Operating instructions
Speed controller for multi-function models

Multi 20	**Multi 40**
Order No. 7019/71	Order No. 7019/72

Dear customer,

In purchasing the aero-naut Multi 20 or Multi 40 you have acquired a modern, micro-controller based digital speed controller (not governor). The Multi 20 version features a BEC system (5V power supply for the receiving system). With a maximum output of 1.5 A this can be used with 6 to 10 (12) NiCd or NiMH cells or a 12V lead-acid battery within the following limits:
Up to 8 cells: max. 4 small servos or 3 larger servos
Up to 10 cells: max. 3 small servos or 2 larger servos
12 cells: max. 2 small servos
If you wish to use a drive battery with a higher cell count you will need to provide a separate receiver power supply, otherwise there is a danger that the excessive input voltage will overload the integral 5V voltage regulator. In this case disconnect and insulate the positive pin at the receiver connector, or cut through the red wire at a convenient point.
The Multi 40 always requires a separate receiver battery. In this version the receiver input is galvanically isolated by an opto-coupler.
Be sure to maintain correct polarity of the battery leads (red = +, black = -)!

The motor power leads are yellow and blue, and can be swapped over at the motor terminals to reverse the motor's direction of rotation. The controller generates positive voltage at the yellow wire when the channel signal is long (i.e. >1.5 ms). The motor should be connected in such a way that this corresponds to the forward direction of running.

Programming
If the Multi 20 / Multi 40 is to work perfectly with your RC system it must first be programmed. This process only needs to be carried out once; the controller stores the settings permanently, or until it is re-programmed.

1. Turn the speed controller over, so that you can see the integral LED. Fit the jumper (bridging plug) on the pins marked >Prog<.
   Caution: the controller is supplied with the jumper fitted on the >Prog< pins as standard.
2. Connect the 3-core lead to the appropriate receiver output.
3. Move the throttle stick on the RC transmitter to the neutral (Stop) position.
4. Switch on the transmitter. Multi 40: now switch on the receiver.
5. Connect the speed controller to the drive battery with correct polarity.
6. Wait until the LED flashes once.
7. Move the throttle stick to "full throttle forward" and wait until the LED flashes twice.
8. Now move the stick back to neutral, and watch the LED flash three times. The Multi has now stored the stick travels. "Full throttle reverse" is always stored as a mirror image of "full throttle forward".
9. The last stage is to program the power-off voltage, i.e. the point at which the controller throttles back or stops the motor in order to prevent damage to the drive battery (see battery monitor). This value varies according to the battery type. If you are using a NiCd or NiMH battery move the stick to around "half throttle forward"; for a lead-acid battery move it to "full throttle forward".. The controller confirms the setting with four flashes (Ni-) or 5 flashes (lead-acid). If incorrect, you can correct the setting again immediately. Finally move the stick back to the Stop position.
10. This completes the programming process, and the Multi 20 / 40 is ready for use. Wait until the LED starts to flash continuously, then disconnect the drive battery. Don't forget to remove the jumper.

Brake options
The Multi 20 / 40 features a brake function which can be programmed to two different modes of operation. They are selected by means of a jumper.

Free-wheel mode
If the jumper is fitted to the pins marked EMK, the power stage works in 2-quadrant mode. The motor is fed pulses of varying length corresponding to the throttle stick position. The pulse frequency is 16 KHz, and is therefore inaudible. At neutral, and between the individual pulses, the motor is "free-wheeling". The proportional EMF brake only takes effect when the throttle stick is moved past the neutral point in the opposite direction. At this point the **Brake Light** socket becomes active. In free-wheel mode it is not possible to reverse the direction of running until the motor has come to a halt.

Motor brake mode
If the jumper is removed, the power stage works in 4-quadrant mode. The motor is still fed pulses of varying length corresponding to the throttle stick position (pulse frequency still 16 KHz). However, the motor is short-circuited momentarily between the individual pulses and also at neutral. The motor now acts as a brake, i.e. braking occurs when you reduce the throttle setting, and is proportional to the stick position (active braking). At the same time the braking energy is fed back into the battery (caution if using a mains PSU!). In this mode the direction of running can be reversed at any time. The brake light is not active.

Auxiliary functions

Multi controllers feature additional sockets for brake light and reversing light. These are de-coupled galvanically from the controller electronics (opto-coupler) and can thus be used independently of the power circuit. If activated, the **B**rake and **R**eversing light sockets are connected to COMMON. Note that the maximum switched voltage is 25 V, the maximum switched current 5 mA. This is sufficient for operating normal LEDs, including several wired in series. If you wish to use filament bulbs or super-bright LEDs you will require a switch amplifier.

B = Bremslicht
R = Rückscheinwerfer
Com = Commen
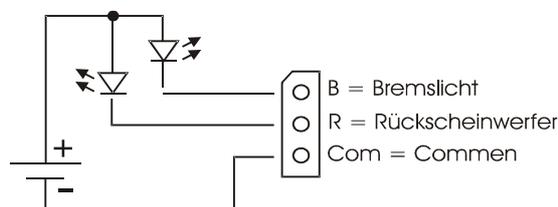
Battery monitor

Deep-discharging can cause permanent damage to the drive battery. To avoid this the Multi electronics constantly monitor the state of the drive battery. The controller determines the cell count by measuring the battery voltage when it is first connected. When the power supply voltage declines, the controller generates a visual warning (LED flashes slowly). If the voltage declines further, the controller throttles the motor back, and eventually stops it completely. This occurs in the following stages, according to battery type:

	NiCd / NiMH battery	Lead-acid battery
Warning at Volts / cell	0.95	1.90
Motor throttled back at Volts / cell	0.89	1.84
Motor stopped at Volts / cell	0.79	1.70

B = Brake light
R = Reversing light
Com = Common

The battery monitor can only work efficiently if the battery is fully charged when first connected. If the battery is overloaded, the battery monitor may be triggered prematurely.

General recommendations and warnings

- Multi-series speed controllers are designed exclusively for use in working models.
- Heat is generated even when the controller is operating normally within the stated range, especially if the BEC system is in use. For this reason it is important to provide an adequate flow of cooling air. Never pack the speed controller in foam rubber or heat-insulating material.
- The controller's pulsed operation generates high-frequency alternating electro-magnetic fields, and these could reduce the effective range of the RC system. You can avoid this by keeping the RC receiver away from the immediate vicinity of the motor, speed controller, and any leads connecting the two.
- Keep all high-current leads as short as possible.
- Fit the usual suppressor capacitors to the motor, but do not fit a Schottky diode, as this is destroyed by any forward-reverse controller; it may also damage the speed controller.
- It is essential to use a polarised connector system between battery and speed controller.

We wish you many hours of pleasure and success with your Multi speed controller.

Conformity declaration
In accordance with the EMC directive 89/336/EC "aero-naut" Modellbau OHG, Stuttgarter Str. 18, D-72766 Reutlingen declares on its own account that Multi speed controllers satisfy the following harmonised norms:
EN55014-1:2001
EN55014-2:1997.
Authorised signatory: Dipl. Ing. (FH) Frank Koehler

Specification	Multi 20	Multi 40
Cell count	6-18	16-32
Continuous current [A]	20	40
Continuous current [A] reverse	20	20
Unlimited part-load operation	yes	yes
Directions: forward - stop - reverse	F/S/R	F/S/R
Reverse, only after motor stop	yes	yes
Current limiting	yes	yes
BEC / Opto-coupler	BEC	Opto-coupler
Max. BEC load [A]	1.5	-
Max. servos (depending on cell count)	4	-
BEC overload protection	yes	-
EMF brake on / off	yes	yes
Proportional EMF brake	yes	yes
Output for LED brake light	yes	yes
Pulse frequency [kHz]	16	16
Power-on pulse suppression	yes	yes
Overheat power-off	yes	yes
- re-armed by Stop after cooling	yes	yes
Low voltage power-off	yes	yes
- re-armed by Stop	yes	yes
Deep-discharge protection	yes	yes
at automatic cell count detection	yes	yes
proportional throttle reduction	yes	yes
Initial current by-pass	yes	yes
Input pulse check	yes	yes
Programmable stick travels	yes	yes
Weight excl./incl. cables [g]	30 / 45	30 / 45
Dimensions [mm]	25 x 40 x 16	25 x 40 x 16
Power-On-Off reset, when switched on and off, and when battery is connected	yes	yes
LED for error signals + programming	yes	yes