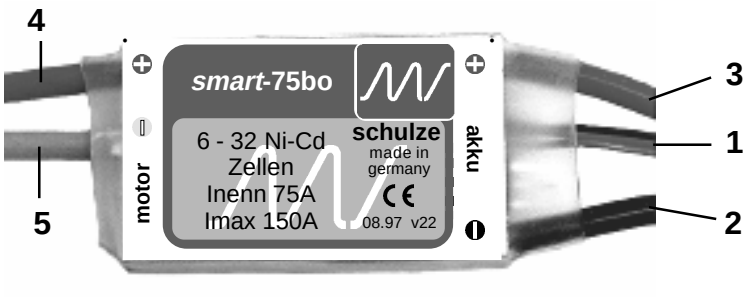


LED:
on back side of pcb

Key to illustrations:

1. Receiver cable (3-pin)
2. Battery connection, negative (-) terminal, black
3. Battery connection, positive (+) terminal, red
4. Motor connection, positive (+) terminal, red
5. Motor connection, negative (-), yellow

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 speed controllers in conjunction with a power supply connected to the mains. Energy reversal can occur when the motor slows down and stops, and this may damage the power supply or cause an over-voltage condition which could damage the controller.

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

On no account connect a separate receiver battery or an electronic battery switch (two receiver batteries), as this may cause damage to the speed controller and could cause current to flow from the receiver battery to the motor. If you want to use a separate receiver battery cut through the + wire in the receiver cable, or pull it out of the connector if possible. However, for greater protection against motor-inducted interference it is always better to use a speed controller with an opto-coupler.

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

Keep the cables to the battery and to the motor as short as possible.

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.)

Note the limited capacity of the BEC system when used with a high number of cells in the flight pack (see Specification, Section 4).

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 controllers may react too slowly to prevent damage. Switch the motor off immediately to prevent permanent damage to the speed controller.

If a transistor fails in the throttle stage, neither a "stop" signal from the transmitter nor the temperature monitor nor the current limiter will be able to throttle back or stop the motor.

Note: Please remember that the monitoring circuits are unable to detect every abnormal operating condition, such as a short between the motor cables. Note also that a stalled motor will only trip the current limiter if the motor's stall current is well above the controller's peak current. For example, if you are using an 80 A controller in conjunction with a 20 A motor, the current monitor will not detect an excessive current even when the motor is stalled.

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 checked regularly for loose wires, oxidation, or damaged insulation, especially when using a BEC system.

... your motor is suppressed by at least two, better: three, ceramic capacitors of 10 to 100nF / 63 to 100V. Extra suppression can also be achieved using filters with coils.

... 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. For example, the magnetic fields around the high-current cables can cause interference to the receiver.

... all high-current cables must be as short as possible. Maximum length between flight pack and speed controller should not exceed 20 cm (7"), between speed controller and motor: 5 cm (2").

... all high-current cables longer than 5 cm (2") must be twisted together. This applies in particular to the motor power cables, which are very powerful sources of radiated interference.

... 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 <u>not</u> 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 (as a rule) in the STOP position (exceptions see Section 9).

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.
As a general rule: receiver interference is more likely to occur when using a controller or governor with BEC system, as these units do not feature an opto-coupler with its optical link.

When Ni-Cd batteries approach the end of their charge, voltage falls drastically and quickly. The ***smart*** 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.

Your receiver also benefits from the stability of the voltage supplied from the battery. If the BEC voltage is stable, the receiver is less liable to suffer interference.

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!

3 Intended applications

Special features of individual controllers:

smart-47bo: a speed controller / current regulator with opto-coupler, designed for use in small to medium-sized models with 6 to 16 Ni-Cd cells.

smart-52bo: a speed controller / current regulator with opto-coupler, designed for use in medium-sized models with 10 to 24 Ni-Cd cells.

smart-75bo: a speed controller with opto-coupler offering high maximum load, a wide range of cells and impressively low interference, and therefore suitable for any application.

smart-70be: this controller is designed for use with 6 to 12 Ni-Cd cells in models where it is necessary to save the weight of a seperate receiver battery. The high-capacity BEC circuit can cope with very high peak currents, i.e. the ***smart*** can be used with 4-6 servos.

Highlights common to all units:

Ultra-small, ultra-light units due to absence of cooling fins.

Better than 200-step resolution over the whole control range for extremely fine speed control.

Variable low voltage threshold, dependent on number of cells and load. Avoids harmful deep-discharge of cells which can result in polarity reversal.

Controllers work reliably and without causing interference right down to the last usable scrap of battery energy; our ultra-high capacity BEC system (max. 3A) with enhanced BEC voltage (5.2V) gives faster servo transit speeds (***smart-70be*** only).

Integral voltage converter produces an auxiliary voltage for the Power MOSFETs, resulting in ultra-low losses (***smart***-75bo and -70be).

High 2kHz pulse frequency, keeping the motor and controller cool and shielding the receiver system from interference.

LED monitor.

"Auto-arm" function and "power-on reset".

“ips” (intelligent programming system) with no pots! The speed controller automatically configures itself to the stick travel when you switch your transmitter on. The brake can also be disabled in the same way if required. During the configuration process the motor acts as a loudspeaker to give you audible confirmation of the procedure.

4 Technical data

Type [unit]	Strom [A]	Ni-Cd [cells]	Size [mm]	Weight [g]	Cable [mm^2]	Thrott. [mΩ]	Brake [mΩ]	Coupling
***smart*-47bo**	47/95	6-16	41 x 31 x 11	21-55	2.5	3.3	10	opto-coupler
***smart*-52bo**	52/105	10-24	41 x 31 x 11	21-55	2.5	2.7	8	opto-coupler
***smart*-70be**	70/140	6-12	52 x 31 x 11	33-65	4.0	2.5	3.3	BEC 5.2V/2.5A peak
***smart*-75bo**	75/150	6-32	52 x 31 x 11	33-65	4.0	2	5.3	opto-coupler

Current rating: **Maximum current / nominal current:**
All ***smart*** feature a current monitor circuit which permits a high start-up current. The maximum current limit will decrease gradually within 1.2 seconds to the nominal current value. The nominal current value is the continous current at which the ***smart*** can be operated at full-throttle when connected to a 10V / 2Ah battery.

Weight: excluding - including cables.

Throttle, brake: Internal resistance of FETs as stated in the maker's data sheets.

Other features: Overheating threshold approximately 110°C. Pulse frequency 2 kHz.

BEC: **5,2V; peak current 3A with 6 Ni-Cd cells, 2.5A/8 cells, 2A/10 cells, 1.5A/12 cells;** peak current can only flow for less than 1 second, followed by a cooling-off period. The maximum permissible continous current is much lower and is limited by the maximum power disspiation of the voltage regulator used. (No limiting circuits!) The maximum power dissipation is about 2.5W, i.e. with a BEC voltage of 5.2V and a battery voltage of 9.6V (difference 4.4V) the maximum continous current is about 0.57A.

5 Protective circuits

Note: the monitor circuits are effective, but they cannot detect every possible operating condition.

Temperature monitor:

The temperature monitor throttles back the motor in two stages before switching it off entirely. You can reset the unit using the "auto-arm" function (throttle stick to stop for about 2 sec.)

If the motor windings are short-circuited the temperature monitor reacts too slowly to prevent damage. Switch the motor off immediately to avoid permanent damage to the speed controller.

Voltage monitor:

As soon as the voltage of the drive battery falls back to about half the no-load voltage or the 5V threshold the motor is throttled back. If voltage continues to fall the controller switches off the motor entirely. Of course, you can re-start the motor again briefly by moving the throttle stick back to "stop" for about 2 sec. to re-arm the system. The speed controller - and your model aircraft - remain fully controllable until the last drop of usable energy is exhausted.
We can not predict how long you can still control your model with the residual battery charge as this depends on many parameters such as the number of cells in the pack, the cell type, actual motor current and the way you control your model. The only solution is for you to time the period yourself with the model on the ground. If the voltage monitor trips, i.e. the motor starts to throttle back without your intervention, you should stop the motor at once with the throttle stick in any case so that you have the maximum possible reserve of power.

Current monitor:

Our ***smart*** controllers feature a current monitor circuit which permits a high start-up current and then gradually - within 1.2 seconds - reduces the threshold value to the maximum permissible continuous current. If the motor is stalled, the controller limits the current drain. This means that a motor which draws an excessive current will never reach full throttle, and the current stays below the specified maximum value. The LED then glows at about half maximum brightness.

Receiver signal monitor:

If the receiver signal fails, or the signal is longer or shorter than the usual range of values, the ***smart*** controller reverts to hold mode for about 0.5 seconds before switching to disarmed mode.

Reverse polarity protection:

These speed controllers are not protected against reversed polarity!

Watchdog:

If this circuit is tripped the speed controller stops working briefly and then reverts to normal operation.

6 Monitor displays

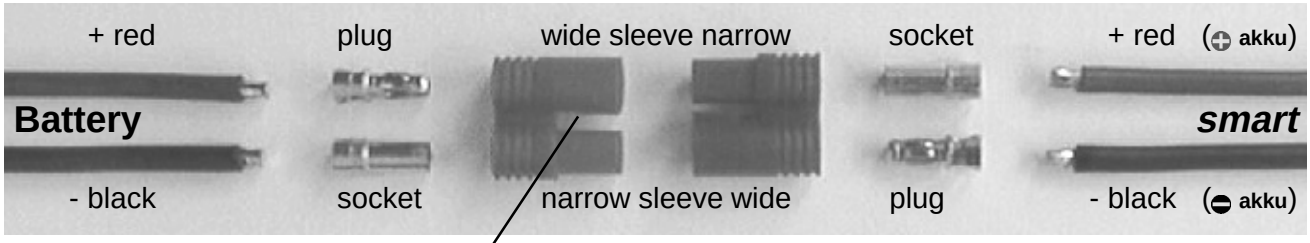
Our ***smart*** controllers feature two LEDs (= one Duo-LED) to help to understand the status of the unit at any time. The meaning of the coloured lights is as follows:

100% brake:	red,	full brightness, flashing
No-load:	g & r,	alternating flashing fast
10% forward:	green,	10% brightness
90% forward:	green,	90% brightness
100% forward:	g & r,	full brightness

Function:	**Note:**
No-load:	
red / green,	alternating , flashing fast. ***smart*** is "armed", throttle and brake off.
Waiting for arming:	
red / green,	alternating, flashing slowly. ***smart*** is "disarmed"
	(always if full throttle is configured first) Throttle stick to brake position activates ***smart***.
Excess temperature:	
red	flashing together. Wait until temperature falls. "Auto-arm" activates ***smart***.

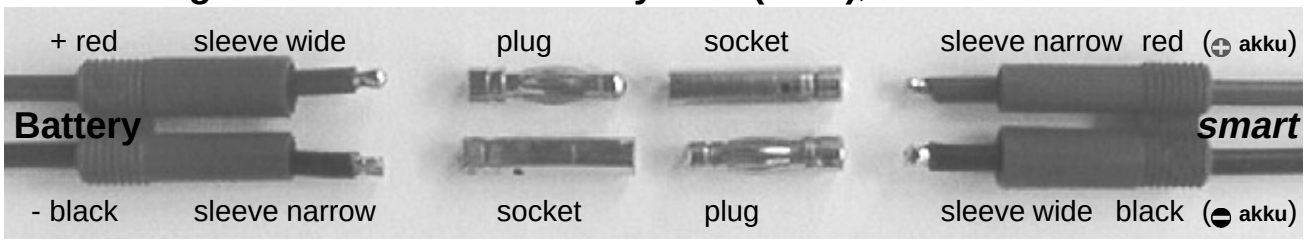
7 Connector systems and mounting instructions

7.1 3.5 mm gold-contact connector system (pp35); max. load > 80A



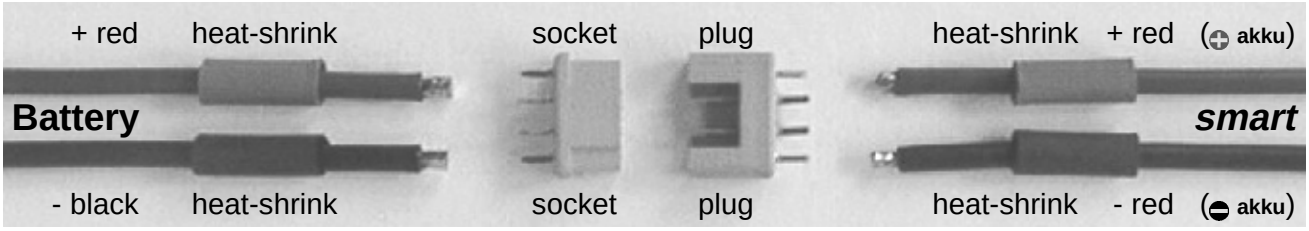
Caution: remove locating lug from battery cable. Do not remove lug from any cables attached to controllers or charge leads!
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Place plastic sleeve vertically on table, grip end up.. **b.** Push contact down into sleeve.
c. Place 2,5mm wide screwdriver blade on top of cable solder joint inside sleeve.
d. Tap screwdriver to press contact into sleeve until latch engages.

7.2 4 mm gold-contact connector system (CT 4); max. load > 80A



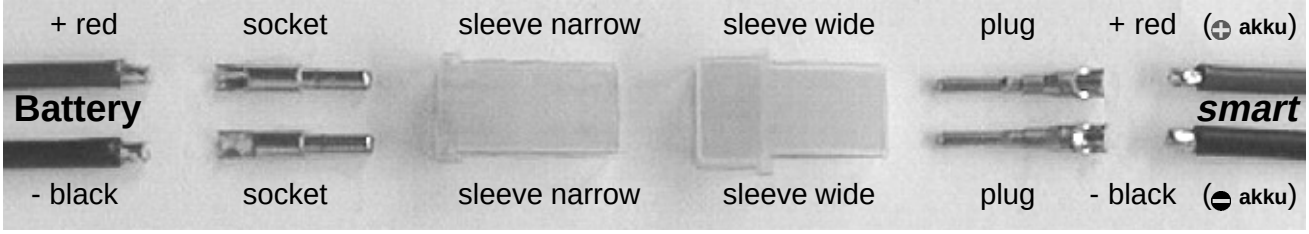
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Rest plastic sleeve on vice jaws with cables hanging down. **b.** Close vice jaws until cables are just free to move.
c. Fit plug into socket and tap into sleeve until latch engages.
d. Fit socket onto plug and tap into sleeve until latch engages.

7.3 MPX gold-contact connector system (green or red); max. load approx. 30A



Fit the connectors in the order shown above; the contacts are soldered as follows:
a. To center the contacts fit plug and socket together before soldering. **b.** Tin all 6 exposed contacts of plug or socket.
c. Fit cable end into triangle of contacts, solder to all three contacts.
d. Position heat-shrink sleeve and shrink over joint.

7.4 2.0 / 2.5 mm gold-contact connector system; max. load approx. 30A



Fit the connectors in the order shown above; the contacts are pressed in as described for the pp35 system.

8 Installation, connections

Installing in the fuselage:
Velcro (hoop and loop) tape is the ideal method of mounting the controller in the fuselage. Do not pack the ***smart*** in foam as this may lead to a heat buildt-up in the controller.

Length of connecting cables:
The cables to the flight battery and - in particular to the motor - should be kept as short as possible. Long cables tend to act as aerials and radiate interference; they also add unnecessary weight. See also Section 2.

Power-connection battery <--> *smart*:
It is essential to use **polarized** gold-plated-contact connectors - fitting any other type of connector invalidates the warranty.
Connectors which are not fitted as standard with a polarized insulating sleeve can be effectively polarized by soldering the positive battery lead attached to the ***smart*** to a socket, and the negative battery lead attached to the ***smart*** to a plug.

Power-connection *smart* <--> motor:
Solder the blue (or yellow) and the red cable (length max. 5cm = 2") directly to the motor terminals, or shorten the existing motor cables. The overall length of the connection after soldering should not exceed 5cm (2").
If you prefer to have a plug-in connection between ***smart*** and motor, solder 2 sockets on the cable attached to the ***smart***, and 2 plugs on the cable attached to the motor. Fit the connectors as described in Section 7.1.

Receiver connection:

Connect the receiver cable attached to the ***smart*** to the receiver servo output corresponding to the throttle stick (or a switch) on the transmitter.

The ***smart-70be*** supplies the receiver with its operating voltage via this output socket. For this reason, check regularly that the receiver cable is undamaged and firmly seated at the ***smart***. On no account connect a separate receiver battery or an electronic battery switch (two receiver batteries), as this may cause damage to the ***smart-70be*** and could cause current to flow from the receiver battery to the motor. If you want to use a separate receiver battery cut through the + wire in the receiver cable, or pull it out of the connector if possible. However, for greater protection against motor-inducted interference it is always better to use a speed controller with an opto-coupler.

9 Using for the first time

9.1 Symbols and terminology

Stick:

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

Brake position or neutral position:

Idle position, or position where the motor just barely runs

Brake position or idle position:

Position of the throttle stick where the motor stops or just barely runs.

Full-throttle position:

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

Audible indicators:

These indicators are only audible when a motor is attached, as the motor itself acts as the loudspeaker.

Single beep

Double beep

Momentary interruption in running (inverse beep)

Wait (0.5 seconds):

9.2 ips, the intelligent programming system for configuring the *smart* to suit your application

The ips reflects the initial set-up procedure used with our speed controllers until recently, i.e. the process of adjusting the braking point with the help of a trim pot. For any normal application with an EMF brake (for a folding propeller) the start-up procedure is entirely conventional: throttle stick to "motor stopped", switch first transmitter-, then receiver on, hold model in lauch position, apply full throttle, launch.

The controller has to be adjusted to match the stick travel of your transmitter - a procedure we term "configuration" - and with these units the process is fully automatic. If you wish to use the controller in a model which does not require a propeller brake, or in a model helicopter in which the full-throttle setting of the motor does not coincide with the maximum collective pitch setting, the procedure is slightly different (see below). The brake point and the full throttle point must be configured in such a way that full stick travel is always available to operate the motor, as this provides the finest possible level of control.

If you have a transmitter with adjustable servo travel we recommend that you set throttle-servo to normal full travel, i.e. +/- 100%.

A single beep always indicates that the controller is armed! When you next move the throttle stick, the motor will start running. If the ***smart*** beeps twice when the transmitter stick is at the brake position (double beep = full-throttle position), you must disconnect the controller and operate the servo reverse facility on your transmitter, otherwise the controller would arm itself (single beep) at the full-throttle setting of your transmitter and would run at full throttle with the stick at the “stopped” position - the exact opposite of what is required.

9.2.1 Propeller brake mode

a Receiver off and flight battery disconnected.

b Set throttle stick to brake position.

c Switch transmitter on.

TXon

d Switch receiver on and connect flight battery.

RXon

e ***smart*** confirms brake position with a single beep, and is now armed!

f Hold model in launch position, keep clear of danger area around propeller.

g Move throttle quickly to full-throttle position and leave it there for about 1/2 second. Motor is already running - as with a conventional speed controller.

h ***smart*** confirms full-throttle position by interrupting the motor run very briefly - a barely perceptible "blip".

i The ***smart*** is completely configured and the model can be flown.

9.2.2 No-brake mode

a Receiver off and flight battery disconnected.

b Set throttle stick to full-throttle position.

c Switch transmitter on.

TXon

d Switch receiver on and connect flight battery.

RXon

e ***smart*** confirms full-throttle position with a double beep.

f Move throttle quickly to idle position and leave it there for about 1/2 second.

g ***smart*** confirms idle position with a single beep, and is now armed!

h The ***smart*** is completely configured.

i Place the model in the launch position. Keep clear of danger area around propeller. Open throttle in the normal way to start the flight.

The configured data is retained in the *smart* until you disconnect the flight pack or switch off the BEC system.

9.2.3 Propeller brake mode, half stick travel

a Receiver off and flight battery disconnected.

b Set transmitter stick to neutral position = brake position (for the technically minded: pulse width smaller than 1.65ms).

c Switch transmitter on. **TXon**

d Switch receiver on and connect flight battery. **RXon**

e ***smart*** confirms brake position with a single beep, and is now armed!

f Place the model in the launch position. Keep clear of danger area around propeller.

g Move throttle quickly to full-throttle position and leave it there for about 1/2 second. Motor is already running - as with a conventional speed controller.

h ***smart*** confirms full-throttle position by interrupting the motor run very briefly - a barely perceptible "blip". If the full throttle position is not confirmed, the ***smart*** cannot supply full-throttle because stick travel between neutral point and full-throttle point is "too short". If this happens, set the servo travel for the throttle channel as high as possible (e.g. 150%; the pulse width for the throttle channel must be at least 1.95ms)

i The ***smart*** is completely configured and the model can be flown.

9.2.4 Helicopter mode (no brake)

a Receiver off and flight battery disconnected.

b Set the collective pitch stick to the position in which the ***smart*** is required to provide full-throttle.
It is important that you can always call up this precise point for the start-up procedure. The best method is to assign the value to one switch position of a Dual-Rate switch.

c Switch transmitter on. **TXon**

d Switch receiver on and connect flight battery. **RXon**

e ***smart*** confirms full-throttle position with a double beep.

f Move throttle quickly to minimum collective pitch (idle position) and leave it there for about 1/2 second.

g ***smart*** confirms idle position with a single beep, and is now armed!

h The ***smart*** is completely configured.

i Place the helicopter in the take-off position. Keep well clear of danger area around rotor. Open throttle gradually to start the flight.

Note: to avoid the motor stopping completely when collective pitch is reduced to minimum we recommend that you switch on idle-up after completing the configuration procedure outlined above.

The configured data is retained in the *smart* until you disconnect the flight pack or switch off the BEC system.

[*] Note: This position must not be the hover point; it should be at least 30% in the direction of maximum collective pitch. For the technically minded: throttle channel pulse width at least 1.65ms.

10 Legal matters

10.1 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).

10.2 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.

10.3 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.