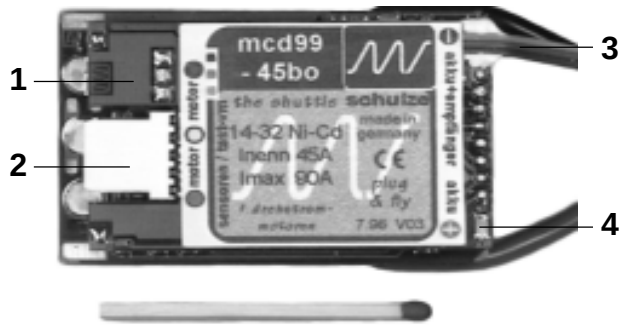

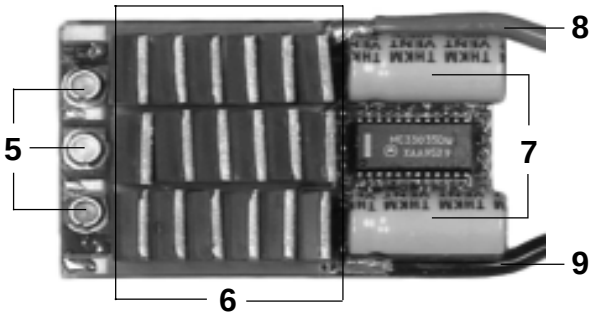

Key:

1. 3 pin configuration input
2. 5 pin motor sensor connector
3. Receiver cable (throttle channel)
4. Red/green dual color LED (on reverse)
5. Motor connector (3 wires)
6. 18 Power MOS FETs
7. Protective capacitors
8. Positive battery wire, RED
9. Negative battery wire, BLACK

Note: The unit is supplied with a set of plugs connected to socket 5.
The external pushbutton for the configuration input 1. is also included

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1 Warning notes, cautions

Electric motors fitted with propellers are dangerous and require proper care for safe operation. Keep well clear of the propeller at all times when the battery pack is connected.

Technical defects of an electrical or mechanical nature may result in unintended motor runs; loose parts may cause serious personal injuriy and/or property damage.

The CE-certificate on the speed controller does not absolve you from taking proper care when handling the system!

Speed controllers and soft-switches are exclusively for use in RC models. Their use in man-carrying aircraft is prohibited.

Speed controllers and softswitches are not protected against reverse polarity (+ terminal and - terminal reversed). Connecting the **battery pack** to the **motor leads** of the controller or soft-switch will almost certainly cause irreparable damage.

Electronic equipment is sensitive to humidity. Speed controllers and soft-switches which have got wet may not function properly even after thorough drying. You should send them back to us for cleaning and testing.

Do not use mcd99 in conjunction with a power supply connected to the mains. Energy reversal occurs when the motor slows down and stops, and this may damage the power supply or cause an over-voltage condition which could damage the mcd99.

Check carefully that all 3 motor wires and all 5 sensor wires are plugged into the correct connectors. Incorrect or incomplete connection of the power and sensor cables will damage the speed controller and/or the motor.

Never disconnect the flight pack while the motor is running, as this could cause damage on the speed controller or soft-switch.

Protect the speed controller or soft-switch from mechanical loads, vibration, dirt and contamination.

Never leave the flight battery connected when ...

... the model is not in use and/or
... the battery pack is being charged.

(Although some speed controllers feature a separate On/Off switch, this does not isolate it completely from the battery.)

Do not exceed the maximum stated length of cable between battery and the mcd99 (max. length: 20 cm / 7...8"). The wiring inside the battery pack must also be as short as possible. Use in-line soldered “stick” packs.
For the same reason use current clamps when measuring current values rather than shunt resistors.

Protect the 3-pin configuration input from short-circuit.

Speed controllers and soft-switches can only function properly if they are in full working condition. The protective and monitoring circuits can also only work if the speed controller is in good operating condition.

In the case of motor failure (e.g.short circuits in the windings) the over-temperature sensor in the mcd99 may respond too slowly to prevent damage. If you notice reduced power due to a motor malfunction, switch off the mcd99 down immediately to prevent permanent damage to the propulsion system.

The mcd99 has no current monitoring circuitry.

Note: Please remember that the monitoring circuits are unable to detect every abnormal operating condition. If the motor runs irregularly: Switch off immediately and send mcd99 back to us for repair.

If you are using a mechanical gyro:
Always disconnect the flight pack before turning off the receiver. As the gyro runs down it may product sufficient voltage for the receiver to send an unwanted signal to the controller, and this could cause the motor to burst into life!

2 Ensuring safe, trouble-free operation

Use only compatible connectors. A 2mm pin cannot provide reliable contact in a 2.5mm socket. The same applies with 2mm gold-contact pins and 2mm tin-plated sockets.

Please also remember that ...

... the wiring of your RC-components must be chekked regularly for loose wires, oxidation, or damaged insulation, especially when using a BEC system.

... all connectors must be tight and the thin sensor cables must not be kinked or broken. Do not pull at the cables when disconnecting the sensor plug. Raise the connector latch to allow the plug to be disconnected easily.

... all 3 motor cables must be connected in the correct sequence. Incorrect and incomplete connection of the power and sensor cables will cause damage to the speed controller and/or the motor.

... the CE certificate on the speed controller does not absolve you from the need to handle the system carefully.

... your receiver and the aerial must be at least 3 cm (>1") away from motor, speed controller and high-current cables.

... that all cables carrying high currents are as short as possible. The length of cable between the mcd99 and the motor must not exceed 5 cm (2"), and the cable between the mcd99 and the battery pack must not exceed 20 cm (8") (incl. the length of any cell links inside the pack).

... you must solder additional protective capacitors between the battery cables close to the mcd99 (no further than 2 cm (1")) if the motor current drain is higher than the nominal current value for the mcd99:
2 x 470 uF/50V if cables are up to 20 cm (8") long;
1 x 470 uF/50V if cables are up to 10 cm (4") long.
If you keep to the 5 cm cable length limit and use in-line soldered battery packs, additional capacitors are not usually needed.

... all high-current cables longer than 5 cm (2") must be twisted together. This applies in particular to the motor power cables.

... in model aircraft: half of the receiver aerial's length should be routed along the fuselage, the other half should be allowed to trail freely (take care not to tread on it). Do not attach the end of the aerial to the fin!

... in model boats: half of the receiver aerial's length should be deployed inside the hull above the waterline, the other half should be threaded into a small tube mounted upright.

Every time you intend to use the power system - before you turn on the receiver - make sure that ...

... no one else is using the same frequency (identical channel number).

... your transmitter is switched on and the throttle stick is in the STOP position.

Carry out a range check before each flight. Ask an assistand to hold the model aircraft and set the throttle stick to the half throttle position (full throttle if using a soft-switch). Collapse the transmitter aerial. Walk away from the model to the distance stated by the RC system manufacturer (this might be a distance of about 50-60 m = 200'). Make sure that you still have full control of the system at this range.

When Ni-Cd batteries approach the end of their charge, voltage falls drastically and quickly. The mcd99 detects this and reduces power to the motor automatically. This should leave sufficient energy to bring your model safely back home. However, if you use a small number of cells of high internal resistance and operate at high motor currents, the controller may reduce power before the pack is discharged. You can eliminate this problem by using low resistance straps to connect the cells, or use the direct cell-to-cell soldering technique (“sticks”) and short, heavy-gauge wire if you assemble your own batteries.

Be sure that you have armed the appropriate configuration. If you chose governor-mode, you must also select either aerobatic mode or helicopter mode (see chapter 9).

After resetting the stick positions and controller characteristics („general reset“), the mcd99 defaults to normal speed controller configuration.

If you subsequently switch to governor mode, the mcd99 will switch to helicopter-optimized configuration. If you wish to use the mcd99 in an aerobatic fixed-wing aircraft, you must re-configure the controller to optimize it for your model (see Chapters 7 and 9).

3 Range of applications

Type of motor:

The mcd99 series of controllers is designed to work with three phase brushless motors. All motors must have three internal sensors to detect the actual position of the rotor and pass it to the mcd99. This guarantees stable operation under all conditions of rotation speed and load. Compatible motors are available from: Aveox, Graupner, Köhler, Kontronik, Plettenberg.

Type of model (radio-controlled only):

Range of applications:

Aircraft (e.g. hot-line fixed wing with/without gearbox and folding propeller; aerobatic model with fixed propeller, controller or governor mode) and
Helicopters (brake off, controller or governor mode) and
Cars and Boats (with forward and reverse running). Note that the controllers does not feature waterproof seals, as provided by the b40, b50 und mcc1010 series.

Specification:

Common Data:

Modes: controller or governor
Separation from receiver and load circuitry: by optocoupler
Low weight: by compact design

mcd99-33bo/E:

Number of cells/type: 6 to 24/Ni-Cd
Low voltage limit: approx. 5V
Application range:
low and middle power applications
Special features:
- voltage increasing circuit which generates a auxiliary voltage supply for all 18 low resistance Power MOS FETs.
- low budget price

mcd99-33bo:

Number of cells/type: 14 to 32/Ni-Cd
Low voltage limit: approx. 12V
Application range: low and middle power applications
Special features: low budget price

mcd99-40bo/E:

Number of cells/type: 6 to 24/Ni-Cd
Low voltage limit: approx. 5V
Application range:
for all applications
Special features:
- voltage increasing circuit
- high maximum current capability

mcd99-40bo:

Number of cells/type: 14 to 32/Ni-Cd
Low voltage limit: approx. 12V
Application range:
for all applications
Special features:
high maximum current capability

mcd99-45bo/E:

Number of cells/type: 6 to 24/Ni-Cd
Low voltage limit: approx. 5V
Application range:
for all applications and F5B/E-contests
Special features:
- voltage increasing circuit
- extra high maximum current capability

mcd99-45bo:

Number of cells/type: 14 to 32/Ni-Cd
Low voltage limit: approx. 12V
Application range:
for all applications and F5B-contests
Special features:
- extra high maximum current capability
- used in last world championship!

mcd99-50bo/E:

Number of cells/type: 6 to 14/Ni-Cd
Low voltage limit: approx. 5V
Application range:
for all applications and F5B/E-contests
Special features:
- voltage increasing circuit
- highest maximum current capability

mcd99-51bo/E:

same as mcd99-50bo/E, but:
Number of cells/type: 6 to 21/Ni-Cd

4 Operating states and modes

Operating state: "awaiting command":

This state occurs if you ...

... connect the mcd99 to the battery when the transmitter stick is in the "motor on" range, or

... press the command button when the motor is turning slowly, when the mcd99 is already armed.

Indication: Both LEDs flash alternately at low rate.

Operating state "armed" (ready to use):

In this state the mcd99 can control or regulate the motor according to its default or configured characteristics (See Chapter 6).

The mcd99 is armed if...

... the "auto-arm" (automatic) function is effective and the stick is at the "idle" or "brake" position for longer than 2 seconds after you connect the battery or complete a re-configuration process.

... the "manual-arm" function is effective and the stick is at the "idle" or "brake" position and you hold the button pressed for longer than 2 seconds and less then 4 seconds after pressing the command button.

Indication:

Throttle stick at neutral: both LEDs flash alternately at high rate.

Throttle stick at brake position: green LED flashes at high rate.

Operating state "safe" (disarmed):

This condition prevails when you are configuring the controller. In this state the mcd99 cannot receive or process control signals.

The mcd99 will be disarmed if ...

... the "manual-arm" function is effective and you press the command button for less than 1 sec.

... the "auto-arm" (automatic) function is effective and you press the command button for less then 1 second and the throttle channel is in any "motor on" position (i.e. not at the idle or brake setting).

The mcd99 stays disarmed if the "auto-arm" function is effective, if...

... the drive battery is connected and the stick is in a "motor on" position.

... the stick is at a "motor on" position at the end of the configuration process.

"Configuration" mode:

Here we have to differentiate between the **standard configuration** process and the **property configuration** process.

In the **standard configuration** process you can ...

... reset all the unit's properties to the factory default values (general reset)

und / oder

... set the brake, idle and full throtte positions of the throttle stick.

In the **property configuration** process you can ...

... set the (main) mode of operation (see below) and many associated properties of the controller (Chapter 9).

Alternatively you can use the optional "flysoft" software, which gives you simple access to all points of a configuration, accurate to a single bit.

"Normal speed controller" mode:

When used as a speed controller the mcd99 passes a voltage to the motor corresponding to the stick position, without making adjustments to allow for load changes.

"Speed governor" mode:

When used as a speed governor the mcd99 detects changes in load and regulates the power fed to the motor to compensate for those changes. The result is constant rotational speed, because the motor always receives the appropriate current to suit the load.

In this mode of operation the mcd99 operates as a standard speed controller to run the motor up to nominal speed, then switches over to governor mode.

Indication: in governor mode the unit's red and green LEDs are on constantly and simultaneously.

It is essential to set the correct optimization (see configuration process) to suit the type of model you are using (helicopter or aerobatic fixed wing).

"Car controller" mode:

As "normal speed controller", but with reverse running and proportional braking for both directions or rotation.
You can only run the motor in reverse after applying full brake for a short period. After a (programmable) waiting period the "brake" range of stick then serves as a proportional control for reverse running. During this period (forward) throttle range acts as a brake until the model comes to a halt, after which it switches back to forward running.

5 Protective circuits

Note:

Please remember that the monitoring circuits are unable to detect every abnormal operating condition. If the motor runs irregularly: switch off immediately and send the mcd99 back to us for repair.

Temperature monitor:

Temperature monitor circuit reduces motor current in two steps before cutting it off completely. When the temperature has fallen sufficiently, you can re-start the motor after leaving the throttle stick in the “idle” or “brake” positions for about 2 seconds. This also works when the mcd99 is in “manual-arm” mode.

In the case of a motor failure (e.g. short circuits in the windings) the over-temperature sensor in the mcd99 may respond too slowly to prevent damage. If you notice reduced power due to a motor malfunction, switch off the mcd99 immediately to prevent permanent damage to the propulsion system.

Low voltage monitor:

This feature automatically reduces motor power when the battery voltage falls to the lower limit of the voltage range. The user can vary the limit voltage as part of the configuration process: either the controller's minimum operating voltage or to the minimum voltage of the battery pack in use.
Once the controller has detected a voltage rise, the motor may be re-started after leaving the throttle stick in the “idle” or “brake” positions for about 2 seconds. This also works when the mcd99 is in “manual-arm” mode.

Current monitor:

This speed controller is not current-limited. It is not able to detect a condition where the current drain is higher than the specified current.

Reverse polarity protection:

The mcd 99 is not protected against reverse polarity.

Watchdog:

The watchdog circuit detects any irregularities in operation and signals a problem by interrupting power to the motor briefly.

Lost receiver signal detection:

If the receiver signal fails or is abnormal, the speed controller holds the last received signal for 100ms, then switches the motor off.

6 Variable properties, default settings

The mcd99 is a multi-purpose speed controller. It is possible to alter certain of its properties by a configuration process to optimize it for use as a normal speed controller, a reversing speed controller or a speed governor (regulator).

The mcd99 is configured at the factory in default mode; changing the operation mode is done by changing the unit's configuration. The table shows the features of the mcd99 which can be altered; note that the factory default values are underlined.

If you have configured the mcd99 to suit a certain model and want to change to a different model at a later date (and in the meantime you may have forgotten the exact configuration of the mcd99) than you can easily perform a "general reset" which returns the mcd99 to the factory default settings.

You can configure the mcd99 using -

- the transmitter throttle stick and the external command button supplied with the controller.
- the throttle stick and the external button/voltmeter combination („tast-vm", optional)
- a PC, using the schulze-software "flysoft" and a suitable adapter cable „prog-adapt" (all optional).

The cable attached to the push-button or the cable of the button/voltmeter can be connected directly to the mcd99 (observe polarity = color codes). Alternatively, the PC adapter cable can be connected directly to the mcd99 (and to the receiver).

Parameters are configured in groups, and these are marked by thick outlines in the table.

Note:

Chapter 9 includes more details about changing the configuration of the mcd99.
If you accidentally store an incorrect value in the mcd99, you can abandon the entry by setting it to "full brake" (throttle stick at minimum) then pressing the button several times until the unit returns to the "awaiting command" state. This procedure takes care that all other values following the incorrect, are not changed. You can now try again.
Note: you can achieve the same result by disconnecting the mcd99 from the battery.

	Parameter	**Note**	
	Brake position (BP)	BP und NP can be identical. If BP between NP and FP: brake deactivated!	Standard Config.
	Neutral position (NP)		
	Full throttle posit. (FP)		
	Throttle acceleration (+)	variable: 1.1s, 930, 780, 630, 570, 450, 390, 330, 270, -180, 150, +120, 90, 60 ms	Application Configuration
	Brake delay (-)		
	Activation	man. / autom.	
	Low voltage protection	battery voltage or 5V/12V	
	Direction motor rotation (in flight-/drive-direction)	reverse = CCW forward = CW	
Governor Mode	Governor gain control	10%...20%...50%	
Governor Mode	Maximum pulses per minute when Throttle stick=Full throttle	Resulting rpm see table in chapter 9.3.1 page 13	
Governor Mode	Divisor factor hardware	1:2; 1:8 caution!	
Car Mode	Minimum throttle	0%...50% Power	
Car Mode	Min. brake effect	0%...100% Brake	
Car Mode	Max. brake effect	0%...100% Brake	
Car Mode	Reverse delay	0s...1.5s...4.5s, reverse off	
op. mode	Car controller with reverse function Governor for helicopter/aerobatic use Normal controller		
	Optimizing governor for aerobatic or heli		
	Calibration of voltmeter test equipment		

7 Special setup for helicopter use

IIn a model helicopter you can use the mcd99 as a speed **controller** or a genuine speed **governor**. Please note very carefully the differences between the two modes relaiting to programming the throttle channel at the transmitter.

A. Speed controller mode:

Connect the servo lead to the throttle channel which would normally use the standard 3-point or 5-point throttle curve to control a throttle servo (for a glow motor). With this arrangement the mcd99 setting varies according to the collective pitch setting.

Disadvantage: this system requires accurate adjustment of the throttle curve for constant system rotational speed.

Before you carry out the configuration process as described in Chapter 9, please note the following points:

Although glow-powered helicopters (and over-powered electric helicopters) hover at half throttle, most electric helicopters hover at around 75-85% throttle, depending on model type and equipment.

Only for the last mentioned, the standard transmitter trim facilities are often useless in this situation, as there is insufficient trim range when the neutral position is set to hover throttle. You can avoid this problem by offsetting the hover throttle point in your transmitter as follows:

1. Increase servo travel in the “motor stopped” direction to 150%
2. Reduce servo travel in the “full throttle” direction to 50%.

Once you have done this you will be able to exploit your transmitter's trim facilities to fine-tune your helicopter.

Idle up:
Set the idle up function so that the motor still receives a small throttle signal when the motor is in a steep descent.

B. Speed governor mode:

Connect the servo lead to a channel which is controlled by a rotary or slide potentiometer in the transmitter, and which is **not** influenced by any mixed function. For example, if you have an mc-18 or mc-20 system use channel 8.

You can now start the motor with this channel and set a rotational speed which is maintained **automatically** in flight, even under varying load conditions.

Setting up the channel:

The servo travel settings for the speed control channel in the transmitter should be +/- 100%.

Carry out the standard configuration process for the mcd99 (see Chapter 9.2)

Set the “speed governor” mode in the **property configuration** process (see Chapter 9.3).

Optimize the controller for “helicopter” (see Chapter 9.3).

Set the mcd99 to the maximum permissible rotational speed. For example, with a gearbox reduction ratio of 1:10 and a rotor speed of 1500 rpm this equates to a motor speed of 15,000 rpm for cruising and aerobatics.

The slider controlling channel 8 can now be used to set the motor speed to any point in the range 0 to 15,000 rpm.

A standard feature of the mcd99 is a non-variable fixed-period softstart, and this prevents abrupt changes in rotational speed when you alter the nominal rotation speed.

The minimum rotational speed which you can set in governor mode is about 1/3 of the maximum speed you have already set in configuration process.

When you start the motor the mcd99 initially operates in standard speed controller mode, raising rotational speed to the minimum governed speed. It then switches to governor mode after a delay of about 5 seconds.

Idle-up settings (pre-set rotational speeds):

a. The mcd99 reverts to standard controller mode as soon as the throttle stick is moved below the 15% mark. You can prevent this occuring by mixing in 15% (or more) throttle before take-off using the trim slider or the idle-up function (toggle switch).

b. If your model hovers at a lower rotational speed than stated above (e.g. 11,250 rpm at the motor), you will only need to turn back the speed pre-set pot (channel 8) by a quarter of its travel. Alternatively you can program a seperate toggle switch on the transmitter to provide a travel reduction of 1/4 of total travel for channel 8 (= 50% from centre).

8 Connections, installation

Receiver connection:

Provides that your model is a car, boat or fixed-wing aircraft, simply connect the receiver cable attached to the mcd99 to the throttle channel in the usual way.

If your model is a helicopter, please refer to Chapter 7.

Length of battery cable:

The maximum length of cable to the flight/drive battery is 20 cm (7")! If you use a longer cable and then use the controller, first the protective capacitors will explode, then the electronics will burn out, as they are no longer protected. One test run is enough!

Connector types:

Please note that your guarantee is invalid unless you use **polarized** gold-plated connectors.

Suitable connectors:

- Conzelmann CT4 system (4 mm)
- schulze perfect plug 35 - system (3.5mm) also used on the motor connections.

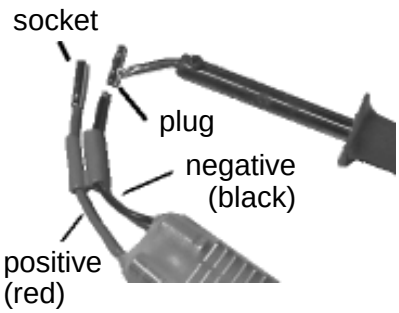
Completing the connections using the CT4 or similar 4mm system:

mcd99 battery cable:

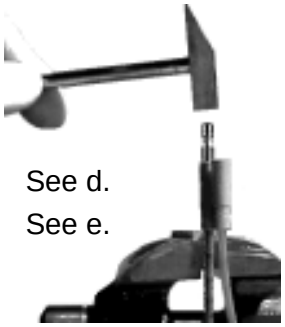
a. Red positive cable: push the wire through the narrow part of the plastic housing from the fluted side, then solder the female socket on the end.

b. Black negative wire: push the wire through the wide part of the plastic housing from the fluted side, then solder the male plug on the end.

c. Place the socket part on the jaws of a vice and close the jaws to the point where the cable can still just move.



d. Using a plug as a guide, use a hammer to tap the socket into the housing.



e. Using a socket as a guide, use a hammer to tap the plug into the housing.

mcd99 motor:

Connect the cables following the colour coding on the sticker.

- Blue or black motor wire to the black / blue mark (marker: on the side of the black battery cable)
- Yellow or green motor cable to the green / yellow mark, centre contact
- Red motor cable to the red mark (marker: on the side of the red battery cable) (note: Koehler motors: green cable).

Although the connectors are very secure we recommend that you wrap fibre-reinforced tape round the motor plugs for peace of mind.

To minimize interference problems the cables attached to the motor should be kept as short as possible.

Connecting the motor sensors to the mcd99:

Locate the polarized plug connected to the motor's rotational speed (rotational position) sensors and connect it to the 5-pin socket on the mcd99 (Koehler motors: see Chapter 1).

Installation in the model's fuselage:

The ideal method of securing the controller in the fuselage is to use Velcro (hook and loop) tape. Avoid any method which allows a build-up of heat in the mcd99. On no account wrap it completely in foam rubber.

Connecting the push-button to the mcd99:

You only need to connect the push-button or the “tast-vm” (see below) when you want to make changes to the speed controllers properties (see Chapter 9), or if the button is to be used as an arming button. In this case it should be mounted in the fuselage.

Connect the standard push-button (supplied) or the combination push-button / voltmeter (“tast-vm”) to the 3-pin connector.

If you are using the “tast-vm” it is important to keep to the colour coding of the 3-pin connector (see sticker on the unit).

9 Altering the properties (configuration process)

Note:

If you are using the mcd99 in an electric model helicopter, please turn on Chapter 7: “Special setup for helicopter use”. If not, then read on:

9.1 Symbols and terminology

Stick:

The throttle stick on the transmitter.
0% = minimum, stick usually pointing towards you; 100%=maximum, stick usually pointing away from you.

Brake position (abbreviation: BP):

Position of the throttle stick where the motor stops.

Symbol: 

Neutral position (abbreviation: NP):

Idle position, or position where the motor just barely runs

Symbol: 

Full-throttle position (abbreviation: FP):

100% voltage passed to the motor (speed controller mode), maximum configured motor rpm (governor mode).

Symbol: 

Throttle position:

The stick position is defined as 1...100% throttle.

Symbol:
(Also used to
select an application) 

Configuration:

Changing parameter settings to suit your application.

LED indicators:

LED full on 

LED full off 

LED flashing (slow rate)  or 

LED flashing (high rate) 

Using the push-button:

Hold button pressed in
(for specified duration) 

Release button 

Push button down and
release immediately 

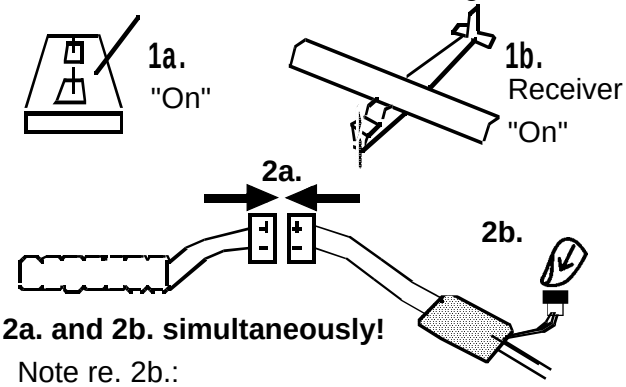
Wait 

You can alter the settings of the mcd99 in two ways: please see chapters 9.2 (standard configuration) and 9.3 (application configuration):

9.2 Standard configuration process and general reset

a. Resets the mcd99 to factory defaults ("general reset"), which is useful if you become confused at some stage in the programming sequence. See the table in Chapter 6.

b. Program the stick positions for brake, idle and maximum rpm. Caution: If you only wish to perform a "general reset" you must disconnect power from the mcd99 when the red light flashes.



2a. and 2b. simultaneously!

Note re. 2b.:

I. > 30seconds: performs "general reset"

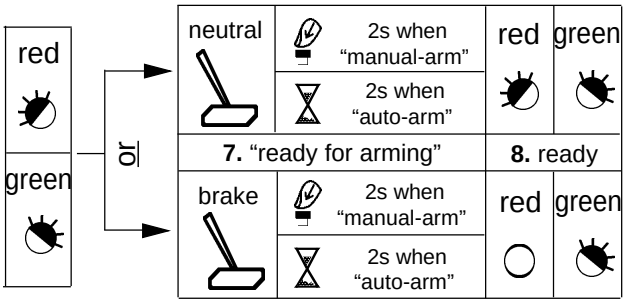
II. >2sec, <20sec: adjusts stick positions only

LEDs		3.
red	green	
○	○	

Remarks:
Re. I.: A "general reset" is confirmed by the red LED flashing
Re. 4. and 5.:
Brake and neutral positions can be identical (identical positions must also be programmed two times)

LEDs			LEDs			LEDs		
red	green	select	red	green	select	red	green	select
●	○	1×	●	○	1×	○	●	1×
4. brake position			**5.** neutral position			**6.** full-throttle posn.		

Configured stick positions valid



mcd99 is armed, LED(s) flicker at a high rate

Note: the mcd99 can be configured to arm itself (ready to use, but motor stopped) ...

I ... automatically (auto-arming) or

II ... when you press the push-button (manual-arming).

(The default setting is "auto-arm" (I), if you want to configure the unit for manual-arming (II), than you have to program this specifically)

Caution: a "general reset" also causes the stick settings (normal/reverse, brake and motor start positions) to revert to the factory defaults.

9.3 Property configuration process

Once you have programmed stick positions in the standard configuration process, you should set the controller to the application you are most likely to use, i.e.: Normal (default), helicopter or car (with reverse). You can then program the specific properties such as start-up response, brake delay etc. (see diagram on next page).

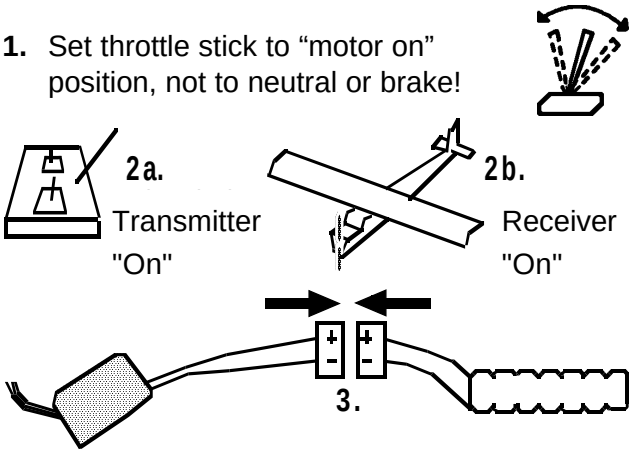
The following instructions show you how to start the sequence for selecting the main application:

Note:

If you choose or change values with the 11 seconds period (see next page), check carefully that the controller is set to the governor or car mode.

A "general reset" resets all data to the values shown underlined in the table in section 9.3, as described in Chapter 6.

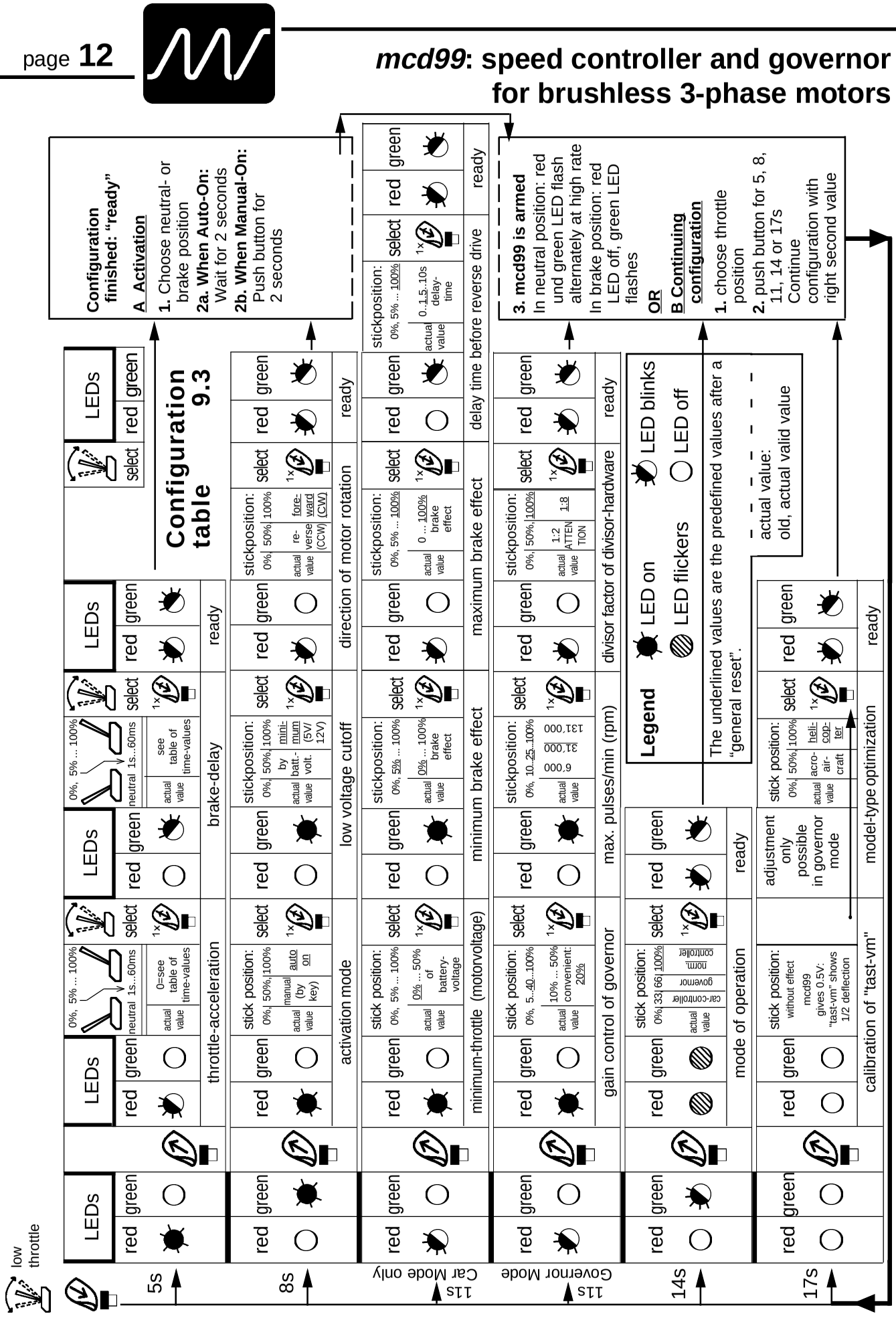
1. Set throttle stick to "motor on" position, not to neutral or brake!



4. Red und green LED flash alternately, low rate

5. Hold button pressed in continuously for 5-17 seconds to change desired characteristic:

mcd99: speed controller and governor for brushless 3-phase motors



9.3.1 Explanatory notes: the properties of the mcd99 speed controller

- When the red and green LEDs are flashing slowly and alternately, the controller's status is “awaiting command”. In this mode you can select any of several parameters and alter them. This is done by holding the button pressed in (the command button or “tast-vm” must be connected).
- If a voltmeter is connected, the idle / brake position always shows the currently set value, and the controller then accepts this value if you simple press the button again (especially if you decide not to alter a parameter value).
- **You can set any of the following 16 time values for “throttle acceleration” and “brake delay”** if you hold the button pressed in for 5 seconds:
10% throttle=1080ms, 930, 780, 630, 570, 510, 450, 390, 330, 270, 210, 180, 150, 120, 90, 60=100% throttle (best set using a voltmeter)
- **Low-voltage monitor motor cut-off characteristic with failing battery voltage** (button is pressed in for 8 seconds):
No. of cells: when battery voltage falls about 50% of initial voltage, the controller reduces voltage to the motor until voltage rises to 50% again. Controller cuts motor off only if the 50% value cannot be maintained.
- **Motor cut-off at minimum permissible operation voltage:** occurs at about 5V with .../E types, at about 12V with all other types.
“Auto-arm” function resets low voltage / temperature monitor when required. To do this: move throttle stick to the idle position, wait at least 2 seconds, “auto-arm” function resets (also when “manual-arm” function is active!). Moderate throttle advance is recommended to avoid tripping the low voltage (or temperature) cut-off again.
- **Minimum throttle (**1st configuration value, button pressed in for 11 seconds, “car controller” mode only):
For some applications it is desirable for a particular throttle setting to be regarded as the minimum. When you advance the throttle, the motor then starts immediately at a throttle value above minimum. This means that the stick's travel between the idle and full throttle position works at even higher resolution.
- **Minimum braking effect** (2nd configuration value, button pressed in for 11 seconds, “car controller” mode only):
For some applications it is useful to set up a non-linear braking effect. For example, if you wish to implement gentle automatic braking before entering a turn, you should raise the minimum braking effect (e.g. to 10%) and then move the throttle trim on your transmitter to the “brake” area when driving. The car will then brake automatically at your selected rate of 10% when you move the throttle stick to neutral.
- **Maximum braking effect** (3rd configuration value, button pressed in for 11 seconds, “car controller” mode only):
On tracks where grip (adhesion) is relatively low, you can avoid the danger of spinning, even under full brake, by limiting the available braking effect.
- **Reverse delay time effect** (4th configuration value, button pressed in for 11 seconds, “car controller” mode only):
In this case the reverse is only selected if you move the throttle stick to the full brake position within the brake range at least once briefly (i.e. the first programmed point in the standard configuration). A time lock prevents instant reversing; for example, this ensures that the car continues moving foreward when you brake before a turn. When the time lock period has elapsed, the programmed brake range works as a proportional reversing range. If you then advance the throttle in the forward direction, the brake is first applied with the car in reverse until the vehicle stops, and only then does it move forward. The controller therefore interprets the throttle stick position as a proportional brake control for the period before the car changes direction.
- **Control amplification** (1st configuration value, button pressed in for 11 seconds, “speed governor” mode only):
To set this value, “flysoft” is recommended. If the set values is too low, the controller will not work correctly / the speed variation will be excessive / the rate of control will be too low. If the set values are too high, uncontrollable oscillations may occur. Favourable value: 20 ... 25%.
- **Maximum number of pulses per minute** (2nd configuration value, button pressed in for 11 seconds, “speed governor” mode only):
The controller calculates motor speed by dividing the signal value by 2 (for a 4-pole motor) or by 5 (for a 10-pole motor) using the internal hardware divisor factor of 1:8. Any of 10 number of max. pulse values can be set using the throttle stick.
- **Divisor factor: hardware divisor** (3rd configuration value, button pressed in for 11 sec., “sp.-governor” mode only):
For most applications this parameter must be left at 1:8 to ensure that the mcd99 works properly. **Note: the variants stated below are equally applicable when the unit is used as a speed controller!**
The mcd99 contains an IC which counts the signals emanating from the motor, and only passes the second or eighth signal through the micro-processor. With a high-revving motor this ensures that the micro-processor has sufficient time between signals to analyse the signals, where necessary to interrogate the receiver signal and analyse it, and also to carry out other tasks such as monitoring the protective circuits. For your own experiments it is permissible to set the divisor ratio to 1:2, but only where the motor is very slow-revving.

Motorspeed rpm (hardware divisor 1:8!)

10-pole	8-pole	6-pole	4-pole	Signals	Throttle
3´000	3´800	5´000	7´500	15´000	10%
5´000	**6´300**	**8´400**	**12´600**	**25´200**	**20%**
7´600	9´600	12´700	19´800	38´200	30%
10´100	**12´600**	**16´800**	**25´200**	**50´400**	**40%**
12´800	16´500	21´400	32´100	64´200	50%
15´700	**19´600**	**26´200**	**39´200**	**78´500**	**60%**
17´700	22´000	29´400	44´100	88´300	70%
20´200	**25´200**	**33´600**	**50´400**	**100´900**	**80%**
23´500	29´400	39´200	58´900	117´700	90%
26´600	**33´300**	**44´400**	**66´500**	**133´200**	**100%**

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internet:http://www.schulze-elektronik.com e-mail: mail@schulze-elektronik.com

10 Typical configurations

Conditions:

All stick positions must be loaded into the mcd99 beforehand, i.e. the standard configuration process must be complete.

1. Assignment:

Adjust "throttle-accelleration" to 0.6 seconds soft-start time:

a. Switch on transmitter and receiver

b. Set stick to any position other than neutral or brake in order to ensure that the controller does not arm

c. Connect the push-button or the “tast-vm” to the mcd99

d. Connect the mcd99 to the flight battery (sparking is normal)
- Red and green LEDs flash alternately at low rate
- mcd99 is in “awaiting command” mode
- mcd99 remains disabled.

e. Hold push-button pressed in for 5 seconds:
- After 5 seconds the red LED is on, the green LED is off

f. Release push-button
- Red LED flashes, green LED off
- mcd99 is in “throttle-accelleration” adjust mode

g. Move stick to 25% throttle. This stick position equates to 630 ms, as shown in the table in chapter 9.3.1.

h. Press push-button
- Red LED off, green LED flashes
- mcd99 is now in “brake-delay” adjust mode

i. Move stick to 0% throttle. This means: leave old brake delay time unchanged

j. Press push-button
- Red and green LEDs flash alternately at low rate
- mcd99 is again in “awaiting command” mode

Configuration process complete

Test:

k. Move throttle stick to neutral position, wait for 2 seconds
- mcd99 is now armed (active), red and green LEDs flash alternately at high rate. If the throttle stick is in the brake position, the red LED is off, the green LED flashes

l. Hold model securely, check for clearance all round propeller, move stick quickly to full throttle position
- Motor starts up slowly, runs to full power within 0,63 seconds

m. Move stick to brake-position
- Motor stops

Test complete

2. Assignment:

Set “throttle accelleration” to ~60 milliseconds soft-start time:

All points under **1.** are identical exept point **g.**

At point **g.** move stick to 100% throttle = 63ms soft-start time

3. Assignment:

Set speed controller mode to “car controller”:

a. Switch on transmitter and receiver

b. Set stick to any other position other to neutral or brake

c. Connect the push-button or the „tast-vm“ to the mcd99

d. Connect the mcd99 to the flight battery (sparkling is normal)
- Red and green LEDs flash alternately at low rate
- mcd99 is in “awaiting command” mode
- mcd99 remains disabled

e. Hold push-button pressed in for 14 seconds:
- after 5s: red LED on, green LED off.
- after 8s: red LED off, green LED on.
- after 11s: red LED flashes, green LED off.
- after 14s: red LED off, green LED flashes

f. Release push-button
- Red LED flickers
- Green LED also flickers

- mcd99 is now in "mode of operation" adjust mode

g. Move stick to 33% throttle. This equates to "car-controller".
   - If you have a voltmeter connected, it will read 3,5=350mV
h. Press push-button
   - Red and green LED flash alternately at low rate
   - **mcd99 is again in "awaiting command" mode**

Configuration process is complete

Test:

i. Move stick to neutral position, wait for 2 seconds
   - red LED off, green LED on
   - mcd99 is now armed
j. Hold model securely, check for clearance all round propeller, move stick slowly to full throttle position;
   - motor must run in "forwards" direction
k. Move stick briefly to the "full brake" position, then back to "half-brake" position
   - Motor stops, restarts with half throttle in reverse direction after 1.5 seconds (adjusted delay time)
l. Move stick to neutral position
   - Motor stops

Test complete

4. Assignment:

Set speed controller mode to "governor", then optimize model type to "aerobatic aircraft".
Maximum rpm = 10,000 using Plettenberg 10-pole motor:

4.1 Set mode of operation:

a. Switch on transmitter and receiver
b. Set stick to any other position other to neutral or brake
c. Connect the push-button or the „tast-vm" to the mcd99
d. Connect the mcd99 to the flight battery (sparkling is normal)
   - Red and green LEDs flash alternately at low rate
   - **mcd99 is in "awaiting command" mode**
   - mcd99 remains disabled
e. Hold push-button pressed in for 14 seconds
   - After 14seconds the red LED off, the green LED flickers
f. Release push-button
   - Red and green LEDs flicker
   - **mcd99 is now in "mode of operation" adjust mode**
g. Move stick to 66% throttle. This equates to "governor" mode
h. Press push-button
   - Red and green LEDs flash alternately at low rate
   - **mcd99 is again in "awaiting command" mode**

4.2 Optimize governor mode to "aerobatic aircraft"

i. Hold push-button pressed in for 17 seconds
   - After 17s red and green LEDs go off
j. Release push-button
   - Red and green LEDs remain off
   - **mcd99 is now in "optimize model type" adjust mode**
k. Move stick to 50% throttle. This equates to "aerobatic aircraft"
l. Press push-button
   - Red and green LEDs flash alternately at low rate
   - **mcd99 is again in "awaiting command" mode**

4.3 Adjust "gain control" and "max. pulses per minute" (maximum rpm)

m. Hold push-button pressed in for 11 seconds
   - After 11sec. red LED flashes, green LED off
n. Release push-button
   - Red LED ist on, green LED is off
   - **mcd99 is now in "governor gain" adjust mode**
o. Advance stick slightly to 40% throttle, equivalent to 20% gain
p. Press push-button
   - Red LED is off, green LED is on
   - **mcd99 is now in "max. pulses per minute" adjust mode (maximum permissible rpm)**
q. Move stick to 40% throttle, equating to ~10100 rpm (see table in section 9.3.1)
r. Press push-button
   - Red LED flickers, green LED off

- **mcd99 is now in "divisor factor of divisor hardware" adjust mode**

s. Move stick on 100% throttle (full-throttle), equating to a divisor factor of 1:8. You should not vary this value except in very rare cases.

t. Press push-button
   - Red and green LEDs flash alternately at low rate
   - **mcd99 is again in "awaiting command" mode**

Configuration process is complete

Test:

u. Move stick to neutral-position, wait for 2 seconds
   - the mcd99 is now armed, the red and greeen LEDs flash alternately at high rate. If the stick is in the brake position, the red LED is off, the green LED flashes.

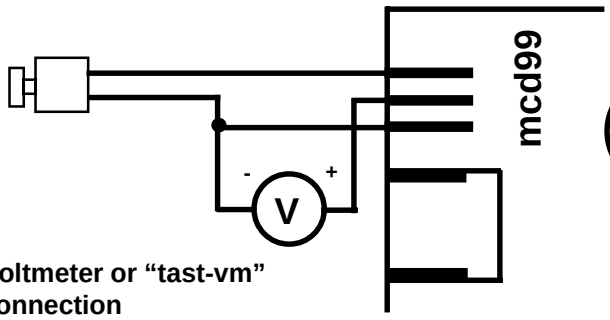
v. Hold model securely, check for clearance all round propeller, move stick to half-throttle position.
   - Motor runs up to about 5,000rpm

w. Set throttle stick to brake position
   - Motor stops

x. Connect battery with a different number of cells. Hold Model securely, check for clearance all round propeller.
   Move stick to same position as before (half-throttle)
   - Motor speeds up (slowly) to the same rpm as before (~ 5,000rpm), despite the different number of cells.
     Obviously this can only happen if the second battery has a high enough number of cells and sufficient capacity to obtain the rotational speed.

y. Move stick to brake position
   - Motor stops

Test complete



Voltmeter or "tast-vm" connection

Programming push-button + Voltmeter (1-2V full scale range)

11 Connection accessories

Push-button (included)
Push-button for adjusting the mcd99.
Also used as a manual arming button.

tast-vm (see left side: connecting a voltmeter)
During the configuration process the voltage reading will vary in proportion to the position of the transmitter throttle stick.
You can also set the output to produce an accurate 0.5V voltage in order to calibrate the voltmeter (17 seconds time, section 9.3)

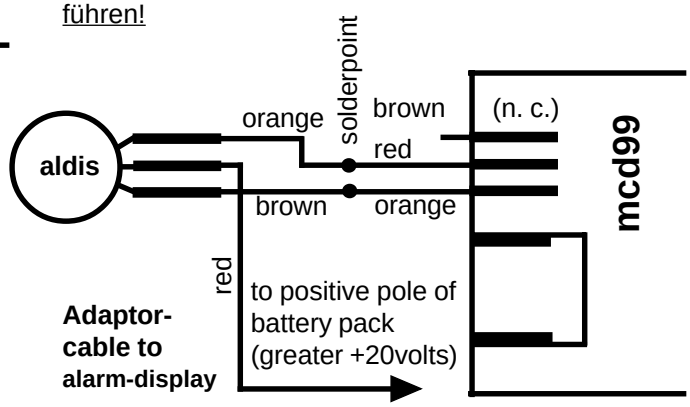
flysoft, carsoft
PC-software to read out data bit-exactly, to manipulate and multi-adjust mcd99.
Comfortable and particularly possibility to adjust mcd99. Especially recommended to optimize parameters in governor modes.
Use only in addition with **prog-adapt** cable.

prog-adapt
The active, buffered adaptor-cable with two cables between PC and mcd99 and one to the receiver
Connect it to the parallel port (LPTx) of the PC.

ct 4
Pair of 4mm high-current gold-plated-contact connectors for soldering to the battery cables of the mcd99. Plastic housings provide reverse polarity protection. The set contains a male plug and a female socket.

pp 35: schulze perfect plug system
Pair of 3,5 mm high-current gold-plated-contact connectors for soldering to the battery cables of the mcd99. Plastic housings provide reverse polarity protection. These connectors are also used for the 3 motor connectors used by the mcd99.

aldis, modified
Mit Hilfe von aldis und eines Adapterkabels kann "Vollgas" im Regelbetrieb (Akkuspannung zu niedrig) dargestellt werden. VORSICHT: Falschanschluß kann zur Zerstörung des mcd99 und/oder des aldis führen!



Adaptor-cable to alarm-display

12 Legal matters

12.1 Warranty conditions

All **schulze** products are 100% dynamically tested by using a battery and a motor. We do not simulate tests.

If your unit develops a problem, please return it to **schulze** or to the importer. Include a description of the problem. Please be careful and precise, and list the battery voltage and capacity, motor type, conditions under which failure occured etc. A note saying “doesn't work” does not help us much, and it may lead to waisted time in trouble-shooting. Before returning the unit for repair, please test it “one more time” carefully. If we find that the controller is operating correctly, whether it is under warranty or not, we will make a charge for our lost time.

One final note:

Please don't try trouble-shoot a defective unit yourself. Very few hobby shops are equipped to analyze and repair surface-mount printed circuit boards. We reserve the right to refuse repair to units which have been modified or “improved” by unauthorized “experts”.

As we mentioned earlier, if you have a problem with one of our products, please send it back to us or our authorized representative (see catalogue). This ensures that the proper replacement parts will be used, and that you will gain maximum pleasure from using these products. You also have the comfort of a properly repaired unit with a renewed warranty. The guarantee period of repaired devices is applicable only to the repair. This period is shorter than the guarantee period of a new product (See our general conditions of business).

12.2 Liability / damages

We have invested a lot of effort in helping you to exploit this unit to maximum. However, since neither the manufacturer (**schulze**) nor the importer have control over how these products are used, we cannot accept liability for any direct or consequential damage, loss and/or injuries to the user, to third-parties or the environment from the use of this product. Taking into account our legal obligations, and regardeless of the legal basis for any action, our liability to compensate for damages shall be limited to the invoice amount of the portion of the merchandise directly involved in the event which incurred the damages. This does not apply in respect of our unlimited liability due to wrongful intend or gross negligence, as prescribed by law.

12.3 CE certification

The products described in this manual are manufactured in accordance with all specific and mandatory European CE guidelines:

EMI 89/336/EEC, 91/263/EEC and 92/31/EEC.

The products have been tested according to the following norms:

EMI-emissions: EN 50 081-1:1992
EMI-resistance: EN 50 082-1:1992 or
EN 50 082-2:1995

The design and construction of our products comply with the requirements for safe operation.

EMI emissions were tested under realistic conditions, i.e. using suitable motors close to the maximum allowed currents. The use of resistors instead of motors do not create maximum emission levels.

Further testing is carried out to ensure adequate EMI resistance against emissions from other apparatus. The RF signals used for these tests are similar to those produced by mobile telephones and RC transmitters.

We wish to point out again that our products are tested under realistic conditions for the most dangerous scenario: exposed to the field of a powerful transmitter, the motor must not start while you are working on the model.

Problems involving our products are most likely caused by unsuitable combinations of radio components or improper installations.

13 Technical data and characteristics

Type [Unit]	Current [A]	Ni-Cd [Cells]	Dimensions [mm]	Weight [g]	Cables [mm²]	Throttle [mΩ]	Brake [mΩ]
mcd99-33bo/E	33/66	6-24	58x38x20	58-67	2.5	2x5.3	3x5.3
mcd99-33bo	33/66	14-32	58x38x20	58-67	2.5	2x5.3	3x5.3
mcd99-40bo/E	40/80	6-24	58x38x20	58-67	2.5	2x3.3	3x3.3
mcd99-40bo	40/80	14-32	58x38x20	58-67	2.5	2x3.3	3x3.3
mcd99-45bo/E	45/90	6-24	58x38x20	58-67	2.5	2x2.7	3x2.7
mcd99-45bo	45/90	14-32	58x38x20	58-67	2.5	2x2.7	3x2.7
mcd99-50bo/E	50/100	6-14	58x38x20	58-72	4.0	2x2.0	3x2.0
mcd99-51bo/E	50/100	6-21	58x38x20	58-72	4.0	2x2.0	3x2.0

Further Information:

Applicable to all types: The max. temperature threshold is about 110 °C, max. pulse frequency 12 kHz.

Stated maximum currents: nominal current / maximum current:

It is save to operate the **mcd99** at the nominal current at full throttle for the period of one complete battery charge (2Ah). The maximum current stated for the **mcd99** should not flow for longer than 10 seconds.

Weight: with / without cables.

Throttle, brake: internal resistance of the FETs, calculated from the manufacturer's data sheet information. The **mcd99** contains 6 switching stages, each consisting of 3 FETs, of which one stage is wired to earth and one stage to positive during normal running of the motor. During braking 3 switching stages are simultaneously wired to earth. For this reason the values stated above for the throttle and the brake stages are prefixed with a 2 and 3 respectively.

The speed controller can scope with a very wide range of applications thanks to:

- three programmable stick positions (brake, idle, full-throttle)
- the configurable nature of many of its properties (soft-start for throttle/brake between 1 second and 60milliseconds, motor matching ...) using the push-button, or with the “flysoft” PC software
- standard speed controller or governor mode, selectable
- extremely fine speed control with 200-step resolution
- automatic or manual arming method
- suitable for hot-line models, aerobatic models (in each case with / without gearbox, with fixed or folding propeller), helicopters, car or boat with forwards and reverse running

Optional reliability and security thanks to:

- power-on pulse suppression; prevents motor starting when battery is connected
- stored configuration data; data is retained even after drive / flight battery is disconnected
- watchdog- and voltage-supervisor ICs
- temperature stability, long term stability
- deep-discharge protection governed by load and number of cells; can be switched to minimum voltage monitoring (5V / 12V depending on type of device). Can be reset when battery voltage recovers. No aprupt motor cut-off at low voltage
- over-temperature guard (can be reset)
- controller features no vulnerable potentiometers
- internal power cable solder joints, lightweight, high-flex, thin-wall silicone cables

High performance due to:

- 18 FETs can tolerate high overload conditions for brief periods, hence extremely high start-up current
- latest top-quality components and super-powerful brake circuit (9 FETs)
- automatic proportional brake (if travel between full-brake and idle stick position is sufficient
- reverse polarity circuit
- genuine speed governor mode