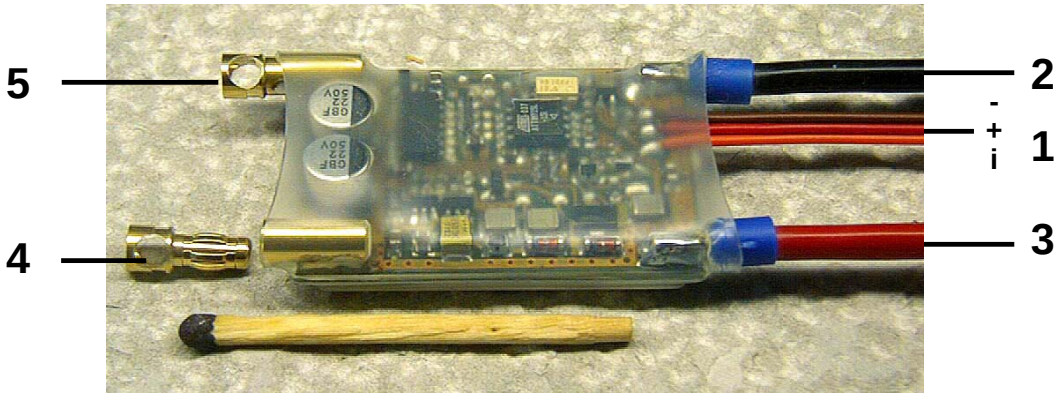


Key to illustration:

1 Receiver cable, 3-pin:
- = negative (black or brown),
+ = positive (red),
p = pulse (white or orange)
2 Battery connection, neg. (-), black
3 Battery connection, pos. (+), red
4 Motor connection, pos. (+), (red)
5 Motor connection, neg. (-), (blue, yellow)
6 Switch socket, bridged (2-pin)

Suitable for Lithium-batteries
Software-Version 10 up

pp35 male plug is included
pp35 male plug is included

Dear customer,

the *smart* which you have purchased is a micro-computer controlled speed controller for electric motors, developed and manufactured entirely in Germany.

All versions of the ***smart*** are amongst the world's smallest, lightest and most powerful speed controllers.

The *smart's* ips (**i**ntelligent **p**rogramming **s**ystem) makes it as simple as possible to configure the controller to suit any radio control system.

The active freewheel circuit ensures cooler running under part-load conditions, with resultant improved efficiency. On certain types this feature can be activated and disabled for different modes of operation.

The integrated motor connector system fitted to the ***smart*** enables you to leave the motor wiring in the model undisturbed if you wish to install the controller in a different model.

Contents

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!

The *smart* is exclusively for use in RC models. Their use in man-carrying aircraft is prohibited.

Speed controllers 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.

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 with a BEC system feature a separate On/Off switch, this does not isolate it completely from the battery.

The *smart* controllers 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 2 mm pin cannot provide reliable contact in a 2.5 mm socket. The same applies with 2mm gold-contact pins and 2 mm 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.

... 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: 12 cm (4").

... 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 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 (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.

You may find that there is a slight delay in your smart controller’s response to a start or stop command or variations of stick positions and/or you may have slight variations of revolutions at certain stick positions and/or ***smart*** run for a few milliseconds when the BEC system is switched off. This is due to the micro-processor’s characteristics and it is quite normal.

The CE symbol is your guarantee that the unit meets all the relevant interference emission and rejection regulations when it is in use.

If you encounter problems operating the ***smart*** controller, please note that many problems are due to an unsuitable combination of receiving system components, or an inadequate installation in the model.

3 Intended applications:

Low-voltage speed controllers:

smart-45bo: this is the controller to choose if you wish to use a small, lightweight unit with opto-coupler instead of a slim-series BEC controller.
It is suitable for general-purpose use in all small to medium-sized powered gliders and sports models with 6 to 18 Ni-Cd/Ni-MH cells.
No heat-sink.

smart-85bo: the low-voltage high-power version for all 10-cell hot-line models and pylon aircraft with brushed motors; also suitable for multi-motor models.
Battery range is also 6 to 18 Ni-Cd/Ni-MH cells.
No heat-sink.

smart-140CWo: the low-voltage high-power version for all model boat operators who don't want to lose a single Millivolt. Naturally, includes splash-proof protection.
Battery range 6 to 18 Ni-Cd/Ni-MH cells.
No heat-sink.

Medium-voltage speed controllers:

smart-50bo: suitable for 6 to 24 Ni-Cd/Ni-MH cells, for modellers who operate medium-sized sport aircraft and powered gliders.
No heat-sink.

smart-50CWo: this controller is designed specifically for model cars and boats (down to 7.2 V 11-turn motors); dip-coated with lacquer for splash-proof protection.
The "ips-car/boat" software allows you to select "proportional brake" or "no brake" when switching on the unit.
Battery range 6 to 24 Ni-Cd/Ni-MH cells.
No heat-sink.

High-voltage speed controllers:

smart-60bo, -80bo: battery range 6 to 32 Ni-Cd/Ni-MH cells; ideal for modellers who operate large sport aircraft and powered gliders.
With heat-sink plate.

smart-60CWo, -80CWo: this controller is designed specifically for model cars and boats (down to 7.2 V 10-turn motors); dip-coated with lacquer for splashproof protection.
The "ips-car/boat" software allows you to select "proportional brake" or "no brake" when switching on the unit.
Battery range 6 to 32 Ni-Cd/Ni-MH cells.
With heat-sink plate; water-cooling at extra cost.

smart-36.160CWo: Especially made for large aircraft and power boats. "ips-car/boat", dip-coated.

smart-45Ho/-60Ho: special version of the smart without brake for helicopters. Battery range 6 to 18 (-45Ho) 6 to 32 (-60Ho) Ni-Cd/Ni-MH cells.
Fixed stick positions for idle and full-throttle, i.e. fixed stick travel.
For fine throttle adjustment use your transmitter's facilities: servo travel adjustment and 3-point or 5-point throttle curve.
Automatic throttle adjustment maintains virtually constant rotor speed as battery voltage declines.
With heat-sink plate.

Highlights of all controllers:

Extremely fine speed control with 245-step resolution over the full control range.

Small and light units due to absence of cooling fins. A crucial point for all modellers who require maximum performance combined with minimum weight.

Better than 240-step resolution over the whole control range for extremely fine speed control.

Controllers work reliably right down to the last scrap of energy in the battery pack.

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

High 3 kHz pulse frequency, keeping the motor and controller cool and shielding the receiver system from interference.

"ips" (**i**ntelligent **p**rogramming **s**ystem) with no pots! The speed controller automatically configures itself every time to the stick travel when you switch your receiver on respectively you connect your battery pack. The brake can also be disabled in the same way if required.
"ips" Also includes a special setup variant for geared motor systems. Fixed stick travel between braking point and full-throttle point, softstart for throttle and brake. It is normally essential to apply full-throttle at the start of the flight. This variant only learns one stick position (brake point) when in use. Fine-tuning the system to match the transmitter's stick travel is still possible, but must be done by adjusting the travel at the transmitter.

"ips-car/boat" only learns neutral point. Fixed stick travel between braking point, neutral and full throttle. Proportional brake / no brake mode. The position of the throttle stick when the smart is connected determines whether proportional brake or no brake is available.

During the configuration process the motor acts as a loudspeaker to give you audible confirmation of the procedure.

4 Protective circuits

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

Temperature monitor:

The temperature monitor switches off the motor. 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 the 5V threshold the motor is throttled back.

With high cell counts the motor is throttled back when voltage falls to 58.6% the initial value. This prevents the battery becoming deep-discharged, and avoids the danger of harmful reversed polarity of individual cells in the battery.

Because of that all ***smart*** are usable for Nikkel- and for Lithium batteries likewise without any adjustments. The only condition is that Lithium batteries must be connected to the ***smart*** at least three-quarters fully charged.

If the situation which caused the controller to throttle back continues for more than a short time, the unit switches the motor off.

Of course, you can re-start the motor again briefly by moving the throttle stick back to "stop" for about 2 seconds to re-arm the system. The speed controller - and your model aircraft - remain fully controllable until the last drop of usable energy is exhausted.

Excess voltage monitor prevents arming of the smart controller if you connect more than the permitted number of cells.

The excess voltage monitor releases the brake briefly, even with soft braking, if the operating voltage should rise to a dangerous level when energy is returned to the pack, due to high-resistance batteries, long cables, batteries not consisting of in-line soldered cells, or defective connections.

Current monitor:

Our ***smart*** controllers feature a current monitor circuit which trips when the current rises highly above the specified maximum value. If the motor is stalled, the motor is throttled back. This means, that a motor which draws an excessive current will never reach full-throttle, and the current may stay below the specified maximum value. If ***smart*** is some seconds in current limiting mode, it will disarm itself (switching off the motor).

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 a half second 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.

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!

5 Monitor displays

The smart is not fitted with LEDs to indicate its operating status.

However, when the unit is being configured the set stick end-points are (in dependence of the used smart-type or ips-mode) confirmed by a beep from the motor or a barely reciptible "blip" in full-throttle position when normal using with activated brake.

---

6 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.

Receiver connection:

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

Since the ***smart*** features an opto-coupler input, you must use a separate receiver battery to power the receiver.

Length of connecting cables:

The cables to the flight battery and - <u>in particular to the motor</u> - 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.

We recommend that you choose your connectors from our selection in Section 7.

Connectors which do not have a polarised insulator can be made safe (i.e. polarised) by soldering the ***smart***'s positive battery wire to a socket, and the ***smart***'s negative wire to a plug.

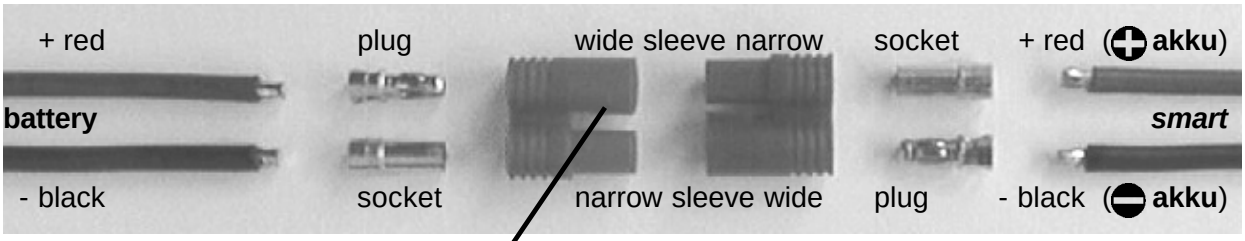
Power-connection smart <--> motor:

Solder one blue (or yellow) and one red cable (length max. 12 cm = 5") directly to the motor terminals, or shorten the existing motor cables to a length of max. 12 cm (5"). Solder the cables to the **pp35** plugs supplied (plugged into the ***smart***).

See also ”Manufacturer’s information” in Chapter 7.1.

7 Connector systems and mounting instructions

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

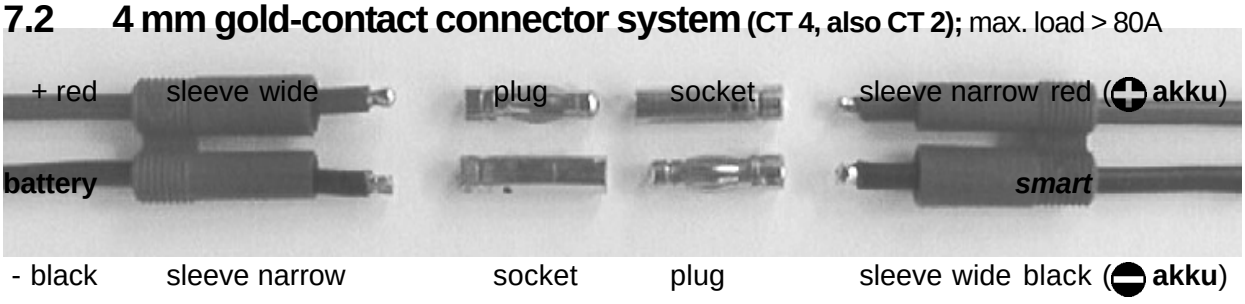


Caution: remove locating lug from battery cable. Do not remove lug from any cables attached to controllers or charge leads!

Manufacturer's information: the **pp35** plug is very short, and this presents the danger that the spring contact could lose its resilience due to excessive heat build-up during the soldering process. You can side-step the problem by keeping the temperature below 200°C as follows: either remove the contact carefully before soldering, or simply push the plug into a piece of wet fine-grain sponge for soldering, or plug it in a 3.5 mm hole of a copper-block.

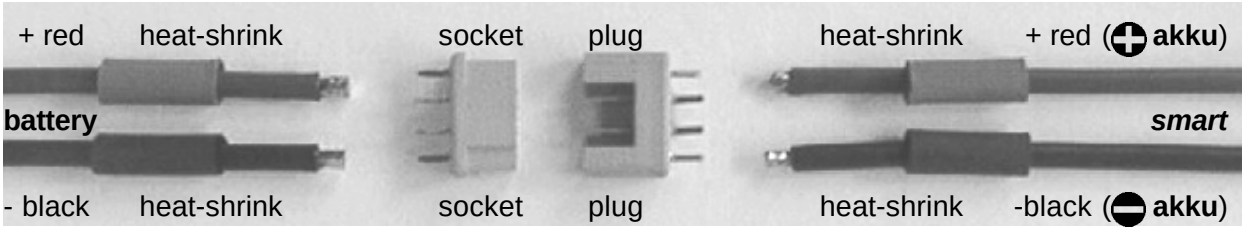
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Place plastic sleeve vertically on table, grip end up.
b. Push contact down into sleeve.
c. Place 2.5mm wide screwdriver blade on top of cable solder joint inside sleeve.
d. Tap screwdriver to press contact into sleeve until latch engages.

7.2 4 mm gold-contact connector system (CT 4, also CT 2); max. load > 80A



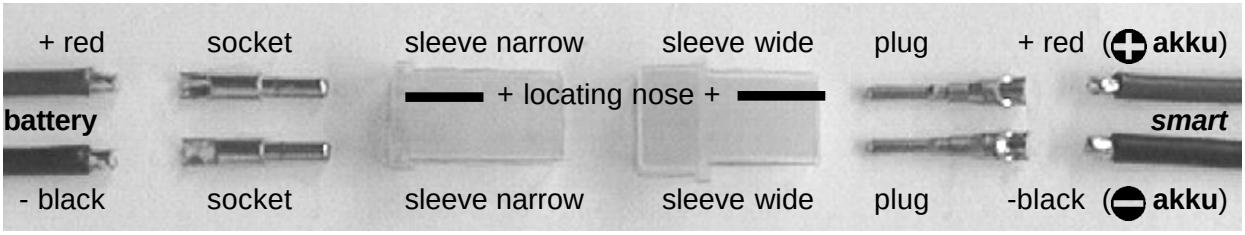
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Rest plastic sleeve on vice jaws with cables hanging down.
b. Close vice jaws until cables are just free to move.
c. Fit plug into socket and tap into sleeve until latch engages.
d. Fit socket onto plug and tap into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

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



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.

8 Initial use

8.1 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. 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 wish to use the controller in a model which does not require a propeller brake, or you are using the Car-versions or the Helicopter-version, the procedure is slightly different (see below).

If you have a transmitter with adjustable servo travel we recommend that you set throttle-servo to normal full travel, i.e. +/- 100%. Adjust Multiplex servo center pulse width to 1.5 ms (= -22% center).

A single beep mostly 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.

8.2 Symbols and terminology

Stick: The throttle stick on the transmitter

Neutral position (self neutralising stick)
Idle position (position where the motor just barely runs) or stop position (brake).

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.

Wait (0.5 seconds)

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)

8.3.1 Propeller **brake** mode (smart-bo)

a Receiver off and flight battery disconnected

b Set throttle stick to brake position 

c Switch transmitter on **TXon**

d Switch receiver on (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 

The active freewheel is activated in this mode of operation.

The configured data is retained in the ***smart*** until you disconnect the flight pack.

8.3.2 **No-brake mode** (smart-bo)

a Receiver off and flight battery disconnected

b Set throttle stick to full-throttle position

c Switch transmitter on

TXon

d Switch receiver on (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 active freewheel is activated in this mode of operation.

The configured data is retained in the ***smart*** until you disconnect the flight pack.

8.3.3 **Gearbox mode** (brake enabled, smart-bo)

• **Setting the unit for a longer soft-start** when throttle and brake are applied.

• **Full stick travel**

a Receiver off and flight battery disconnected

b Set transmitter stick to centre position
(technically: 1.5 +/- 0.15 ms pulse width)

c Switch transmitter on

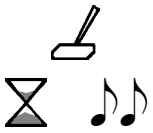
TXon

d Switch receiver on (connect flight battery)

RXon

e ***smart*** detects "gearbox mode", confirms with triple beep

f **Only for no brake use, skip if brake is necessary:**
Move transmitter stick to full throttle position and leave it there until motor beeps twice.
smart learns full throttle position



g Move transmitter stick quickly to brake position and ...
(technically: pulse width less than 1.35 ms)

... leave it there for half a second.

h ***smart*** learns brake/idle position, calculates full-throttle position if brake operation (stop point + 0.6 ms), confirms with single beep and is now armed!

i The ***smart*** is completely configured and is ready for use.

j Moving the transmitter stick towards full throttle starts the motor running. The model can be launched.

The active freewheel is disabled in this mode of operation.

The configured data is stored in the ***smart*** until you disconnect the flight battery.

8.3.5 smart-Co - car mode

proportional brake
half stick travel, self neutralising

• **Excess current and low voltage** cause motor to be throttled back, but not immediately shut off

• **Min. motor turns with 6 cells / 3 slot motor:**
no limit (-140CWo) / 10 (-50CWo) / 12 (-60CWo)

• **Splashproof design**

a Receiver off and drive battery disconnected

b Set transmitter stick to centre position (neutral)
(technically: 1.5 +/- 0.15 ms pulse width)

c Switch transmitter on

TXon

d Switch receiver on (connect drive battery)

RXon

e ***smart*** learns neutral position,
calculates full-throttle position (neutral position + 0.3 ms)
and brake position (neutral position - 0.3 ms) confirms with
single beep and is now armed!

f The ***smart*** is completely configured, the model can be used

g Moving the transmitter stick towards full throttle starts the motor running

h Moving the transmitter stick towards full brake slows the model proportionally

The active freewheel is disabled in this mode of operation.

The configured data is stored in the ***smart*** until you disconnect the drive battery.

8.3.6 <u>smart-Co - boat mode</u>

unbraked
full stick travel, non self neutralising

• **Excess current and low voltage** cause motor to be throttled back, but not immediately shut off

• **Min. motor turns with 6 cells / 3 slot motor:**
no limit (-140CWo) / 10 (-50CWo) / 12 (-60CWo)

• **Splashproof design**

a Receiver off and drive battery disconnected

b Set transmitter stick to centre position
(technically: pulse width less than 1.35 ms)

c Switch transmitter on **TXon**

d Switch receiver on (connect drive battery) **RXon**

e ***smart*** learns neutral position, calculates full-throttle position (neutral position + 0.6 ms pulse width), confirms with <u>double beep</u> and is <u>now armed!</u>

f The ***smart*** is completely configured, the model can be used

g Moving the transmitter stick towards full throttle starts the motor running

The active freewheel is <u>disabled</u> in this mode of operation.

The configured data is stored in the ***smart*** until you disconnect the drive battery.

8.3.4 smart-Ho - controller for helicopters

- **No brake**
- **Fixed stick positions:** idle = 1.2 ms, full throttle = 1.8 ms
- **Excess current and low voltage** cause motor to be throttled back, but not immediately shut off.

a Receiver off and flight battery disconnected

b1 **For normal operation without "active freewheeling":** Set transmitter stick to idle/min. pitch position (< 1.5 ms)

or

b2 **For operation in "load compensation mode" and with "active freewheeling":** Set transmitter stick to full throttle/ max. pitch position (pulse width larger than 1.5 ms)

c Switch transmitter on — **TXon**

d Switch receiver on (connect flight battery) — **RXon**

e **<u>if b1 was selected: skip to h</u>**

f **only if b2 is selected: *smart*** detects "load compensation mode" desired and confirms with <u>double beep</u>

g Set transmitter stick to idle/minimum pitch position

h The ***smart*** detects idle position, confirms with <u>single beep</u>, and is <u>now armed!</u>

i The ***smart*** is completely configured and is ready for use

j Moving the transmitter stick towards full throttle starts the motor running **(move slowly, no smooth start circuit!)**

k The helicopter can be taken off

The "load compensation mode" is activated, when motor runs the first time on half throttle.

The configured data is stored in the ***smart*** until you disconnect the drive battery.

9 Legal matters

9.1 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.
Warranty claims are processed according to our current General Conditions of Business, which are enclosed in our price list or our web page.

The warranty does not cover consequent damage or damage due to incompetent usage, such as: damage caused by moisture, by soldering cables using an acid-based flux (especially relating to speed controllers), or due to the use of non-polarised connectors. This means that you have to ship your controllers to us originally as used (particularly do not remove the plug system on the leads!).
When a brushless controller has a need to repair it is often necessary to send it to us together with the battery pack, the motor and the airscrew. The warranty does also not cover those controllers which are not used with those connectors (of the fitting current) shown in our operating instructions and/or those connectors which can not serve the reliable function e.g. by dirt.

One further note:

If a problem arises with a schulze device, send it straight back to us or our authorized representative (see catalogue); don’t attempt to repair it!
This allows us to repair it as quickly as possible, as we can detect warranty defects without any doubt and thus keep costs low. You can also be certain that we will fit genuine replacement parts which are a perfect match to your device. (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”.
You also have the comfort of a properly repaired unit with a renewed warranty. The warranty period of repaired devices is applicable only to the repair. This period is shorter than the warranty period of a new product (See general conditions of business).

9.2 Liability limits / compensation

We at Schulze Elektronik GmbH are unable to monitor methods of installation and operation, and have no control over how you fit, use and maintain the devices we produce. For this reason we accept no liability for loss, damage or costs which arise from the incorrect or incompetent use of our products, or are connected with that use in any way.

In so far as the law allows, our obligation in respect of compensation, regardless of the legal grounds, is limited to the invoice value of that quantity of goods which was immediately involved in the event which caused the damage. This does not apply if legally binding regulations oblige us to accept unlimited liability in a particular case, or if deliberate or gross negligence can be proved on our part.

9.3 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.

10 Specifications

Type	Current	Ni-Cd Ni-MH	Size	Weight	Cable	Throtl.	Brake	Cooling
Unit	[A]	[CellCount]	[mm]	[g]	[mm²]	[mΩ]	[mΩ]	
Sport/Sailplane								
***smart*-45bo**	45/60	6-18	40*28*9,5	14-22	2,5	1,33	2	no
***smart*-85bo**	85/110	6-18	40*28*9,5	14-29	4,0	0,66	1,33	no
***smart*-50bo**	50/66	6-24	40*28*9,5	14-22	2,5	1,5	3	no
***smart*-60bo**	60/80	6-32	40*28*11+5	16-24	2,5	2	4	1.0 mm plate
***smart*-80bo**	80/107	6-32	40*28*11+5	16-31	4,0	1,1	2,2	1.0 mm plate
Helicopter								
***smart*-45Ho**	45/60	6-18	40*28*9,5	14-22	2,5	1,33	2	no
***smart*-60Ho**	60/80	6-32	40*28*11	16-24	2,5	2	(4)	1.0 mm plate
Car/Boat								
***smart*-140CWo**	140/180	6-18	40*28*9,5	16-31	4,0	0,4	(0,8)	no
***smart*-50CWo**	50/66	6-24	40*28*9,5	16-24	2,5	1,3	(1,8)	no
***smart*-60CWo**	60/80	6-32	40*28*11+5	18-26	2,5	2	(4)	1.0 mm plate
***smart*-80CWo**	80/107	6-32	40*28*11+5	18-33	4,0	1,1	(2,2)	1.0 mm plate
Large models/powerboats								
***smart*-36.160CWo**	160/213	6-36	91*59*14	70-130	2*4,0	0,83	(1,7)	1,5 mm plate

Current rating: **Maximum current / nominal current:**
The excess current level lies above the maximum current value for each unit.
The nominal current value is the continous current at full throttle at which the smart can be operated when connected to a 10 V / 2 Ah battery.

Weight: **Values** excluding - including cables.

Cable: **Values** in brackets: recommended conductor cross-section - unit supplied without power cables.

Throttle, brake: **Internal** resistance of FETs as stated in data sheet.
Brake response time 8 sec at **-bo**, at **-CWo** Types unlimited. **A** whistling or twittering sound from the motor under part-load conditions and when braking is due to technical reasons, and is perfectly normal. (Values in brackets: Active freewheeling circuit)

Pulse times: General: allowed range: 0.8 ms ... 2.5 ms, cycle time: 10 ... 30 ms.
Gearbox-mode: brake point <1.35 ms, fixed travel brake point <-> full throttle: ~0.6 ms.
smart-50He: fixed neutral point = 1.2 ms, fixed full throttle point = 1.8 ms.
ips-car, boat mode: neutral point < 1.35 ms; fixed travel neutral <-> full throttle ~0.6 ms.
ips-car, car mode: neutral point 1.5 +/- 0.15 ms; full brake <-> neutral ~0.3 ms,
neutral <-> full throttle ~0.3 ms. Tolerances: ~ + - 10%

Other features: Overtemperature threshold approximately 110°C. Pulse frequency 3.125 kHz.
Suitable for lithium batteries.

Hints: For example, if you wish to operate a multi-motor model, we recommend that you use a separate ***smart*** controller for each motor. The ***smart***s can then be connected to the receiver via a Y-lead.
If you wish to operate a large 4-pole motor (Dino types),the ***smart-36.160CWo*** is the fitting replacement.

Active freewheel: to reduce the operating temperature of your smart controller under part-load conditions we recommend that you use a mode with active freewheel activated. **This applies in particular to multi-motor models.**
The drawback of this mode is that the motor has a marked tendency to ”drag on the throttle stick”, i.e. when you reduce the throttle setting the motor is braked by the forced energy feedback (current fed back into the drive / flight battery).