM® controllers:

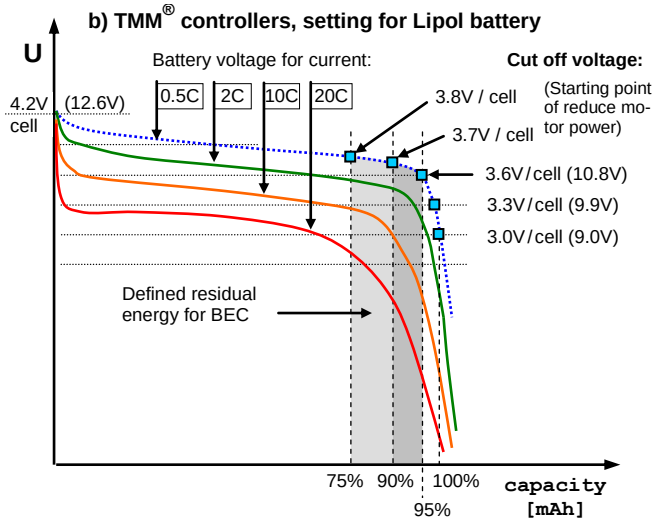
1) Thanks to the use of the automatic current fuse (**ACF**) the possibility of current overload of controller, motor and accumulators (and their possible damage) even at crisis points is significantly reduced - controller disconnects the motor.
2) the used system of intelligent power reduce (**IPR)** always ensures through measurements of voltage, currents, accumulator condition and calculations an optimal point of starting continuous reduction of motor performance (or the point when motor is switched off, according to the setting), so that the accumulator cells do not get extremely discharged – which is very important specially for Lipol cells. This, not mentioning other advantages, reduces the possibility of reversal of poles of lower cells (applies mainly to NiCd / NiMH cells).
3) This system at the same time **enables retaining defined energy for BEC (perfect RPC) –** applies to controllers with BEC. It is extremely important for flying models (you do not crash due to not having enough energy for receiver and servos). The amount of retained energy can be set by the user (by setting the switch-off voltage).
4) the automatic current reduce (**ACR**) does not allow a drop in voltage for BEC even under extremely big current load.

When switching the motor off (reducing power) at a solid boundary as it is with standard controllers **(chart a)** it is not possible to determine the amount of energy for BEC which is kept in the controller after the motor is switched off. It strongly depends on currents and inner resistance of the battery. The better the cells (harder) you have and the smaller the instantaneous current, the less energy (= time) remains for landing after the motor is switched off by the controller. On the other hand, the worse the cells and the higher the instantaneous currents, the more energy remain – but you do not know how much energy exactly.
Comparing to this, **TMM® controllers** (**chart b**) ensures that the remaining energy (after the motor is switched off by the controller) is practically independent on currents and inner resistance of the battery and it is possible to change its amount for some types of controllers according to one's needs (higher for gliders, etc.). From the motor operation time view it is usually an insignificant amount of energy, the motor power would decrease very fast anyway. However, this energy is very significant in regards to feeding BEC.

a) standard controllers determine for Lipol battery



b) TMM® controllers, setting for Lipol battery



Regular controllers (even Lipol compatible) have either a solid switching off voltage (for example 3V per cell) or it is possible to set this value. For example for set boundary 3V per cell the controller is switch off or it starts to reduce revolutions when this value is reached no matter how big the drawn current is. **This means that the residual energy significantly changes according to a instantaneous current load of batteries** (and also according to inner resistance of the cells] from 0 to 95 % - depending only on the set voltage boundary. If the example on the graph above is considered with a set boundary of 3V per cell the controller will switch off when drawn current is 20C when there is still 40% of energy still left, while for 5C current when only 5% of energy is left. For boundary of 3.3V per cell the controller would switch off for currents of 20C when only few percent of energy were consumed while for 5C after 92% of energy would be consumed.

TMM® controllers handle the situation quite differently. The switching off voltage is always recalculated into „inner" voltage of the battery – therefore is independent on both drawn current as well as inner resistance of the accumulator. **This means the set residual energy is always the same and does not depend on currents and inner resistance of battery.** Batteries are then always discharged to same level, regardless how big currents are drawn. The value of set residual energy is therefore only little dependent on the features of battery and the discharging current. For example for switching voltage 3.7V per cell controller switches off the motor or starts to reduce revolutions always after 90% of energy is used up no matter if the drawn current is 20C or 5C.
(The voltage of accumulator after switch of the current always rises to a value close to curve of 0.5V – this discharging curve is close to „inner" voltage of battery. This curve describes how much the controller is discharged.

Switching-off voltage:

Thanks to the above described mechanisms, the switching—off voltage (always meant as switching-off voltage per cell !) of **TMM®** controllers is independent on the amount of drawn current and the inner resistance of the battery. For each type of cells, switching-off voltage is preset (A123 to 2.5V, Lipol to 3.2V etc). **The controllers also feature possibility to set universal switching-off voltage** for existing types of cells and even for those that do not exist today, **UNI.** This voltage range is 0.1 – 60.0 V/cell.

Update SW inside the controller (firmware).

When you want make update firmware in you controller to newest available version, you need **USBCOM 4** module and **CC_11** cable (the same as for standard programming of parameters).
USBCOM 4 as well as CC_11 cable is necessary order separately.

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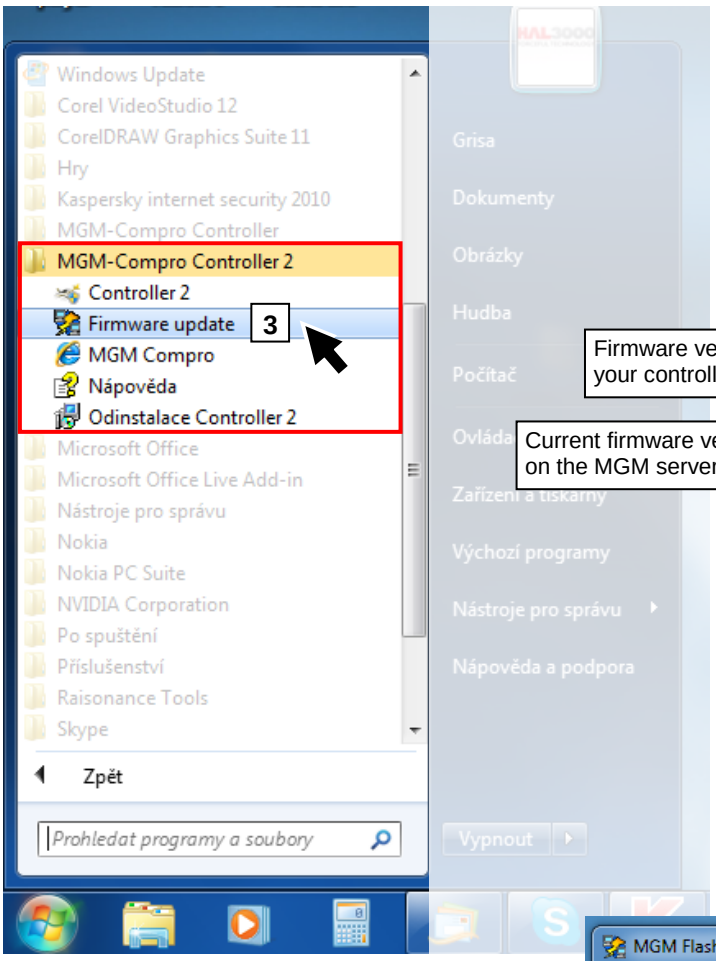
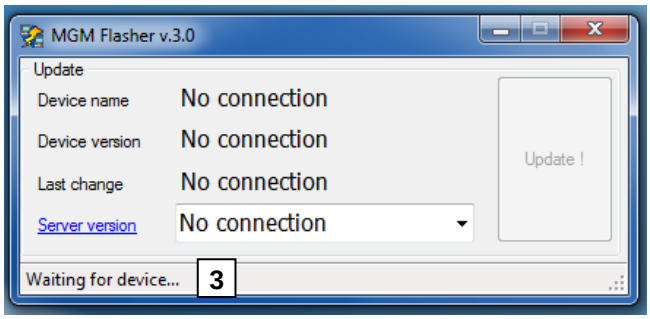
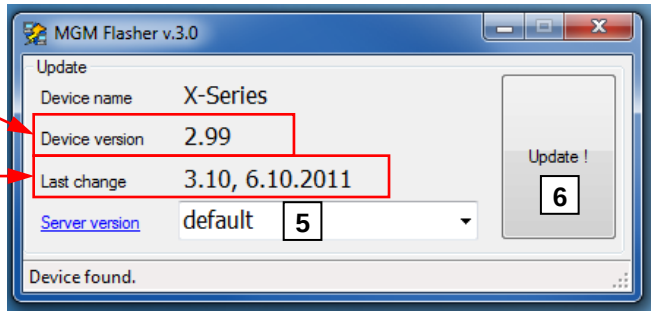
After an installation of **Controller 2** program, you can select application called **Firmware update** in the **Controller 2** subfolder in the **Start menu**.

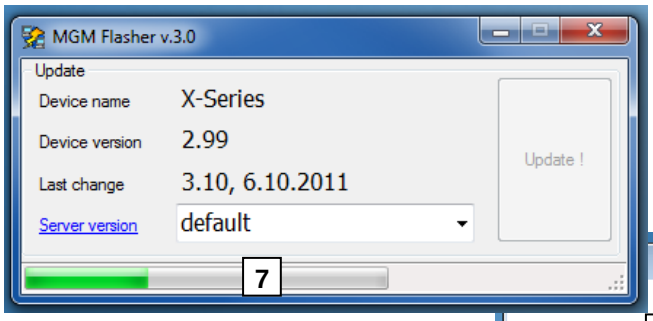


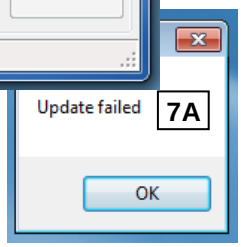


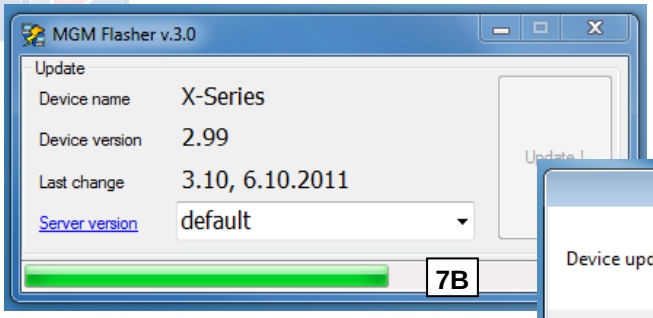


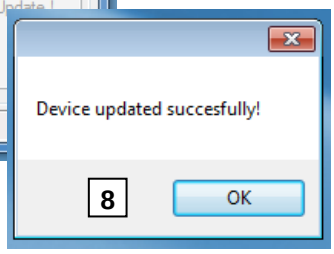
Firmware version in your controller

Current firmware version on the MGM server



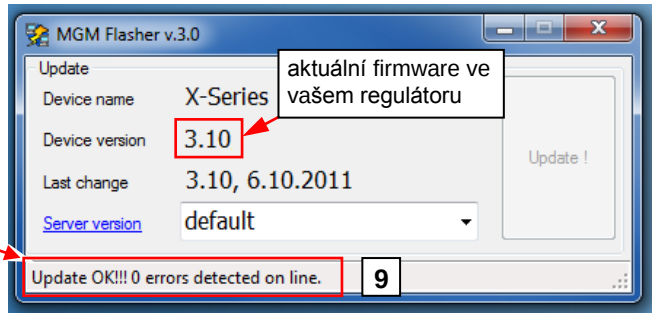






Starting sequence for firmware updating follows:

0. Finish program ***Controller 2*** first.
1. Connect USBCOM 4 to the PC and ESC (by CC_11 cable)
2. Wait for driver installation to finish (if you plug in USBCOM 4 for the first time)
3. Start the “Firmware update” application (it shows “waiting for device” message)
4. Turn the ESC on by its switch or applying main voltage
5. Wait few seconds to the “Update” button release. If it stays gray, turn the ESC off and on once again
6. Press the “Update” button
7. Wait for update procedure to finish [**7B**]. If any error occurs [**7A**], close MGM Flasher (Firmware update) application and start once again from point 3.
8. When procedure finished [**7B**], message will appear. Push OK.
9. When all updating procedures and tests finished correctly, Flasher give message “Update OK !” . You can switch of controller and Flasher – you have update firmware in your controller to last version.



You can start updating procedure for unlimited amount of tries,
the controller cannot be broken down by failed update, but you have to finish the update procedure without errors [**9**] if you want to use it with motor.

Note: Please, check also, if newest version of program „***Controller 2***“ isn’t available. Newest parameters or other changes, which correspond with new version of the firmware, can be added.
Without corresponding version of program „***Controller 2***“ cannot be settings fully and correct function !

Installation and run program Controller 2.

Are very simply and intuitive. Details are described in manual „***Installation and controlling of program Controller 2***“, follow instructions in this manual please.

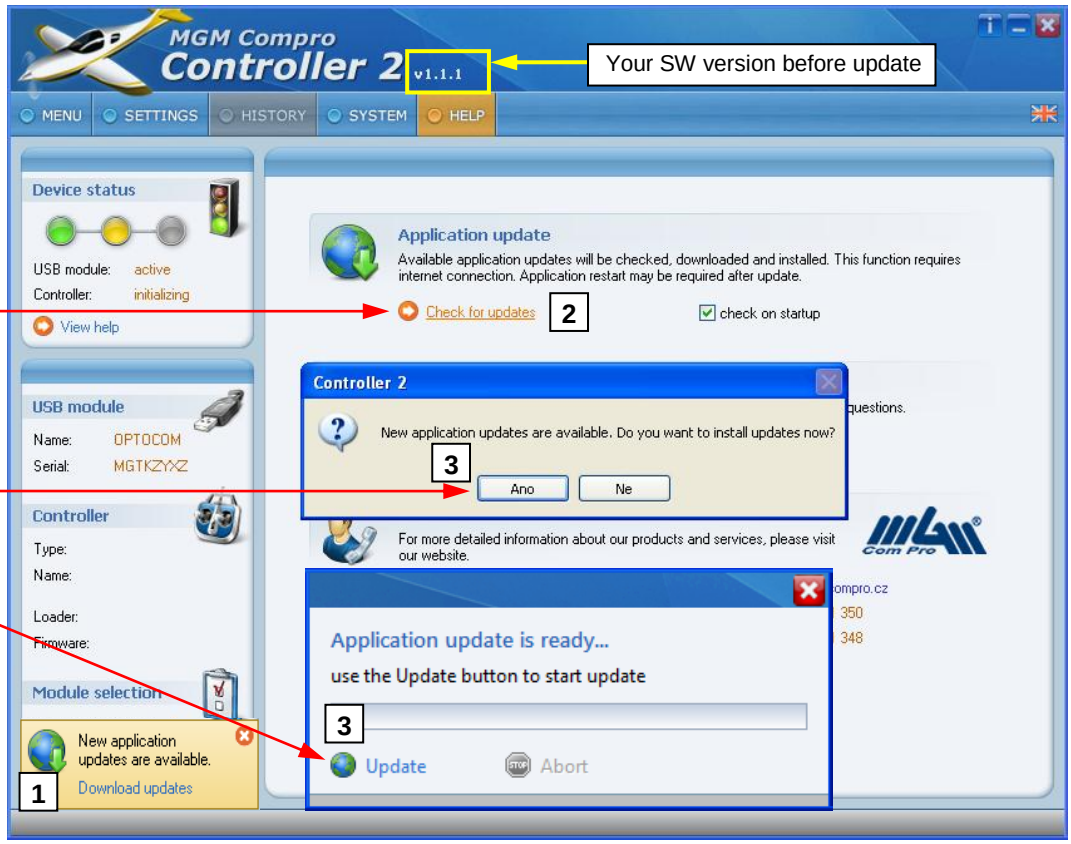
Update of program Controller 2

Update SW version of your program Controller 2 is possible make by two ways.

1. After start program automatically advice to new version in left lower corner – start update by this way.

OR

2. You can check if new version is available any time → click to **HELP**, **Application update** and **Click for updates**

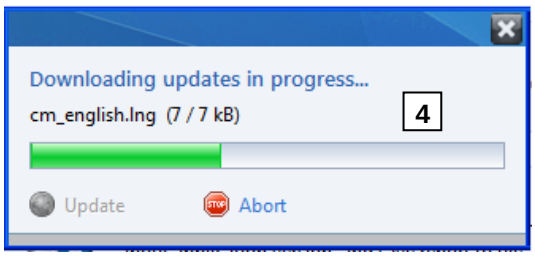


3. When is new version available, click to **Yes**

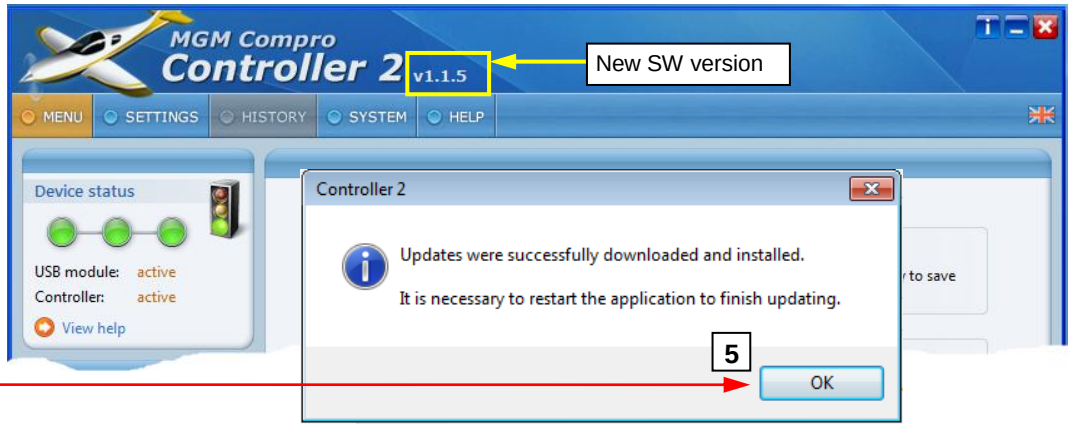
   or **Update**,

   depend on start condition

4. Wait for finishing



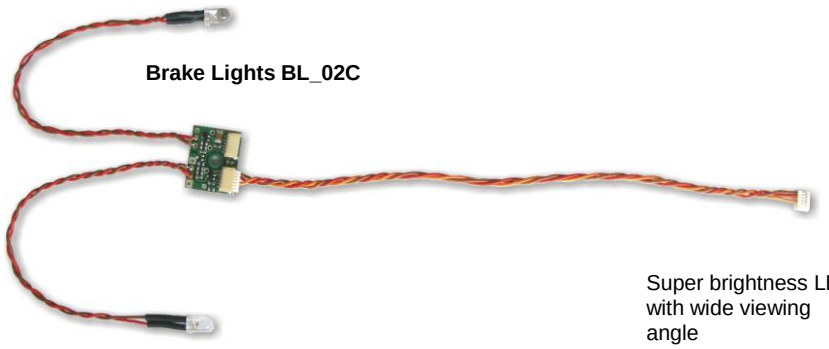
5. Last step is restart, after this you have newest current version.



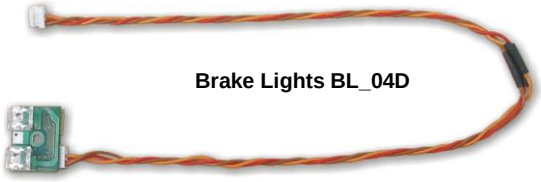
Accessories.

Braking lights is possible order and connect to the controller. Available are three modification:
– with 2 high lighting LED (BL_02C)
– with 4 high lighting LED (BL_04C)
– with 4 high lighting AUTO LED (BL_04D) - Super brightness LED with wide viewing angle

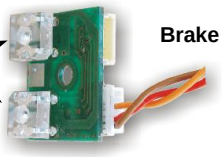
Brake Lights BL_02C



Brake Lights BL_04D

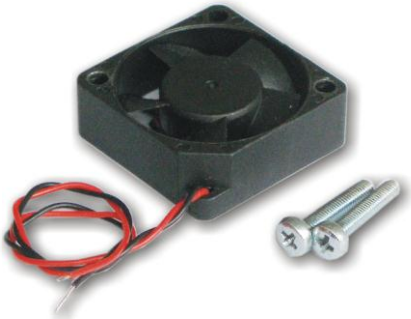


Super brightness LED with wide viewing angle



Brake Lights BL_04D - detail

FAN 05 with screws



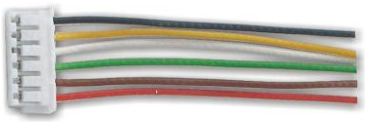
Brake Lights BL_04C

For mounting fan(s) to original cooler (on the controller) is possible use only enclosed screws.
Use another type of fan or another screws for mounting to controller is strictly prohibited !

Extended cable EC_2 to ICS-2 connector

Battery temperature sensor (BT)

Cable for motor sensors,
EFRA compatible CMS_6 (20 cm)



Used abbreviations and terms.

ACF - automatic current fuse
ACR - automatic current reduce
APS - automatic parameter setup
BEC - battery eliminator circuitry – circuit ensuring feeding of servos and receiver from the traction battery
BLDC - brushless DC motor – brushless direct current electromotor (correct name of „alternate“ modelers motors)
IPR - intelligent power reduce – system of intelligent power reduction when batteries are low
LED - light emitting diode
PWM - pulse width modulation – used for lossless control of motor power
RPC - radio priority circuit – priority preservation of sufficient voltage for BEC

Content of delivery.

- Controller in antistatic bag
- 3 pcs of antispark resistors (see page 25)
- CD with program Controller 2, with manual and other information
- Printed basic (general) information
- Warranty certificate

Product Warranty.

MGM compro guarantees, this product to be free from factory defects in material and workmanship. Warranty period is of 24 months from date of purchase and purchase within the EU. Warranty for purchases made outside the EU is inline with the respective legal regulations. Warranty liability shall be limited to repairing or replacing the unit to our original specifications.

The warranty may be claimed under the following conditions:
The product has been used in the coherence with the instructions for use and only for purposes stated in the instructions and provided that none of the conditions for which the warranty cannot be claimed (see below) occurred.

It is necessary to provide together with the product for repair:
- a copy of sales receipt (if a warranty repair is claimed)
- detailed description of the problem – how it occurred and what is the problem
- description of the RC set you were using when the problem occurred (number of cells, their capacity, motor, throttle, etc.)
- your phone number and/or email address in order to allow further consultations regarding the problem

.

The warranty does not cover and therefore cannot be claimed for damages/destroys cause by:
- forced mechanical damage, crash of the model etc.
- chemical substances
- unqualified manipulation, incorrect installation
- any interference with the controller (soldering, change of wires, change components, exposed circuit board etc.)
- reversal of poles
- disconnecting from the battery (or switch-off) while the motor is still turning
- overloading with a higher number of cells than specified
- feeding from unspecified source (e.g. mains source instead of the specified cells)
- shortcut on the output
- overload
- overloading BEC, shortcut BEC or servocable to feeding or motor cables
- water or any other substances (except "WR" version)
- salt water
- running with damaged motor
- operations with not recommended (not suitable) connectors
- not following the instruction in the manual or operating in conflict with recommendations or manual

The warranty also does not apply when:
- the connectors are cut (servocable etc.)
- the controller or its parts are worn by regular use
- the plastic cover (shrinking sleeve) is cut or the controller is taken out of it
- acts of God (e.g. strike by lightening)

We do reserve the right to change our product warranty at any time without prior notice.

Service and Technical Support

Send product for service to address: **MGM compro, Sv. Čecha 593, 760 01 Zlín, Czech republic, EU**

Call your questions and requests to: **+420 577 001 350** or write on: mgm@mgm-compro.cz .

Information about products, technical notes, news, recommendation: www.mgm-compro.cz

Update firmware and SW on: www.mgm-compro.cz

Recycling

This symbol on the product and / or accompanying documents mean that used electrical and electronic products should not be mixed with general household waste.
For proper treatment, recovery and recycling, please take these products to designated collection points, where they will be accepted on a free of charge basis.

Electromagnetic Conformity declaration

CE

For these products of the X-series family we confirm that the electromagnetic compatibility directives are met.