future-u (u = universal)

speed controller for brushless and sensorless motors

operating instructions v1(FAI)/v2(Heli) date of issue: 04 MAY 2002

schulze elektronik gmbh

Please read 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

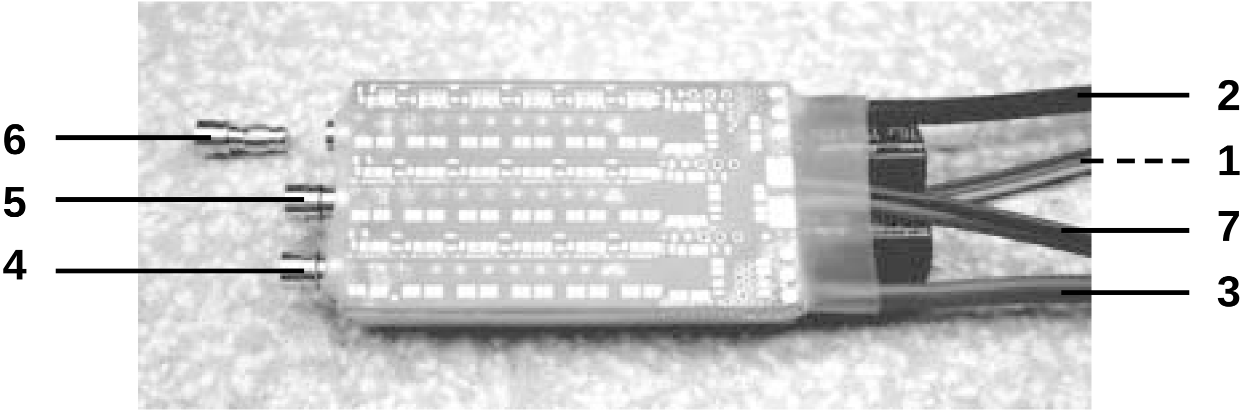
Please note the following guidelines, which apply when you are connecting the motor and reversing its direction of rotation:

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 DIL-switch facing the outside of the fuselage.

schulze elektronik gmbh • prenzlauer weg 6 • D-64331 weiterstadt • fon: 06150/1306-5, fax: 1306-99
internet: http://www.schulze-elektronik.com e-mail: mail@schulze-elektronik.com



Key to illustration:
(Low voltage type with BEC)

4 Motor connection a . . . red
5 Motor connection b . . . white, yellow
6 Motor connection c . . . blue, black

7 BEC-cable , 2-core
- = neg. . . . . braun
+ = pos. . . . . rot

1 Receiver cable, 3-core
2 Battery connection neg. (-) black
3 Battery connection pos. (+) red

DIL-switch configured to: wing, brake enabled, no gear, soft timing, 9 kHz

DIL-switch configured to: heli, const.-rpm, high-rpm hard timing, 9 kHz

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 *ipsu* (**i**ntelligent **p**rogramming **s**ystem for ***future-u***niversal) makes it as simple as possible to configure the controller to match any radio control system and operating mode: The transmitter stick travel settings of the wing programs is fully automatical, the operating modes can easily be configured by the DIL switch.

The integral motor connector system is a feature of all ***future*** controllers up from 28 A 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.

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!

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 <u>not</u> attach the end of the aerial to the fin!

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

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

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

... your transmitter is switched on and the throttle stick is (as a rule) in the STOP position (exceptions see Section 9).

Carry out a range check before each flight. Ask an assistand to hold the model aircraft and set the throttle stick to the half throttle position. 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 and common highlights:

Common Highlights:

Almost all of this series of future controllers are universal types which can be used in model aircraft, helicopters, boats and cars; they include an opto-coupler which ensures minimum possible transfer of interference to your receiver. Some versions include a BEC system, and the opto-coupler is by-passed if you use it. However, if you encounter interference problems, the opto-coupler can be re-activated by disconnecting the twin-core BEC lead (Chapter 6).

The types with an ”F” in the designation feature a special program for FAI gliders with an abbreviated soft-start, instead of the helicopter program.

All future controllers with a ”K” in the type designation feature a finned heat-sink instead of a plain heat-sink. These units are an excellent choice for use under part-load conditions, i.e. operating them primarily at part-throttle settings does not lead so quickly to overheating, even with high cell counts.

Better than 250-step resolution over the whole control range for extremely fine speed control.

„Auto-arm“ function and „power on reset“.

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

„ipsu“ (**i**ntelligent **p**rogramming **s**ystem for ***future-u***) with no pots! The speed controller automatically configures itself every time to the stick travel when you go airborn. The brake can also be disabled in the same way if required.

During the “Power-On” process the motor acts as a loudspeaker to give you audible confirmation of the procedure.

„W“-Types (splash **w**ater protected) available.

All ***future-u*** types include a timing and switching frequency adjustment facility, which enables you to make adjustments by a DIL switch. 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 (see section 8.3). 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).

Low voltage types with BEC:

***future*-12.36e:** For 6-12 (in helicopters up to 10 cells only) Ni-Cd resp. Ni-MH cells when 5 V/3 A BEC system is used. Can be used otherwise up to 18 cells. For motors up to 36 A in small soft-sailplanes, motor models or helicopters.

***future*-12.46e:** For 6-12 (in helicopters up to 10 cells only) Ni-Cd resp. Ni-MH cells when 5 V/3 A BEC system is used. Can be used otherwise up to 18 cells. For motors up to 46A in sailplanes, motor models or helicopters.

***future*-12.46We:** For Eco and Mono I/II boats

***future*-18.97Fe:** For 6-12 Ni-Cd resp. Ni-MH cells. For motors up to 97A. FAI- instead of Heli-programm. Well suited for 10th scale cars.

***future*-18.97FWe:** For Eco, Mono, Hydro I/II boats.

Niedervolt-Typen ohne BEC:

***future*-18.36:** For 6-18 Ni-Cd resp. Ni-MH cells. For motors up to 36A in sailplanes, motor models or helicopters with lower currents.

***future*-18.46K:** For 6-18 Ni-Cd resp. Ni-MH cells. For motors up to 46A. Contains cooling fins for excessive part load use in car models, larger wing aircraft or areobatic helicopters.

***future*-18.46WK:** For Eco, Mono, Hydro I/II boats.

***future*-18.61:** For 6-18 Ni-Cd resp. Ni-MH cells. For motors up to 61A. For hotliners and ducted fan models

***future*-18.97F:** For 6-18 Ni-Cd resp. Ni-MH cells. For motors up to 97A. FAI- instead of helicopter program. Best suited for the 10 cells FAI-programm and 10th and 8th scale RC-cars.

***future*-18.97FW:** For Eco, Mono, Hydro I/II boats.

***future*-18.129F:** For 6-18 Ni-Cd resp. Ni-MH cells. For motors up to 129A. FAI- instead of helicopter program. Best suited for all applications in cars and wing aircraft, where you will not give away a single millivolt.

***future*-18.129FW:** Best suited for all applications in boats and cars, where you will not give away only 1 millivolt.

24 cells high voltage-types:

***future*-24.40K:** For 6-24 Ni-Cd resp. Ni-MH cells. For motors up to 40A. Contains cooling fins for excessive part load use in wing aircraft or helicopters.

***future*-24.89F:** For 6-24 Ni-Cd resp. Ni-MH cells. For motors up to 89A. FAI- instead of helicopter program. Best suited for all applications in wing aircraft, where you will not give away a single millivolt in e.g. 24 cells FAI-sailplanes.

32 cells high voltage-types:

***future*-32.28K:** For 6-32 Ni-Cd resp. Ni-MH cells. For motors up to 28A. Contains cooling fins for excessive part load use in helicopters (scale - not 3D) or low current draw sport models.

***future*-32.40K:** For 6-32 Ni-Cd resp. Ni-MH cells. For motors up to 40A. Contains cooling fins for excessive part load use in helicopters (3D) or medium current draw sport models.

***future*-32.55:** For 6-32 Ni-Cd resp. Ni-MH cells. For motors up to 55A. Best suited for all high current draw aircraft and 5th scale cars.

***future*-32.55WK:** Best for Hydro III and power boats.

***future*-32.80F:** For 6-32 Ni-Cd resp. Ni-MH cells. For motors up to 80A. Best for contest use of F5B-sailplanes or 5th RC-Cars.

future*-32.80FWK:** When the ***32.55WK is not strong enough...

4 Protective circuits

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

Temperature monitor:

The temperature monitor throttles down the motor and later 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*** without BEC system 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.

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.

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. 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.

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). re-arming = 2 seconds “stopp”.

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 (helicopter = 1.5 s) 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 Kontrollanzeigen

Die *future* is not fitted with LED to indicate its operatinng state.

However, when the unit is being configured the set stick end-points are confirmed by a beep from the motor or a barely reciptible "blip" in full-throttle position when normal using with activated brake. (See also the corresponding section 8).

6 Installations, 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 (3-core) 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 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 and could cause current to flow from the receiver battery to the motor.

If you want to have a better protection against interference caused by the motor or want to switch off the BEC system by other reasons, please activate the opto-coupler by simply pull the two core BEC cable out of the receiver. Use now a separate receiver battery.

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 (end-to-end) 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 7 - 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).

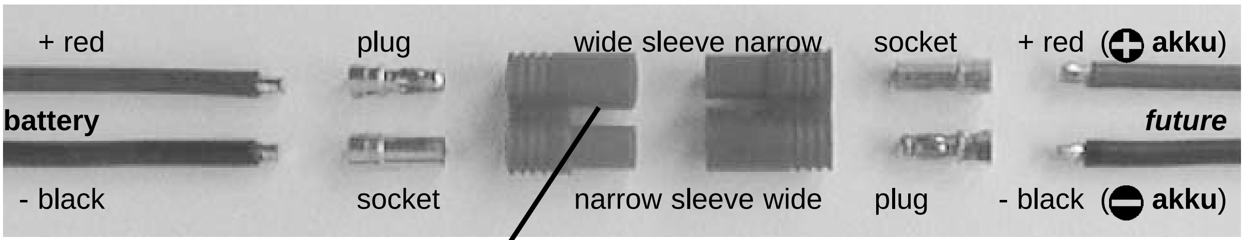
Cut down the existing motor cables to a length of no more than 10 cm. Do not extend the motor cables except in exceptional cases; although this generally does not harm to the ***future*** itself.

Locate the cables with the pp35 plugs supplied with the controller (plugged into the ***future***), and solder them to the motor cables. Observe solder instructions in section 7.1. 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; servos

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

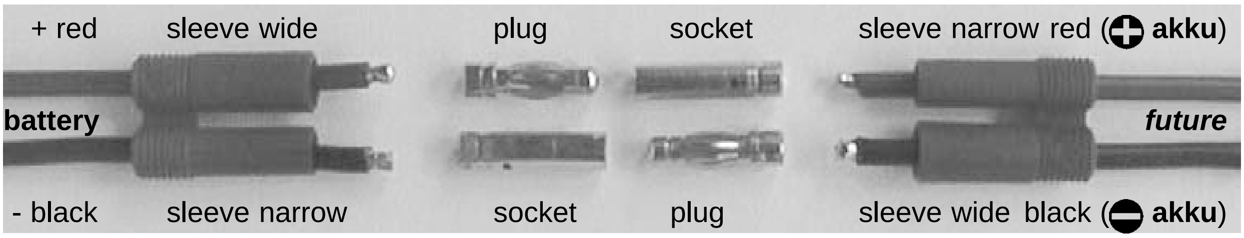


Caution: remove locating lug from battery cable. Do not remove lug from any cables attached to controllers or charge leads!

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.

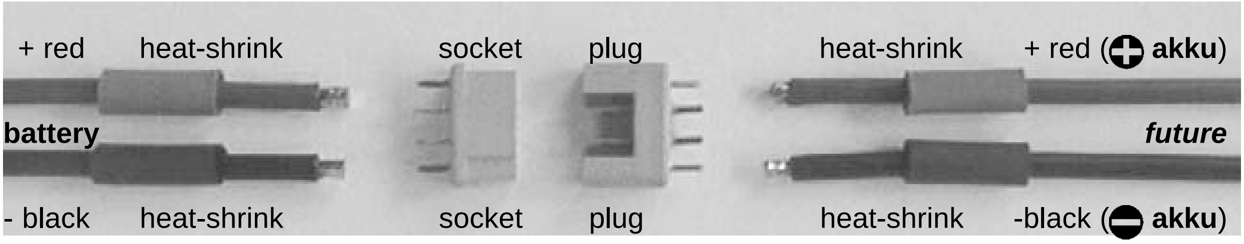
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Place plastic sleeve vertically on table, grip end up.
b. Push contact down into sleeve.
c. Place 2.5mm wide screwdriver blade on top of cable solder joint inside sleeve.
d. Tap screwdriver to press contact into sleeve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

7.2 CT4-4mm, CT2-2mm gold-contact connector system (current CT4 up to 80A; CT2 to 30A)



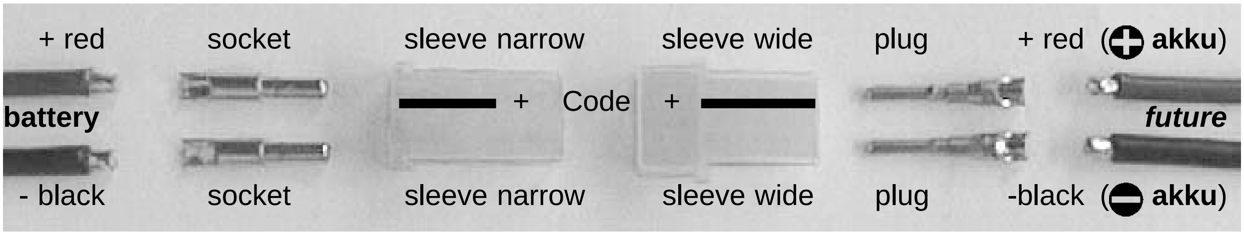
Fit the connectors in the order shown above; the contacts are pressed in as follows:
a. Rest plastic sleeve on vice jaws with cables hanging down.
b. Close vice jaws until cables are just free to move.
c. Fit plug into socket and tap into sleeve until latch engages.
d. Fit socket onto plug and tap into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

7.5 Suitable servos for BEC operation (selection)

DYMOND	D 60
FUTABA	5102
GRAUPNER	C261, C341, C351, C3041, C3321
MEGATECH	MTC FX200
ROBBE	FS40 #8433
VOLZ	Microstar, Wingstar, Zip

8 Initial use

8.1 ipsu, the intelligent programming system

for configuring the ***future-universal*** to suit your application

In general terms: in its standard form 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 or use uni-mode).

The ipsu consists of two components:

a) The DIL switch bank for setting the operating mode (configuring the controller to the application and motor) and

b) automatic transmitter stick travel setup.

Point **a)** is explained in the following pages; point **b)** includes two different procedures, of which **b1)** is also explained in the following pages:

The stick travel setup process is based on the previous standard procedure when the unit is first switched on, and is fully automatic:

b1) Under normal circumstances you simply proceed as previously: **1.** Transmitter to stop, **2.** Switch on receiver, **3.** Connect flight pack / drive battery (***future*** confirms this with "Power-On" tones = flight pack / drive battery connected), then learns the Stop position and confirms this with a beep; it is then armed, **4.** Hold model in launch / start position, **5.** Apply full-throttle (***future*** learns full-throttle point, confirms with brief drop in rotational speed), **6.** Launch / Start model. The process configures both the brake point and the full-throttle point, so full stick travel is always available when you operate the motor, giving ultra-fine control.

b2) If you find the brief motor speed drop at the full-throttle setting disturbing (confirmation of learned full throttle position), or don't wish to apply full throttle at launch / start, there is an alternative method: set the transmitter stick to the full-throttle position before you switch on the receiving system and connect the flight pack / drive battery. After the "Power-On" tones the ***future*** emits two beeps (to confirm it has learned the full throttle position); the transmitter stick is then moved to Stop, and the future emits one beep (to confirm it has learned the brake position); the controller is now armed, and the model can be launched or started at any throttle position.

In the model car and boat programs the controller only learns the neutral point; the full-throttle position is a fixed margin from the learned neutral point.

In the FAI and helicopter programs the stick travels cannot be configured by the user; i.e. the brake setting and full-throttle setting are both fixed.

If you wish to use one of the four type groups mentioned above, but want to exploit the full travel of the transmitter stick to vary motor speed, we recommend that you program a slight reduction in servo travel at the transmitter. Caution: if you reduce servo travel too far, full throttle will not be available, and - especially in the FAI and Heli program - the controller will not reach the Stop setting, and therefore will not reach the armed state!

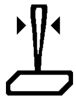
If your ***future*** beeps twice (double beep = full throttle position) when the transmitter stick is at the brake position, you must reverse the throttle channel using your transmitter's servo reverse function. If you neglect to do this, the future will be armed (single beep) at the transmitter's full-throttle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

The following pages explain exactly which type-specific setup facilities (operating modes) are available. They are sub-divided into the different applications of model aircraft, helicopters, cars and boats.

8.2 Symbols and terminology

Stick: The throttle stick on the transmitter

Neutral position (self neutralising stick, 1.4 ... 1.67 ms pulse width)
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.

Power-On melody (Flight-/drive battery connected)**:** ♪♪♪♪♪

Single beep (Brake position detected/learned, future is armed)**:** ♪

Double beep (Full throttle position detected/learned, future not armed)**:** ♪♪

Duotone beep(s) (future works with 38 kHz switching frequency)**:** ♪♪ (♪♪)

Momentary interruption in running (full throttle position learned while running)**:** (♪)

8.3 Changing part-load switching frequency

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.

Normally every DIL switch position takes effect directly when you connect the flight pack / drive battery, **but the process for switching to 38 kHz is an exception**; this only takes effect after you connect the battery, and switch from the 9 kHz setting (DIL switch #6=0, see below). Hint: Your action=underlined.

9 kHz: DIL switch #6 = 0, Power-ON, future beeps ♪ or ♪♪ according to stick position. This switch position also causes the unit to switch back from 19 kHz or 38 kHz to 9 kHz.

19/38 kHz: DIL switch #6 = 1, Power-ON, (**19 kHz:** future beeps ♪ or ♪♪; **38 kHz:** ♪♪ or ♪♪ ♪♪).

Switching from 9 kHz to 38 kHz: Throttle stick to full-throttle, DIL switch #6 = 0 (= 9 kHz), Power-ON, future beeps ♪♪; after the beeps: DIL switch #6 = 1 (= 38 kHz), future beeps ♪♪ ♪♪. Now move stick to Stop to arm the controller or disconnect the battery.

Switching from 38 kHz to 19 kHz: DIL switch #6 = 0 (= 9 kHz), Power-ON, future beeps: ♪ or ♪♪, according to stick position. Now disconnect flight pack / drive battery and wait 5 seconds. Move DIL switch #6 = 1 (= 19 kHz), Power-ON again, future again beeps ♪ bzw. ♪♪.

Note: If you configure the future to 19 or 38 kHz using **DIL switch position #6 = 1**, the setting is retained after you disconnect the flight pack / drive battery. At 9 kHz and 19 kHz all Stop and full-throttle beeps are emitted as single or double beeps (♪ or ♪♪); at 38 kHz they take the form of single or double duotone beeps (♪♪ or ♪♪ ♪♪) , in each case according to the throttle stick position.

8.4 Changing motor timing

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 possible to match model aircraft and boat propellers to suit a particular motor by altering (offsetting) the timing. ***future*** controllers feature up to four optional timing settings, but timing stages 2 and 4 are **not** available in the fixed-wing aircraft (wing) and helicopter programs (heli). In these programs DIL switch # 4 is used for certain auxiliary functions.

The numbers below refer to the positions of the DIL switches mentioned above:
0 = AUS/OFF = switch toggle towards motor sockets,
1 = EIN / ON = switch toggle towards battery cables.

Timing 1: Hard timing
DIL-switch # 5 = 0 „hard“
DIL-switch # 4 = 0 „not softer“ (other function on „Land“ and „FAI“-programs)
- Maximum efficiency at highest power and rotational speed
- Optimum for all Ikarus, Köhler, LRK, Plettenberg motores and all other motors when maximum rotational speed is needed

Timing 2: Medium timing
DIL-switch # 5 = 0 „hard“
DIL-switch # 4 = 1 „softer“ (available on „Land“ and „Air-FAI“-programms)
- Motor efficiency is set to medium motor currents
(e.g. runtime problems on Ikarus, Köhler, LRK, Plettenberg motors)
- 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 in FAI operation.

Timing 3: Soft timing
DIL-switch # 5 = 1 „soft“
DIL-switch # 4 = 0 „not softer“ (other function on „Land“ and „FAI“-programs)
- 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 Astro, Aveox, Bittner, Hacker, Kontronik and Lehner motors
- Not for Plettenberg motors

Timing 4: Very soft timing
DIL-switch # 5 = 1 „soft“
DIL-switch # 4 = 1 „softer“ (available on „Land“ and „Air-FAI“-programms)
- Motor efficiency is set to very 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

8.5.1 Mode setting <u>wing aircraft</u> models

DIL-switch # 1 = 0 (Air-Luft), # 2 = 0 (Wing-Fläche)

DIL-switch # 3 = 0 = brake OFF,
1 = brake enabled.

DIL-switch # 4 = 0 = direct drive or toothed wheel gearbox
1 = Belt drive gearbox

DIL-switch # 5 = 0 = Timing 1 (see section 8.4)
1 = Timing 3 (see section 8.4).

DIL-switch # 6 = 0 = 9 kHz part throttle switching frequency,
1 = 19 kHz resp 38 kHz (see section 8.3)

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*** confirms „Power-On“, ♪♪♪♪♪

f waits about 1 second, confirms <u>brake position</u> with a single tone beep (♪ resp. ♪♪ at 38 kHz) and is <u>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 

8.5.2 Mode setting <u>FAI sailplanes</u> (only in *future*...**F**)

DIL-switch # 1 = 0 (Air-Luft), # 2 = 1 (FAI)

Fixed throttle stick positions:
Stop =1,1 ms, full throttle=1,9 ms

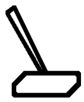
DIL-switch # 3 = 0 = brake OFF,
1 = brake enabled.

DIL-switch # 4 = 0 = Timing as # 5 (see section 8.4)
1 = Timing as # 5 + 1 (timing 2 resp. 4)

DIL-switch # 5 = 0 = Timing 1 (see section 8.4)
1 = Timing 3 (see section 8.4).

DIL-switch # 6 = 0 = 19 kHz **(!!!)** throttle switching frequency,
1 = 19 kHz resp. 38 kHz (see section 8.3)

a Receiver off (flight battery disconnected)



b Set throttle stick to brake position

c Switch transmitter on — **TXon**

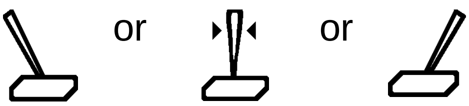
d Switch receiver on (connect flight battery) — **RXon**

e ***future*** confirms „Power-On“, ♪♪♪♪♪

f waits about 1 second, confirms <u>brake position</u> with a single tone beep (♪ resp. ♪♪ at 38 kHz) and is <u>armed</u>! ⧗ ♪

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

h The ***future*** is completely configured and the model can be launched without, with half throttle or full throttle.



8.5.3 Mode setting helicopter models (not in *future*...**F**)

DIL-switch # 1 = 0 (Air-Luft), # 2 = 1 (Helicopter-Hubschrauber)

DIL-switch # 3 = 0 = normal speed controller,
1 = speed governor (**const**ant rotor speed).

DIL-switch # 4 = 0 = Low rpm (see next page - Tips),
1 = High rpm (see next page - Tips)

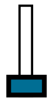
DIL-switch # 5 = 0 = Timing 1 (see section 8.4)
1 = Timing 3 (see section 8.4).

DIL-switch # 6 = 0 = 9 kHz part throttle switching frequency,
1 = 19 kHz resp. 38 kHz (see section 8.3)

a Receiver off (flight battery disconnected)

b Set pitch stick to „minimum pitch“

(c) **In speed governor mode only** („const. = ON“)**:**
Move slider resp. toggle switch to „motor off“ position

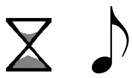


d Switch transmitter on **TXon**

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

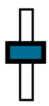
f ***future*** confirms „Power-On“,

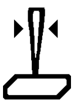
g waits about 1 second, confirms idle position with a single tone beep (♪ resp. ♪♪ at 38 kHz) and is armed!



h Model is ready to launch, keep clear of danger area around rotor blades!

(i) **In speed governor mode only** („const. = ON“)**:**
Move slider very quickly resp. set toggle switch in direction of hoovering throttle to set the rotor speed you require





j Move the transmitter stick towards hoovering position, the helicopter can be flown

Common to the helicopter mode:

- **Fixed stick positions:** Idle (off)=1,1 ms, full throttle=1,9 ms
- **slow initial motor start** up to 10 seconds

Speed ranges (v2, linear divided to the throttle slider), relating to **2-pole** motors:

approx. % values relating to the servo travel of the mc18...mc24 transmitters

Low rpm: Slider at 1,16 ms (-84,5%) = 3250 rpm, 1,9 ms (+100%) = 29500 rpm

High rpm: Slider at 1,16 ms (-84,5%) = 13000 rpm, 1,9 ms (+100%) = 118000 rpm

Unter-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.

Tips (see also section 9.6)**:**

Low rpm, high rpm:

To find out if you need to use the **low rpm** or **high rpm** operating mode do as follows: Start always in **low rpm** mode. If the maximum rotor speed is good for aerobatic, you found the right mode. Otherwise use **high rpm** mode.

Example 1: **Eco 8**, X250-4Hblack, 15 teeth pin.: **high rpm**, 1200rpm=-6%, 1500rpm=+19%
Example 2: **Logo10**, BL50-18S, 14 teeth pin.: **low rpm**, 1200rpm=+13%, 1500rpm=+23%
Example 3: **Logo20**, HP300/xx/Ax, 9 teeth pin.: **high rpm**, 1200rpm=-18%, 1500rpm=+5%

A %-calculation program „**HeliCalc**“ is available on our web page for download.

Pre-set of rotor speed:

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. It is usual to use a 3-position toggle switch (motor off / hover / cruise) or better: Autorotation / hoover- / cruise and a separate OFF-switch if you wish to use fixed rotational speeds.

Auto-rotation:

If the slider channel is moved back to minimum speed by a mixer (not to the “motor stopped” position, but to about 1.15 ms (Graupner=-87,5%)), 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, fast „soft“-start) opening the throttle again. If you preselect the “motor stopped” position (less then 1.14 ms) for autorotation, it will be nearly impossible to interrupt autorotation by means of the 10 second soft start.

8.5.4 Mode setting <u>car</u> models

DIL-switch # 1 = 1 (Land), # 2 = 0 (Auto-Car)

Fixed throttle stick travel:
Brake = neutral - 0,3 ms
Full throttle = neutral + 0,3ms

DIL-switch # 3 = 0 = Reverse gear OFF,
1 = Reverse gear enabled.

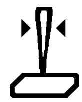
DIL-switch # 4 = 0 = Timing as # 5 (see section 8.4)
1 = Timing **softer than** # 5 (=timing 2 resp..4)

DIL-switch # 5 = 0 = Timing 1 (see section 8.4)
1 = Timing 3 (see section 8.4).

DIL-switch # 6 = 0 = 9 kHz part throttle switching frequency,
1 = 19 kHz resp. 38 kHz (see section 8.3)

a Receiver off (flight battery disconnected)

b Set transmitter stick to centre position (1.4 ... 1.67 ms)



c Switch transmitter on

TXon

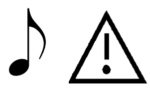
d Switch receiver on (connect flight battery)

RXon

e ***future*** confirms „Power-On“

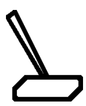
f waits about 1 second and calculates the full throttle and full brake position **(neutral position + - 0,3 ms)**,

g confirms <u>neutral position</u> with a single tone beep (♪ resp. ♪♪ at 38 kHz) and is <u>armed</u>!



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

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



j **If reverse gear is enabled:**
If you leave the stick in the reverse position (over 75% reverse travel, i.e. less than 0.225 ms below the learned neutral position) for longer than 1.2 seconds, the car will accelerate slowly in reverse.

8.5.5 Mode setting <u>boat</u> models

DIL-switch # 1 = 1 (Land), # 2 = 1 (Boot-Boat)

Fixed throttle stick travel: value depends on stick positions

DIL-switch # 3 = 0 = Reverse gear OFF,
1 = Reverse gear enabled.

DIL-switch # 4 = 0 = Timing as # 5 (see section 8.4)
1 = Timing **softer than** # 5 (=timing 2 resp. 4)

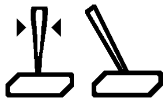
DIL-switch # 5 = 0 = Timing 1 (see section 8.4)
1 = Timing 3 (see section 8.4).

DIL-switch # 6 = 0 = 9 kHz part throttle switching frequency,
1 = 19 kHz resp. 38 kHz (see section 8.3)

a Receiver off (flight battery disconnected)

b1 Set stick to centre position (for forward/reverse use) or
b2 Set stick to end posltion (stop, for double stick travel)

oder



c Switch transmitter on **TXon**

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

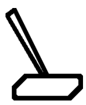
e ***future*** confirms „Power-On“, waits about 1 second and

f1 calculates the full throttle and reverse position **(idle + - 0,3 ms)**
f2 resp. calculates the full throttleposition **(idle + 0,6 ms)**,

g confirms with a single tone beep (♪ resp. ♪♪ at 38 kHz) and is <u>armed</u>!

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

i2 Moving the transmitter stick towards reverse gear the boat slow down



j2 **If reverse gear is enabled and b2):**
If you leave the stick in the reverse position (over 75% reverse travel, i.e. less than 0.225 ms below the learned neutral position) for longer than 1.2 seconds, the boat will accelerate slowly in reverse.

9 Tips

9.1 Rotational speeds:

future speed governors and controllers generally produce higher rotational speeds in **timing 1** mode than Kontronik controllers. In order to maintain the same load on the motor when you switch to the ***future***, you have to use **timing 3** mode. Otherwise you will overload the motor.

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.

6.4 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, Kontronik or 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 (const. rpm):
- The first step is to test the ***future*** in standard speed controller mode (not constant speed 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 or -of course- ***a schulze-alpha-receiver*.**
- Please mount the gyro directly 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 troubleshooting. 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 <u>straight back to us</u> or our authorized representative (see catalogue); <u>don’t attempt to repair it</u>! 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 <u>not</u> 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 product summary ***future-universal*** in section 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 continuous current at full throttle at which the future can be operated when connected to a 2 Ah battery without forced cooling. The nominal current value actually achieved may vary in either direction with different types of motor, rotational speeds and cell counts.

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.
Otherwise: See header of the future operating modes.

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. 4 W (444 mA continuous current at 14 V). See also „important tips“ on our web page and in section 12.

Part-load-switching frequencies: 9,7 kHz, 19,1 kHz, 37,8 kHz, selected by DIL-switch.

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 type of ***future***.

12 Product overview *future-universal*

Type	Current	Ni-cells	Size	Weight	Cable	Thrott.	Brake	Rot.Sp.	Vers.	Remark
Units -->	[A]	[cell count]	[mm]	[g]	[mm^2]	[mΩ]	[mΩ]	[min^{-1}]		
12 cells low voltage types with BEC 5 V / 3 A (and opto coupler):										
***future*-12.36e**	36/47	6-12	77*30*11	37-45	2,5	2*3,5	3,5/3	63000	2a	12 FETs, leightweight
***future*-12.46e**	46/60	6-12	77*30*11	37-45	2,5	2*2,3	2,3/3	63000	2a	18 FETs, leightweight
***future*-12.46We**	46/60	6-12	77*30*11	38-46	2,5	2*2,3	2,3/3	63000	2a	18 FETs, sealed
***future*-12.97Fe**	97/128	6-12	77*30*12,5	37-50	4,0	2*0,8	0,8/3	63k/120k	1b	54 FETs, FAI, leight
***future*-12.97FWe**	97/128	6-12	77*30*12,5	38-51	4,0	2*0,8	0,8/3	63k/120k	1b	54 FETs, FAI, sealed
18 cells low voltage types with opto coupler:										
***future*-18.36**	36/47	6-18	77*30*10	29-37	2,5	2*3,5	3,5/3	63000	2a	12 FETs, cooling plate
***future*-18.46K**	46/60	6-18	77*30*14	37-45	2,5	2*2,3	2,3/3	63000	2a	18 FETs, cooling fins
***future*-18.46WK**	50/65	6-18	77*30*16	43-51	2,5	2*2,3	2,3/3	63000	2a	18 FETs, water cooling
***future*-18.61**	61/81	6-18	77*30*10	29-42	4,0	2*1,3	1,3/3	63000	2a	18 FETs, cooling plate
***future*-18.97F**	97/128	6-18	77*30*12,5	37-50	4,0	2*0,8	0,8/3	63k/120k	1b	54 FETs, FAI, leight
***future*-18.97FW**	97/128	6-18	77*30*12,5	38-51	4,0	2*0,8	0,8/3	63k/120k	1b	54 FETs, FAI, sealed
***future*-18.129F**	129/171	6-18	77*30*12,5	37-50	4,0	2*0,4	0,4/3	63k/120k	1b	54 FETs, FAI, leight
***future*-18.129FW**	129/171	6-18	77*30*12,5	38-51	4,0	2*0,4	0,4/3	63k/120k	1b	54 FETs, FAI, sealed
24 cells high voltage types with opto coupler:										
***future*-24.40K**	40/53	6-24	80*30*14	37-45	2,5	2*3	3/3	63000	2c	18 FETs, cooling fins
***future*-24.89F**	89/119	6-24	80*30*12,5	37-50	4,0	2*1	1/3	63k/120k	1d	54 FETs, FAI, leight
32 cells high voltage types with opto coupler:										
***future*-32.28K**	28/37	6-32	80*30*14	37-45	2,5	2*8	8/3	63000	2e	18 FETs, cooling fins
***future*-32.40K**	40/53	6-32	80*30*14	37-45	2,5	2*3,7	3,7/3	63000	2e	18 FETs, cooling fins
***future*-32.55**	55/73	6-32	80*30*14	44-52	2,5	2*2,7	2,7/3	63000	2e	54 FETs, cooling plate
***future*-32.55WK**	62/80	6-32	80*30*20,5	56-64	2,5	2*2,7	2,7/3	63000	2e	54 FETs, water cooling
***future*-32.80F**	80/106	6-32	80*30*12,5	37-50	4,0	2*1,2	1,2/3	63k/120k	1f	54 FETs, FAI, leight
***future*-32.80FWK**	95/115	6-32	80*30*20,5	56-69	4,0	2*1,2	1,2/3	63k/120k	1f	54 F.,FAI,water cooling

Key to table above

Type-ending	Remark	Meaning
-	cooling plate	plate, no cooling rips
e	leight...	no cooling plate or rips, BEC pcb
F	leight..., FAI	no cooling plate or rips
K	cooling fins	cooling fins for excessive part load use
W	sealed	splash water protected
FW	FAI, sealed	splash water protected + FAI program
WK	water cooling	splash water protected + cooling tubes
FWK	FAI, waater cooling	splash water protected + cooling tubes + FAI program

Important hint:

Practical maximum load with BEC suitable servos depending on the cell count

up to 6 cells max.	6 servos
up to 7 cells max.	6 servos
up to 8 cells max.	6 servos
up to 9 cells max.	4,5 servos
up to 10 cells max.	4 servos
up to 11 cells max.	3 servos
up to 12 cells max.	3 servos

All data above are clues. Depending on the used servo type, cooling air and motor current data can vary.