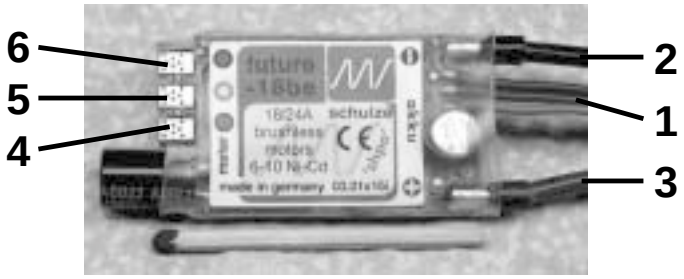
Please read all the instructions carefully (including those who hate to read instructions!)



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 connectin pos. (+) .	red	**Reverse use:**
4	Motor connection a	red	blue, black
5	Motor connection b	white, yellow	white, yellow
6	Motor connection c	blue, black	red

Please note the following guidelines, which apply when you are connecting the motor and reversing its direction of rotation:

1) The controller can be used with sensorless and sensor-controlled motors. If your motor is sensor-controlled, the 5-pin connector is not used.
2) The three motor cables can be connected in any order.
3) To reverse the direction of rotation you have to swap over two of the three motor cables; we recommend that you swap the two outer wires.

Unfortunately the colour coding of the motor windings may not apply consistently to the sensor-controlled and sensorless types.

Note: for right-hand rotation, Plettenberg motors should be connected as the colour code shows. Mostly ***futures*** should be connected with the cooling plate facing the outside of the fuselage.

Dear customer,

Congratulations on your choice of a ***future*** speed controller, which is a micro-computer controlled unit developed and manufactured entirely in Germany, designed for brushless and sensorless 3-phase rotary current motors.

All models of the ***future*** are amongst the world's smallest, lightest and most capable speed controllers.

future controllers have the most intelligent, comprehensive software, which means that this speed controller (or governor) is capable of operating virtually any brushless motor currently on the market with optimum efficiency.

The *ips* (**i**ntelligent **p**rogramming **s**ystem) which is a standard feature of the -bo/ -Ko/ -be versions of the ***future***, makes it as simple as possible to configure the controller to match any radio control system.

The transmitter stick travel settings of the special types (future -P, -F, -W, -H) are pre-set and fixed.

The integral motor connector system is a feature of all ***future*** controllers up from 35A nominal current, and makes it possible to remove the unit for servicing, or for fitting in another model, simply by unplugging the cables - no soldering is required.

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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 are 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 will almost certainly cause irreparable damage.

Electronic equipment is sensitive to humidity. Speed controllers 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.

Please take care when switching off the receiver battery: depending on the receiver you are using, it may send an incorrect throttle signal to the ***future*** at this moment, which could then cause the motor to burst into life unexpectedly.

If you are using a ***future*** with BEC system:
a) 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.

b) 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 from mechanical loads, vibration, dirt and contamination.

Keep the cables to the motor as short as possible (max. length = 10 cm / 4”).

Do not exceed the maximum stated length of cable between battery and ***future*** (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 a clamp-type amperemeter, not a series meter with shunt resistor.

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.

Speed 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.

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 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: 10 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. 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 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 ***future*** 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 by a BEC system. If the BEC voltage is stable, the receiver is less liable to suffer interference.

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

Important note: Please switch on your transmitter before switching on your receiver. When receiving no transmitter signal some PCM-receiver give no servo-pulse to the output but a constant high voltage. This voltage will set the ***future*** after 5 seconds into the brush mode (see section 9.3.8). You can indicate this mode by the double-tone-beep when arming. Please switch back this mode in the same manner.

3 Intended applications:

Low voltage types:

future*-18be:** For motors up to 100g (Astro 020, Aveox 1005); 6...10 Ni-Cd/Ni-MH cells; BEC 5V/1,5A; ***ips.

future*-25be:** For softliners, small sport-models, small ducted fans; 6...10 cells; BEC 5V/1,5A; ***ips.

***future*-18/ -20Le:** Special controller for Hornet (-18Le: max. 70cm rotor) and LMH 110 (-20Le: max 1m rotor diameter) or similar without collective pitch. 6-10 Ni-Cd/Ni-MH cells; BEC 5V/1,5A - allowed servos see chapter 12. Motor throttles back at under voltage.

***future*-18/ -20He:** Controller and constant speed regulator for mini helicopters (e. g. Hornet) with collective pitch. 6-8 Ni-Cd/Ni-MH cells; BEC 5V/1,5A - allowed servos see chapter 12.

future*-45bo:** This controller is primarily designed for use in electric gliders or all purposes with non excessive half throtle use. 6 to 17 Ni-Cd / Ni-MH cells. Can be configured using the ***ips facility.

future*-45be:** Identical to the ***future-45bo, but with the addition of a BEC system. That's why can be used with 6 - 12 cells.

future*-45Ko:** The controller for longer durating half throttle as used in sport models, aerobatic models or ducted fan models. Batt. range 6 - 17 cells; finned heat-sink; ***ips.

future*-45We/-45/-62/-88/-102/-105/-157Wo:** The special controller for boats. Splash water protection. Different cell counts and cooling plates (see section 12). 6 different timings. ***ips-boat.

***future*-45He/Ho:** Controller for helicopters with long durating initial softstart. 6-10 Ni-Cd / Ni-MH cells (...**He**), up to 17 cells (...**Ho** version); cooling rips; fixed stick positions for neutral and full throttle. Normal speed controller and constant rpm use. Autorot. use.

***future*-58bo:** This version can be used with 7 to 17 Ni-Cd cells in any model where the capacity of the 45A version is marginal, and where the 90A type would represent a sledgehammer to crack a nut.
With its improved efficiency it is also a good choice in models where cooling can be problematic. The intended applications therefore include small hotliners and small ducted-fan models. Can also be configured using the ips facility.

future*-58Ce/Co,-88Ce/Co,-102Co:** the special controller for cars. 6-10 resp. 16-24 Ni-Cd / Ni-MH cells. ***ips-car (Fixed stick travel, learning neutral point; proportional brake/no brake); cooling fins.

***future*-70/88Po:** The special controller made for pylon racers. Full throttle use with 7-10 Ni-Cd cells. Extra leightweight, short and low profile. Fixed stick travels; brake cannot be disabled. 4 different timings. **-88Po** for F5D.

***future*-88Fo:** Speed controller for 10-cell glider competition work. Can be used with 7 - 17 cells. Fixed stick travels; brake cannot be disabled. 4 timings.

***future*-111Fo:** For those who require even more than 90 A in 10-cell competition work.
Can be used with 7 - 17 cells. Fixed stick travels; brake cannot be disabled. 4 different timings.

High voltage types:

future*-35bo:** The controller for high cell numbers, for example as used in ducted-fan models. Battery range 16 - 30 cells; finned heat-sink; ***ips.

***future*-35Ho:** Controller for helicopters with long durating initial softstart. 16-30 Ni-Cd / Ni-MH cells; cooling rips; fixed stick positions for neutral and full throttle. Normal speed controller and constant rpm use. Autorotation use.

future*-55bo:** The high-current controller for high cell count. Batt. range 16...30 cells; finned heat-sink; ***ips.

future*-55Wo:** The high-current controller for high cell count. 16...30 cells; finned heat-sink; ***ips-boat.

***future*-80Fo:** The thoroughbred controller for 27-cell competition gliders with geared motos. Only for brief operation: 5 seconds followed by 15 seconds pause. Use with 16 - 28 cells, 1000 or 1250 mAh capacity. Fixed stick travels; brake cannot be disabled; heat-sink; 72 FETs.

future*-102Fo:** Same purpose as ***future-80Fo, but made for 18*RC2400, 19*RC2000 or 24*CP1700 cells.

Highlights common to all units:

Ultra-small, ultra-light units. A crucial point for all modellers who require max. performance combined with minimum weight.

Better than 250-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".

"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.

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

All ***future*** types with shpa include a timing and/or pulse frequency adjustment facility, which enables you to make adjustments without additional cables or push-buttons. This feature allows us to cater more accurately for the different magnetic field geometries and flux concepts employed by the various motor manufacturers. This function also lets you offset the maximum efficiency point to suit your particular application.

Use with Tango/Samba motors: set the pulse frequency of your ***future*** to 38 kHz. You may find that your power system operates at higher efficiency set to 19 kHz, but this is below the pulse frequency which the manufacturer approves for these motors (to avoid invalidating the warranty).

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.

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.

If you use a ***future*** with opto-coupler you retain full control of the model until the receiver battery is flat;
if you use a ***future*** with BEC system the power system and the model remain fully controllable until the last usable energy in the flight pack 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 ***future*** controllers feature a current monitor circuit which trips when the current rises 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 ***future*** is some seconds in current limiting mode, it will disarm itself (switching off the motor).

Maximum speed monitor:

If maximum rotational speed of the motor will exceed, ***future*** throttles down. In this state do not use longer then 1 second.
future bo or ko types cut off instantly.
Because of this: Do not run motor without airscrew.

Minimum speed monitor:

To ensure that the controller detects the rotor position reliably, this series of ***future*** types sets a defined minimum rotational speed. If the rotor speed falls below this value continuously, the controller switches the motor off. You can over-ride the reset with the “auto-arm” function (throttle stick to stop for about 2 sec). This protective function can cause the motor to be reluctant to start up if its torque limit is exceeded. If you are using one of the ...bo types with V03 software the only time you may notice this is when you first start the motor after changing the battery. In this case a propeller one step smaller in diameter must be used. If this should happen, check that the maximum permissible motor current is not exceeded.

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 300 milliseconds before switching to disarmed mode.

This warning function enables you to eliminate receiver interference before you actually lose your model, perhaps by modifying the installation or changing the radio control components

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.

5 Monitor displays

The *future* is fitted with LEDs to indicate its operating status „disarmed“, „neutral“ or „brake enabled“.

However, when the unit is being configured the set stick end-points are (in dependence of the used ***future***-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 ***future*** in foam as this may lead to a heat buildt-up in the controller.

Receiver connection:

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

The *future* receives its control signal via this receiver socket.

If you use a ***future*** with BEC system and one receiver cable, power is supplied to the receiver via the same cable. If the ***future*** has two receiver cables, please connect the two-core cable to the receiver socket to which the receiver battery would normally be connected, or to any other vacant receiver socket.
Check regularly especially in this case that the receiver cable is undamaged and firmly seated at the ***future***.
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.

Length of connecting cables:

Power-connection battery <--> *future*:
Do not exceed the maximum stated length of cable between battery and ***future*** (max. length: 20 cm / 7...8”), otherwise the speed controller may be damaged. This rule still applies even if your power system features a retractable (folding) motor, or your model necessarily includes a long battery cable!!! Battery packs which are assembled in a zig-zag pattern also produce ”long cable” effects; use in-line soldered packs exclusively. It is essential to use polarized gold-plated-contact connectors - fitting any other type of connector invalidates the warranty.

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

We recommend that you choose your connectors from our selection in Section 8 - fitting any other type of connector invalidates the warranty.

Power-connection *future* <--> motor:

The cables to the motor should be kept as short as possible to avoid interferences to your reiceiver. Long cables tend to act as aerials and radiate interference; they also add unnecessary weight (see also section 2).

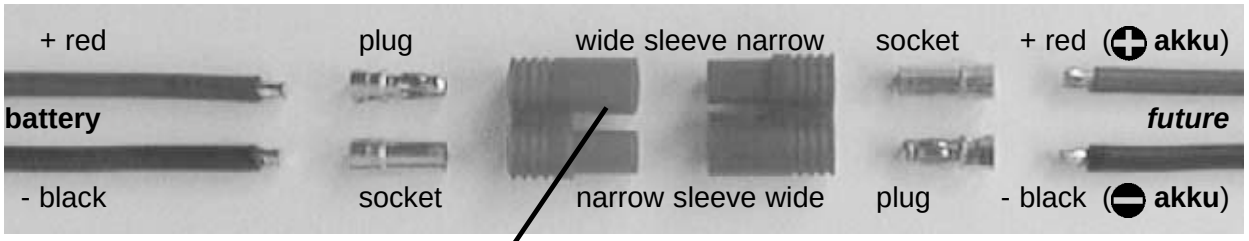
Cut down the existing motor cables to a length of no more than 10 cm. Do not extend the motor cables except in exceptional cases; although this generally does not harm to the ***future*** itself.

Locate the cables with the pp35 plugs supplied with the controller (plugged into the ***future***), and solder them to the motor cables. See separate sheet (page 1) for details of cable configuration.

Avoid pulling on the motor cables; we recommend that you secure the three motor plugs with glass-reinforced tape to prevent them being pulled out.

7 Connector systems and mounting instructions

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

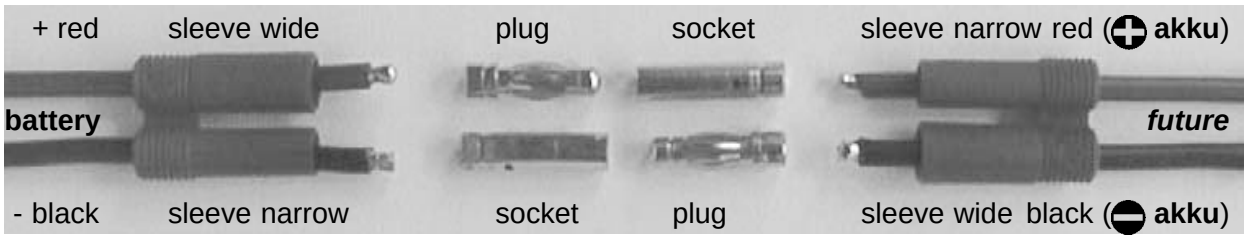


Caution: remove locating lug from battery cable. Do not remove lug from any cables attached to controllers or charge leads!

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.

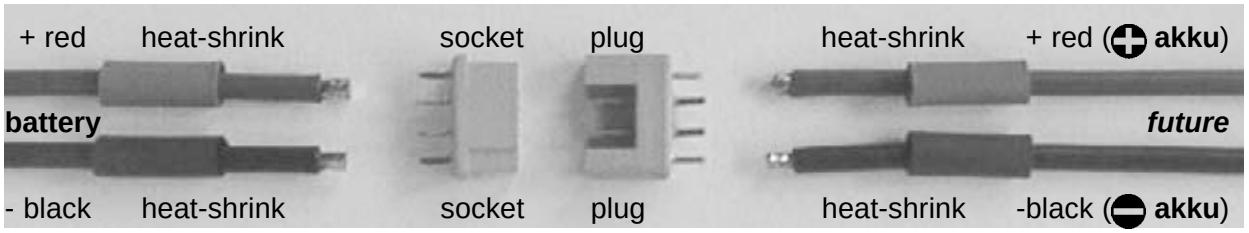
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Place plastic sleeve vertically on table, grip end up.
b. Push contact down into sleeve.
c. Place 2.5 mm wide screwdriver blade on top of cable solder joint inside sleeve.
d. Tap screwdriver to press contact into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

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



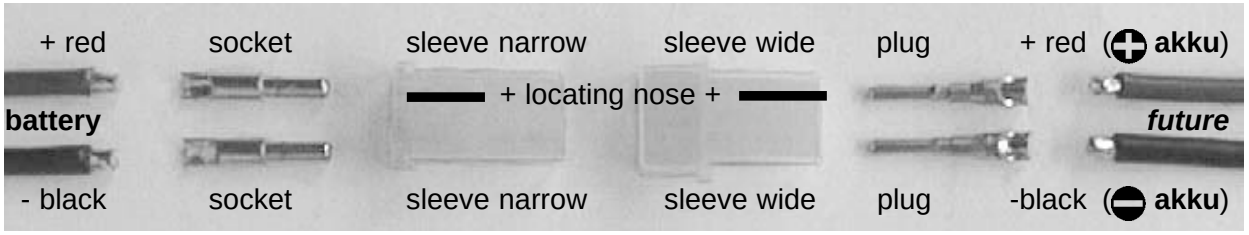
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Rest plastic sleeve on vice jaws with cables hanging down.
b. Close vice jaws until cables are just free to move.
c. Fit plug into socket and tap into sleeve until latch engages.
d. Fit socket onto plug and tap into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

In general terms: in its standard form (mode 1 = default mode) the *future* works with all motors known to us, i.e. without you having to make any adjustments to it!

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).

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 the procedure is slightly different (see below).

With the -Fo/ -Po/ -Ho/ -He types the user has no means of configuring the stick travels, i.e. the brake and full-throttle positions are both pre-defined. The -Wo/ -Co/ -Ce types ”learn” the neutral point only; the full-throttle point is set at a fixed spacing from the learned neutral point.
If you wish to control motor speed whilst exploiting full transmitter stick travel with these types, we recommend that you reduce the servo travel slightly at the transmitter.

If your ***future*** -bo/ -be/ -/Ko beeps twice (double beep = full throttle position) when the transmitter stick is at the brake position, you must reverse the throttle channel using your transmitter’s servo reverse function. If you neglect to do this, the ***future*** will be armed (single beep) at the transmitter’s full-throttle setting, and run at full-throttle at the stop setting, which is not recommended!

If your ***future*** -bo/ -be/ -Ko beeps three times (triple beep = gearbox mode) when the transmitter stick is at the brake position, then you have made one of the following errors: you have not set servo travel at the transmitter to 100%, or you are using an MPX transmitter and have not carried out the -22% neutral point shift.

The next page includes instructions on operating your speed controller. There you will discover that the ***future*** emits a certain number of beeps when you connect the power battery; the number of beeps varies according to the set mode. This is how the ***future*** tells you the part-load switching frequency and timing which are currently set on your particular controller.
The range of adjustment facilities (operating modes) varies according to controller type, and they are described in full in the section covering the use of the controller. Chapter 8.5 describes how to set the various operating modes.

Once the ***future*** is configured, the set operating modes are stored in the unit until you change them again, i.e. they are not lost when you disconnect the battery.
In contrast, the ips settings (normal operating mode, without brake or toothed belt gearbox) are only retained until the ***future*** is disconnected from the battery.

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

Double tone

Momentary interruption in running (inverse beep)

8.3 Notes on changing motor timing and switching frequency

The general rule is: the harder the timing, the higher the current at which maximum efficiency occurs. However, optimum timing also varies according to the design of the motor. For this reason we state recommended timings for each motor type. Within certain limits, it is also possible to adjust the motor to suit a particular aircraft propeller or boat propeller by modifying the timing.

When selecting the switching frequency the general rule is this: the lower the motor's inductivity, the higher the switching frequency should be. Increasing the switching frequency reduces non-linearity in the current flow in part-load mode, but at the same time causes a rise in eddy current losses in the motor and switching losses in the controller. The simplest method is to try out different switching frequencies, and select the one at which the motor and the ***future*** heat up the least.

Mode 1 is the standard mode. As a rule ***future*** is shipped in this mode.

8.4.1.1 Propeller <u>brake</u> use (*future* -bo / -Ko/ -be)

a Receiver off (flight battery disconnected)

b Set throttle stick to brake position 

c Switch transmitter on **TXon**

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

e ***future*** shows “set operating mode” with single tone beep(s) 

f ***future*** waits 2 seconds, confirms “brake use” with a single tone beep and is <u>now armed</u>. 

g Hold model in launch position, keep clear of danger area around propeller! 

h Move throttle <u>quickly</u> to full-throttle position and ... 

... leave it there for about 1/2 second. Motor is already running - as with a conventional speed controller 

i ***future*** confirms <u>full-throttle position</u> by interrupting the motor run very briefly - a barely perceptible <u>"blip"</u> 

j The ***future*** is completely configured and the model can be flown 

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

Also see “set operating mode“ section 8.4.1.4 and setting procedure for “set operating mode“ section 8.5.1

8.4.1.2 **No-brake use** (***future*** -bo / -Ko/ -be)

a Receiver off (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 ***future*** shows “set operating mode” with single tone beep(s) ♪(♪…♪)

f ***future*** waits 2 seconds, confirms “no brake use” with two single tone beeps. 

g Move throttle quickly to idle position and ... 

... leave it there for about 1/2 second 

h ***future*** confirms idle position with a single beep and is now armed! ♪

i The ***future*** is completely configured 

j 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 stored in the ***future*** until you disconnect the flight battery.

Also see “set operating mode“ section 8.4.1.4 and setting procedure for “set operating mode“ section 8.5.1

8.4.1.3 Belt-drive gearbox use (*future* -bo / -Ko/ -be)

- **Sets throttle and brake to a longer soft-start**.
- **Fixed stick travel (brake use):** Full throttle = Stopp position + 0.6 ms

a Receiver off (flight battery disconnected)

b Set transmitter stick to centre position
(technically: 1.4 ... 1.67 ms pulse width)

c Switch transmitter on **TXon**

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

e ***future*** shows “set operating mode” with single tone beep(s) ♪(♪...♪)

f ***future*** waits 2 seconds, confirms “belt drive use”
with three single tone beeps.

g **only for no brake use; skip to h if brake is necessary:**
Move transmitter stick to full throttle position and leave it there until motor beeps twice (“no brake”).

h Move transmitter stick quickly to brake / neutral position and leave it there for half a second.
(technically: pulse width less than 1.4 ms)

i ***future*** learns brake / neutral position, calculates full-throttle position (brake / neutral position + 0.6 ms), confirms with single beep and is now armed!

♪

j The ***future*** is completely configured and is ready for use.

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

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

8.4.1.4 “set operating modes” *future*-18be/-25be and -18Le/ -20Le/-18He/ -20He

(remaining *future* -bo/ -Ko/ -be/ -He/ -Ho see 8.4.1.5)

Mode 1: Very hard timing, **9.6 kHz,** 1 beep (♪)

- Maximum efficiency at highest power and rotational speed
- Optimum for all Plettenberg motors and all other motors when maximum rotational speed is needed

Mode 2: medium hard timing, **9.6 kHz,** 2 beeps (♪♪)

- Use when having problems with runtime and/or too much current on Plettenberg motors
- Motor efficiency is set to medium motor currents (e. g. for long duration flights with helicopters)
- Recommended when changing from a Kontronik to a Schulze speed controller with a given motor
- With Hacker, Kontronik and Lehner motors the rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Aveox, Astro and Kontronik KBM motors

Mode 3: Medium timing, **9.6 kHz,** 3 beeps (♪♪♪)

- Motor efficiency is set to lower motor currents (e. g. for long duration flights with helicopters)
- Recommended when changing from a Lehner to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Hacker, Kontronik (BL&Fun) and Lehner motors
- Not for Plettenberg motors

Mode 4: Soft timing, **9.6 kHz,** 4 beeps (♪♪♪♪)

- Motor efficiency is set to low motor currents
- Use when having problems with runtime and/or too much current on very sharp Lehner and Hacker motors at relatively low currents
- For lowest idle current on Hacker, Kontronik BL/Fun-series and Lehner motors (e. g. duration contest)
- Not for Astro, Aveox, Bittner, Köhler and Plettenberg motors

See also setting procedure for “set operating mode” section 8.5.1

8.4.1.5 “set operating modes” *future* -bo/ -be/ -Ko/ -Ho/ -45He
(future -18be/ -18&20Le/ -18&20He/ -25be see 8.4.1.4)

Mode 1: Hard timing, **9.6 kHz,** 1 beep (♪)

- Maximum efficiency at highest power and rotational speed
- Optimum for all Bittner, Köhler, Ikarus and Plettenberg motors and all other motors when maximum rotational speed is needed

Mode 2: Soft timing, **9.6 kHz,** 2 beeps (♪♪)

- Motor efficiency is set to lower motor currents
(e. g. for long duration flights with helicopters)
- Recommended when changing from a Lehner to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Astro, Aveox, Hacker, Kontronik and Lehner motors
- Not for Ikarus and Plettenberg motors

Mode 3: Hard timing, **19 kHz,** 3 beeps (♪♪♪)

- Maximum efficiency at highest power and rotational speed
- Optimum for all Bittner, Köhler, Ikarus and Plettenberg motors and all other motors when maximum rotational speed is needed

Mode 4: Soft timing, **19 kHz,** 4 beeps (♪♪♪♪)

- Motor efficiency is set to lower motor currents
(e. g. for long duration flights with helicopters)
- Recommended when changing from a Lehner to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Hacker, Kontronik and Lehner motors
- Not for Ikarus and Plettenberg motors

Mode 5: Hard timing, **38 kHz,** 5 beeps (♪♪♪♪♪)

- Maximum efficiency at highest power and rotational speed
- Optimum for all Tango and Samba motors when maximum rotational speed is needed

Mode 6: Soft timing, **38 kHz,** 6 beeps (♪♪♪♪♪♪)

- Motor efficiency is set to lower motor currents
- Recommended when changing from a Kontronik to a Schulze speed controller with a given motor
- With Hacker, Kontronik and Lehner motors the rotational speeds coincide more closely with the manufacturers' stated figures
- Optimum for all Hacker, Kontronik (BL and Fun) and Lehner motors with very low winds (fewer than 7 turns)
- Optimum for all Tango and Samba motors when long motor run times are required
- Not for Ikarus, Köhler and Plettenberg motors

See also setting procedure for "set operating mode" section 8.5.1

8.4.2.1 *future*-35Wo/ -45Wo/ -45We/ -55Wo/ -88Wo/ -105Wo/ -157Wo (ips-boat)

- **Unbraked**
- **Half stick travel - self neutralising or**
- **Full stick travel - non self neutralising**
- **Splashproof design**
- **BEC 5 V / 3 A in *future*-45We, otherwise opto coupler**

a Receiver off and drive battery disconnected

b1 Set transmitter stick to centre position
(technically: 1.36 ... 1.67 ms pulse width)
or

or

b2 Set transmitter stick to idle position
(technically: pulse width less than 1.36 ms)

c Switch transmitter on **TXon**

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

e ***future*** **learns** neutral position,
shows "set operating mode" with single tone beep(s),
calculates full-throttle position
(neutral position +0.3 ms resp. +0.6 ms pulse width),
and is <u>now armed!</u>

♪(♪…♪)

f Moving the transmitter stick towards full throttle starts the motor running.

Take care if your transmitter's neutral point is close to the stick centre position (see b1):
If you leave the stick in the reverse position (over 80% reverse travel, i.e. less than 0.24 ms below the neutral position) for longer than 1.7 seconds, the boat will accelerate slowly in reverse (to a maximum of 30% full throttle).

Disabling reverse mode: set servo travel for reverse mode to significantly less than 80%.

The configured <u>throttle positions</u> are stored in the ***future*** until you disconnect the drive battery.

8.4.2.2 “set operating modes” boat- *future*

Mode 1: Very hard timing, **9.6 kHz,** 1 beep (♪)

- highest power and rotational speed
- Optimum for all Plettenberg motors and all other motors when maximum rotational speed is needed

Mode 2: Hard timing, **9.6 kHz,** 2 beeps (♪♪)

- Use when having problems with runtime and/or too much current on Plettenberg motors
- Optimum for all Astro, Bittner and Köhler motors

Mode 3: Medium hard timing, **9.6 kHz,** 3 beeps (♪♪♪)

- Motor efficiency is set to medium motor currents
- Recommended when changing from a Kontronik to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Aveox and Kontronik KBM motors
- Not for Plettenberg P6 motors

Mode 4: Medium timing, **9.6 kHz,** 4 beeps (♪♪♪♪)

- Motor efficiency is set to lower motor currents
- Recommended when changing from a Lehner to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Hacker, Kontronik (BL&Fun) and Lehner motors
- Not for Plettenberg motors

Mode 5: Soft timing, **9.6 kHz,** 5 beeps (♪♪♪♪♪)

- Motor efficiency is set to low motor currents
- Use when having problems with runtime and/or too much current on very sharp Lehner and Hacker motors at relatively low currents
- For lowest idle current on Hacker, Kontronik BL/Fun-series and Lehner motors (e. g. duration contest)
- Not for Astro, Aveox, Bittner, Köhler and Plettenberg motors

Modus 6: Very soft timing, **9.6 kHz,** 6 beeps (♪♪♪♪♪♪)

- For lowest idle current on Hacker, Kontronik BL/Fun-series and Lehner motors (e. g. duration contest)
- Not for Astro, Aveox, Bittner, Köhler and Plettenberg motors

See also setting procedure for “set operating mode” section 8.5.2

8.4.3.1 *future*-70Po/-88Po and -80Fo/ -88Fo/ -111Fo

(F5D-Pylon and F5B and F5F Sailplanes)

- **Fixed stick positions:** brake = 1.2 ms, full throttle = 1.8 ms

a Receiver off (flight battery disconnected)

b Set transmitter stick to brake position (technically: pulse width less than 1.2 ms)

c Switch transmitter on

TXon

d Connect flight battery, ***future*** confirms with 'power-on' beeps

♪♪♪♪♪

e Switch receiver on

RXon

f The ***future*** detects brake position,
shows "set operating mode" with single tone beep(s),
and is now armed!

♪(♪…♪)

g The ***future*** is completely configured and is ready for use

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

i The model can be taken off

8.4.3.2 “set operating modes” Pylon- und FAI- *future*

Mode 1: Very hard timing, **19 kHz,** 1 beep (♪)

- highest power and rotational speed
- Optimum for all Plettenberg motors and all other motors when maximum rotational speed is needed

Mode 2: Hard timing, **19 kHz,** 2 beeps (♪♪)

- Use when having problems with runtime and/or too much current on Plettenberg motors
- Optimum for all Astro, Bittner and Köhler motors

Mode 3: Medium hard timing, **19 kHz,** 3 beeps (♪♪♪)

- Motor efficiency is set to medium motor currents
- Recommended when changing from a Kontronik to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Aveox and Kontronik KBM motors
- Not for Plettenberg P6 motors

Mode 4: Medium timing, **19 kHz,** 4 beeps (♪♪♪♪)

- Motor efficiency is set to lower motor currents
- Recommended when changing from a Lehner to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Hacker, Kontronik (BL&Fun) and Lehner motors
- Not for Plettenberg motors

Mode 5: Soft timing, **19 kHz,** 5 beeps (♪♪♪♪♪)

- Motor efficiency is set to low motor currents
- Use when having problems with runtime and/or too much current on very sharp Lehner and Hacker motors at relatively low currents
- For lowest idle current on Hacker, Kontronik BL/Fun-series and Lehner motors
- Not for Astro, Aveox, Bittner, Köhler and Plettenberg motors

Modus 6: Very soft timing, **19 kHz,** 6 beeps (♪♪♪♪♪♪)

- For lowest idle current on Hacker, Kontronik BL/Fun-series and Lehner motors
- Not for Astro, Aveox, Bittner, Köhler and Plettenberg motors

See also setting procedure for “set operating mode” section 8.5.2

8.4.4 *future* -He/ -Ho/ -20Le (Helicopter)

- **Fixed stick positions:** idle (off)=1,1 ms, full throttle=1,9 ms
- **Soft initial start** (**-H** types = up to 10 seconds)
- **See also:** section 9 “tips helicopter use“
- **“set operating modes”:** -20Le: section 8.4.1.4; others: section 8.4.1.5

8.4.4.1 Standard controller mode helicopter- *future*

a Receiver off (flight pack disconnected)

b1 Set transmitter stick to idle position (motor off)
(in technical terms: pulse widths less then 1.1 ms)

c Switch on transmitter **TXon**

d Switch on Receiver (connect flight pack) **RXon**

e ***future*** shows “set operating mode” with single tone beep(s) ♪(♪…♪)

f ***future*** waits 2 seconds, confirms “standard controller mode” with a single tone beep and is now armed.

g ***future*** is completely configured and ready to use

h Move the transmitter stick towards full throttle,
and the motor starts running.

i The helicopter can be flown

Tip: To provide finer control of the pre-set rotor speed, set up the slider channel on the transmitter so that the full-throttle end-point correspondends to the maximum rotor speed you ever need (e. g. for aerobatics). You can achieve this by reducing servo travel, and/or adjusting the neutral point if necessary. It is usual to use a 3-position toggle switch (motor off / hover / cruise) if you wish to use fixed rotational speeds.
The reduced servo travel normally does not affect initialisation of the **high rpm** mode.

Speed ranges of armed ***future***, relating to 4-pole motors:

Low rpm:	Slider at 1.15 ms = 3.966 rpm;	Slider at 1.9 ms = 28.935 rpm
High rpm:	Slider at 1.15 ms = 7.931 rpm;	Slider at 1.9 ms = 57.870 rpm

8.4.4.2 Speed regulator mode helicopter- *future*

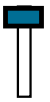
• **Constant** rotor head speed (only -H types, not for ***future-20Le***)

a Receiver off (flight pack disconnected)

b2 Regulator mode 2- and 4-pole motors (**low rpm**):
Set slider slightly above idle (motor start) position
(motor start ... center pos. = -90% ... 0% servo travel,
in technical terms: pulse width 1.15...1.5 ms).

b3 Regulator mode 6-, 8- and 10-pole motors (**high rpm**):
Set slider to mechanical end point (pre-chosen rpm)
(pulse width for **high rpm** is in the range of 1.5 ... 2.0 ms =
center...full throttle position = 0%...+150% servo travel).

or



c Switch on transmitter **TXon**

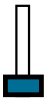
d Switch on Receiver (connect flight pack) **RXon**

e ***future*** shows "set operating mode" with single tone beep(s) ♪(♪…♪)

f ***future*** detect idle position, confirms with
2- or 3 beeps (according to mode)


♪♪(♪)

g Move slider to minimal possible pulse widths (motor off) (in
technical terms: pulse widths lower 1.1 ms)



h ***future*** detect idle sitting, confirms with beep and is armed

i ***future*** is completely configured and ready to use

j Move slider in the direction of full-throttle to set the rotor
speed you require (see below)

k The helicopter can be flown

Unknown pole count of the motor: To find out the **low rpm** or **high rpm** "stick operating mode" do as follows: Start in **low rpm** mode. If the maximum rotor speed is good for cruise, you found the right mode. Otherwise use **high rpm** "stick operating mode".

Auto-rotation: If the slider channel is moved back to minimum speed by a mixer (not to the "motor stopped" position, but to about 1.18 ms (Graupner=-80%)), the integral soft-start designed for manual speed changes is reduced to the point where an auto-rotation can be interrupted quickly by suddenly (autorotation switch, no soft start) opening the throttle again. If you preselect the "motor stopped" position (less then 1.1 ms) for autorotation, it will be nearly impossible to interrupt autorotation by means of the 10 second soft start.

Under-voltage: As soon as the voltage of the drive battery is not high enough the motor is throttled back first. Later ***future*** is switched off.

8.4.5.1 *future*-58Ce/ -58Co/ -88Ce/ -88Co/ -102Co (ips-car)

- **Proportional brake**
- **Full stick travel:** full throttle/brake = neutral position + - 0.3 ms
- **BEC 5.7 V / 3 A** (future-__Ce only)
- **Splashproof sealing** for offroad use (optional, additional costs)

a Receiver off (drive battery disconnected)

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

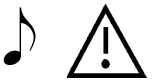
c Switch transmitter on **TXon**

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

e ***future*** learns neutral position and
shows “set operating mode” with single tone beep(s) ♪(♪…♪)

f ***future*** waits 2 seconds,
calculates full-throttle position (neutral position + 0.3 ms)
and brake position (neutral position - 0.3 ms)

g ***future*** confirms with single beep and is now armed!



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

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

Hint:

If you leave the stick in the reverse position (over 80% reverse travel, i.e. less than 0.24 ms below the learned neutral position) for longer than 1.2 seconds, the boat will accelerate slowly in reverse.

Disabling reverse mode: set servo travel for reverse mode to significantly less than 80%.

The configured throttle positions are stored in the ***future*** until you disconnect the drive battery.

8.4.5.2 “set operating modes” car- *future*

Mode 1: Very hard timing, **9.6 kHz,** 1 beep (♪)

- Maximum efficiency at highest power and rotational speed
- Optimum for all Plettenberg motors and all other motors when maximum rotational speed is needed

Mode 2: Very hard timing, **19 kHz,** 2 beeps (♪♪)

- similar to mode 1, but higher switching frequency especially for low turn motors

Mode 3: Medium hard timing, **9.6 kHz,** 3 beeps (♪♪♪)

- Motor efficiency is set to medium motor currents
- Recommended when changing from a Kontronik to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Aveox and Kontronik KBM motors

Mode 4: Medium hard timing, **19 kHz,** 4 beeps (♪♪♪♪)

- similar to mode 3, but higher switching frequency especially for low turn motors

Mode 5: Medium timing, **9.6 kHz,** 5 beeps (♪♪♪♪♪)

- Motor efficiency is set to lower motor currents
- Recommended when changing from a Lehner to a Schulze speed controller with a given motor. The rotational speeds coincide more closely with the manufacturers’ stated figures
- Optimum for all Hacker, Kontronik (BL&Fun) and Lehner motors
- Not for Plettenberg motors

Mode 6: Medium timing, **19 kHz,** 6 beeps (♪♪♪♪♪♪)

- similar to mode 5, but higher switching frequency especially for low turn motors

See also setting procedure for “set operating mode” section 8.5.2

8.5.1 Mode setting of the “set operating mode” of *future* -bo/ -be/ -Ko/ -Le/ -He/ -Ho

a	Switch transmitter on	**TXon**
b	Switch receiver on (***future*** with opto coupler)	**RXon**
c	Set transmitter stick to full throttle position	
d	Connect Drive-/Flight battery	**BATTon**
e	***future*** shows old “set operating mode“ with single tone beep(s)	♪(♪..♪)
f	Wait, ***future*** beeps “stick operating mode” (2 or 3 beeps, according on type)	⧖ ♪♪(♪)
g	Wait for double tone beep (10 s)	⧖ ♪♪
h	Move throttle stick to stop position within 1.5 seconds	
i	Wait for double tone beep again (1.5 s)	⧖ ♪♪
j	Move throttle stick to full throttle position within 1.5 seconds	
k	Wait for double tone beep again This beep means: ”Caution, count signals” (i.e. with your fingers)	⧖ ♪♪
l	Wait for 2 seconds, after that first beep sounds (mode 1) To select mode 1: after that instantly go to **r**	⧖ ♪
m	Wait for 2 seconds, after that second beep sounds (mode 2) To select mode 2: after that instantly go to **r**	⧖ ♪
n	Wait for 2 seconds, after that third beep sounds (mode 3) To select mode 3: after that instantly go to **r**	⧖ ♪
....		**....**
q	Wait for 2 seconds, after that last beep sounds (max. possible mode n) To select mode n: after that instantly go to **r**	⧖ ♪
r	Move throttle stick to stop position instantly	
s	Wait for double tone beep (again: ”count signals”)	⧖ ♪♪
t	The ***future*** waits 2 seconds, then repeats the stored “set operating mode” and continues with **s** (To interrupt this you must disconnect the battery)	⧖ ♪(♪..♪)

Note: if the number of maximum possible modes is exceeded, the mode change is invalid. This means: if you wait longer than 2 seconds after the maximum possible number of mode beeps, or if you fail to observe the time sequence described above, the mode change is invalid.
The ***future*** then beeps continuously using the old mode (which is still valid), and waits until you disconnect the battery.

8.5.2 Mode setting of the “set operating mode” of *future* -C (Car), -W (Boot), -F (FAI), -P (Pylon)

a	Switch transmitter on	**TXon**
b	Switch receiver on (***future*** with opto coupler)	**RXon**
c	Set transmitter stick to full throttle position	
d	Connect Drive-/Flight battery	**BATTon**
e	***future*** confirms with ‘Power-On’ beeps (not available in -C and -W type)	
f	Wait for double tone beep (10 s)	
g	Move throttle stick to stop position within 1.5 seconds	
h	Wait for double tone beep again (1.5 s)	
i	Move throttle stick to full throttle position within 1.5 seconds	
j	Wait for double tone beep again This beep means: ”Caution, count signals” (i.e. with your fingers)	
k	Wait for 2 seconds, after that first beep sounds (mode 1) To select mode 1: after that instantly go to **q**	
l	Wait for 2 seconds, after that second beep sounds (mode 2) To select mode 2: after that instantly go to **q**	
m	Wait for 2 seconds, after that third beep sounds (mode 3) To select mode 3: after that instantly go to **q**	
....		**....**
p	Wait for 2 seconds, after that last beep sounds (max. possible mode n) To select mode n: after that instantly go to **q**	
q	Move throttle stick to stop position instantly	
r	Wait for double tone beep (again: ”count signals”)	
s	The ***future*** waits 2 seconds, repeats the stored “set operating mode” and is armed	

Note: if the number of maximum possible modes is exceeded, the mode change is invalid. This means: if you wait longer than 2 seconds after the maximum possible number of mode beeps, or if you fail to observe the time sequence described above, the mode change is invalid.
The ***future*** then beeps once using the old mode (which is still valid), and waits until you arm the system by moving the transmitter stick to the “Stop” position.

9 Tips

9.1 Rotational speeds:

future speed governors and controllers generally produce higher rotational speeds than Kontronik controllers. In order to maintain the same load on the motor, this requires a change to a motor pinion around 8% smaller (i.e. around 1 - 2 teeth) when you switch to the ***future***, otherwise you will overload the motor.
This applies not to Plettenberg or Köhler motors. Depending on the construction of the motor they will run about 2% faster only.

9.2 Start-up problems, controller / governor faults:

We have now established that the usual cause of unreliable motor start-up problems is poor contact in the connectors.
Inadequate contact can result in faults due to excessive voltage, especially when the high-voltage versions of the ***future*** are used, because the high resistance of the connectors prevents the voltage being passed back into the battery at mid-range settings, and especially during braking. Examples of poor practice:

- Solder between the contact segments of the plug
  - Remedy: solder on a brand-new plug.
- Resin (electronic solder flux) under the contact segments of the plug
  - Remedy: remove flux residues with meths or contact cleaner.
- Over-long leads between battery and ***future***
  - Remedy: shorten to permissible length (chapter 6).
- Lack of spring pressure in the contact segments
  - Remedy: solder on brand-new plugs, and be sure to cool the segments when soldering.
- Poor-quality connectors. Oxidised sockets (black inside), discoloured gold plating (greenish or grey).
  - Remedy: use high-quality plugs and sockets from a brand-name manufacturer
  - Remedy: don't use cheap goods from the Far East
  - Remedy: contact segments should be made of copper-beryllium - no mild steel contacts!

9.3 Overheating motors:

If you are using a Graupner Carbon 70, Hacker, Kontronik BL or Simprop motor, never shorten the winding wires which project from the motor. The strands are coated with high-temperature lacquer, and it is impossible to solder through this material. To obtain a sound soldered joint you must mechanically remove the lacquer coating all round each individual strand. Any strands which are not soldered or fractured cause an increase in current flow through each remaining wire, and this in turn causes a lower efficiency and increase in motor temperature.

9.4 Interferences:

We regognized some interference in combination with certain types of motors. These interferences occurs in combinations with different manufacturers of controllers.

9.5 Multi-motor operation:

In general terms we do not recommend operating multiple motors with a ***future***. From some of our customers we have heard that this certainly works with some (but not all) Aveox, Hacker and Lehner motors, provided that the currents do not exceed the permissible maximum values for the speed controller concerned. However, we cannot guarantee that both motors will rotate over the full load range.
It is never permissible to run more than one Plettenberg motor connected to a single ***future***: you must use a separate ***future*** for each motor. However, you can certainly power both controllers from a single drive battery.

9.6 Helicopter use:

9.6.1 Note: Fixed stick positions means: idle (off) = 1.1 ms, full throttle = 1.9 ms. If you are using a Graupner RC system this equates to +/- 100% stick travel. If you find that you cannot arm the controller reliably, the solution is to increase servo travel to about 105%...110%.
In speed regulator mode the full throttle setting on a slider should be different - according to the maximum rotational speed you require - and must not be necessarily 100%.
Important: If you are using the ***future*** as a normal speed controller in your helicopter, you must connect the future's servo cable to the receiver output which produces the throttle curve set on the transmitter when you operate the collective pitch control.
If you are using the ***future*** as a speed regulator (governor), you must not connect the controller to the receiver channel which produces the throttle curve. Instead connect it to a channel which is controlled directly by a slider or rotary control on the transmitter, i.e. a channel not affected every time by the collective pitch control. If you ignore this, motor speed will change every time you give a collective pitch command.

9.6.2 Helicopter motors (efficiency / temperature):

For helicopter applications the motor's maximum efficiency should be around 15 A, and not at the maximum currents which can occur briefly in aerobatics.

9.6.3 Rotational speed fluctuations in governor mode:

- The first step is to test the ***future*** in standard speed controller mode (not speed regulator mode). Test it if the air is not smooth. If tail oscillation occur, the gyro is incorrectly set up, and/or the tail rotor servo is too slow, and/or the tail rotor control mechanism and/or the helicopter chassis is not rigid enough. There must be absolutely no play in the sliding sleeve linkage, the blades, the ballraces in the sleeve and in the tail rotor blades.
- If the transmission includes a belt drive, especially in the main rotor system, the belt must be adaquately tensioned.
- Receiver interference may affect the nominal rotor speed, and cause fluctuations in rotational speed. In "normal controller" mode this interference is not usually detectable. Please use a PCM-receiver.
- Please mount the gyro on the tailboom, not in or on the chassis.

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.
Warranty claims are processed according to our current General Conditions of Business, which are printed in our catalogue.

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).

10.2 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.

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.

10.4 Connection to Tango and Samba motors

We do not recommend that you operate these motors with ***future*** controllers, as this may invalidate the warrantee. **However,** in technical terms there is no problem, provided that you set the appropriate frequency.

11 Specifications

Key to the product summary on the next page (in Chapter 12).

Weight: **Excluding** - including cables

Current rating: **Nominal current / maximum 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 ***future*** can be operated when connected to a 2 Ah battery (1 Ah for -18be, -25be, -20He; 1250 mAh - 80Fo).

Throttle, brake: **Internal** resistance of the MOSFETs, based on data sheet values (25°C / 10 V gate voltage). At 125°C the resistance is about 40% higher. For this reason you should always provide an effective flow of cooling air over the ***future*** to prevent it getting too hot.

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.
future-__Fo: Fixed brake point = 1.2 ms, fixed full throttle point = 1.8 ms.

Rotational speed: the rotational speed stated above is the limit value for a 4-pole motor (...P4). The following multiplication factors apply: P2= *2; P4= *1; P6= *0.67; P8= *0.5; P10= *0.4. The speed limiter provides some level of protection against the armature magnets of HP 220 motors flying off. Note: this speed limit is too high for the "washing machine" motor types.

BEC: **The** stated peak current is dictated by the maximum current value of the 5V voltage regulator; it can only flow for less than 0.5 seconds, followed by a cooling-off period.
The stated continous current is much lower and is determined by the maximum power dissipation of the voltage regulator used in the unit ($V_{loss} = V_{battery}$ - 5 V BEC-voltage).
Pay attention when connecting micro-servos: the current consumption is mostly 2...3 times higher than the current of the Graupner C341 servo! The BEC System can be overload by temperature when using more than 8 cells and more than 3 servos!
Maximum permissible dissipated power: approx. 2 W with ***future***-18 ...-25 (400 mA continuous current at 10 V). Approx. 3.6 W (400 mA continuous current at 14 V) with the other ***future*** types with BEC (-45be, -45He).

Pulse frequency: see "set operating modes" of every type group.

Soft-start: the soft-start feature on throttle and brake is not the same for the standard versions and special versions (boat, car, helicopter, pylonracer or FAI-sailplane); it is matched to the requirements of each application.

Temperature: Overtemperature threshold approximately 110°C.

Note: **If** you have been using a sensor-controlled speed controller, you may find that now your motor's maximum speed is different when you use the ***future***. **The** timing of sensor-equipped motors is set for a particular rotational speed and a particular load (similar to the advance setting of an internal combustion engine's timing), but the ***future*** automatically optimises the timing (within the pre-setted timing) for maximum efficiency under all load conditions. **This** means that the timing does not depend on the position of the speed sensors as dictated by the mechanical design, nor on the accuracy with which they are installed. **The** net result is that you may find that the maximum rotational speed of your motor is higher - combined with higher current; or lower - combined with lower current.
For this reason it may prove necessary to experiment with new propeller sizes when you make the switch to a sensorless controller or you simply use the timing adjustment features of this new ***shpa*** software.

12 Product overview

Type	Current	Ni-Cd	Size	Weight	Cable	Thrott.	Brake	Rot.Sp.	Version	Special features
unit	[A]	[cells]	[mm]	[g]	[mm²]	[mΩ]	[mΩ]	[min⁻¹]		
Common Airplane:										
***future*-18be**	18/24	6-10	50*25*10	16-21	1.5	6.5+7	6.5/3	63000	15i	15 FETs,BEC5V/1.5A
***future*-25be**	25/33	6-10	50*25*12	18-23	1.5	4+4.7	4/3	63000	15i	15 FETs,BEC5V/1.5A
***future*-45bo**	45/60	6-17	74*24*12	25-35	2.5	2.2*2	2.2/3	63000	15a	36 FETs, w.cool.plate
***future*-45be**	45/60	6-12	74*24*17	32-42	2.5	2.2*2	2.2/3	63000	15a	BEC 5V / 3A " "
***future*-45Ko**	45/60	6-17	74*24*14	28-38	2.5	2.2*2	2.2/3	63000	15a	36 FETs, w.cool.rips
***future*-58bo**	58/77	7-17	74*24*12	25-35	2.5	1.4*2	1.4/3	63000	15a	36 FETs, w.cool.plate
***future*-35bo**	35/45	16-30	81*24*14	28-38	2.5	4.0*2	4.0/3	63000	15a	36 FETs, w.cool.rips
***future*-55bo**	55/70	16-30	81*24*19	37-50	2.5	2.0*2	2.0/3	63000	15a	72 FETs, w.cool.rips
Contest (FAI-sailplane):										
***future*-88Fo**	88/130	7-17	74*24*14	27-44	4.0	0.7*2	0,7/3	120000	17b	36 FETs, w.cool.plate
***future*-111Fo**	111/148	7-17	74*24*16	33-50	4.0	0.7*2	0.7/3	120000	17b	72 FETs, no cool. plate
***future*-80Fo**	80/110	16-28	81*24*19	38-50	2.5	2.0*2	2.0/3	120000	17d	72 FETs, w.cool.rips
***future*-102Fo**	102/136	16-24	81*24*19	37-57	4.0	0.8*2	0.8/3	120000	17b	72 FETs, w.cool.rips
Pylon:										
***future*-70Po**	70/120	7-10	69*24*10	21-31	2.5	1.4*2	1.4/3	120000	17b	36 FETs, thin, leightw.
***future*-88Po**	88/130	7-10	69*24*11	24-41	4.0	0.7*2	0.7/3	120000	17b	36 FETs, thin, leightw.
Helicopter:										**Allowed servo type:**
***future*-18Le**	18/24	6-10	50*25*10	16-21	1,5	6,5+7	-	63000	17L	BEC5V/1,5A - **C261**
***future*-18He**	18/24	6- 8	50*25*10	16-21	1,5	6,5+7	-	63000	~~17f~~	BEC5V/1,5A - **C261**
***future*-20Le**	20/33	6-10	50*25*12	18-23	1,5	4+4.7	-	63000	17L	BEC,cool.plate
***future*-20He**	20/33	6- 8	50*25*14	20-25	1.5	4+4.7	-	63000	~~17f~~	BEC,cool.rips - **C261**
***future*-45Ho**	45/60	6-17	74*24*14	28-38	2.5	2.2*2	-	63000	17f	36 FETs, w.cool.rips
***future*-45He**	45/60	6-10	74*24*17	32-44	2.5	2.2*2	-	63000	17f	BEC 5V/3A, w.cool.rips
***future*-35Ho**	35/45	16-30	81*24*14	29-39	2.5	4.0*2	-	63000	17f	36 FETs, w.cool.rips
Car:										
***future*-58Co**	58/77	6-10	69*24*18	36-46	2.5	1.4*2	1.4/3	63000	15e	36 FETs, w.cool.rips
***future*-58Ce**	58/77	6-10	69*24*21	43-55	2.5	1.4*2	1.4/3	63000	15e	BEC 5.7V/3A, cool.rips
***future*-88Co**	88/130	6-10	69*24*18	36-53	4,0	0,7*2	0,7/3	63000	15e	36 FETs, m.Rippen-Kk
***future*-88Ce**	88/130	6-10	69*24*21	43-62	4,0	0,7*2	0,7/3	63000	15e	BEC 5,7V/3A, m.R.-Kk
***future*-102Co**	102/136	16-24	81*24*31	56-73	4,0	0,8*2	0,8/3	63000	15e	72 FETs, m.Rippen-Kk
Boat (Water):										
***future*-45Wo**	56/65	6-17	74*24*18	44-54	2.5	2.2*2	-	63000	16w	36 FETs, w.cool.tubes
***future*-45We**	56/65	6-12	74*24*24	46-58	2.5	2,2*2	-	63000	16w	BEC 5V/3A,w.cool.tub.
***future*-62Wo**	62/82	7-22	74*24*18	44-54	2.5	1.5*2	-	63000	16w	36 FETs, w.cool.tubes
***future*-88Wo**	88/130	7-17	74*24*14	29-46	4.0	0.7*2	-	63000	16w	36 FETs, w.cool.plate
***future*-105Wo**	105/130	7-17	74*24*18	41-58	4.0	0.7*2	-	63000	16w	36 FETs, w.cool.tubes
***future*-157Wo**	157/209	7-17	74*24*16	33-50	4,0	0,3*2	-	63000	16w	72 FETs, w.cool.plate
***future*-35Wo**	42/50	16-30	81*24*18	41-51	2.5	4.0*2	-	63000	16w	36 FETs, w.cool.tubes
***future*-55Wo**	65/80	16-30	81*24*23	53-63	2.5	2.0*2	-	63000	16w	72 FETs, w.cool.tubes
***future*-102Wo**	102/136	16-24	81*24*16	40-57	4,0	0,8*2	-	63000	16w	72 FETs, w.cool.plate

Conversion to and from brushed motor mode

Brushed motor mode is not longer available from production date 23.8.00 because of new improvements.

The *future-...bo,Co,Ce,Wo* could be used to control conventional motors at up to 2/3 of the controller's nominal current. These motors must be connected to the outer two sockets marked "motor".