PowerBox Systems

World Leaders in RC
Power Supply Systems

PowerBox Gemini

Operating instructions

Double voltage stabilisation with
linear regulation and double battery monitor,
second voltage level for gyros and gyro servos,
electronic safety switch (SensorSwitch Mini)

Dear customer,

We are delighted that you have decided to purchase the **PowerBox Gemini** from our range.

Your valuable model aircraft can now be fitted with one of the most capable battery backers available, enabling you to couple two batteries battery backer) and also constantly monitor the voltage of the two batteries of your choice (NC, NiMH or LiPo).

The minimum value of the battery voltage curves is stored, and can be called up again after each flight.

The battery backer also provides a **stabilised** power supply (**linear stabilisation**) of 5.90 Volts for the receiver and servos.

The special feature of the **PowerBox Gemini** is the second stabilised voltage level of 5.3 Volts, which can be used to power a gyro and the associated gyro servo.

Although the unit is simple to operate, you do need to understand certain points if you are to exploit its advantages to the full. These instructions are designed to help you feel “at home” with your new equipment as quickly as possible. To ensure that this is the case, please read through these instructions attentively before using the power supply system for the first time.

We hope you have many years of pleasure and success with your **PowerBox Gemini**!

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1. History of PowerBox Systems voltage-stabilised battery backers

TOC 2002, Las Vegas: this is where the development of the first voltage-stabilised power supply systems for model aircraft began. In October 2002 Sebastiano Silvestri took part in the Tournament of Champions at Las Vegas; he was the first TOC participant to have a type of receiving system power supply installed in his Katana which had never been seen before. This was the **PowerBox** 40/24 **Professional**, developed by us and an extremely successful unit, with "remotely accessed" channels (i.e. remote >from the receiver), signal amplification, voltage monitoring and much more besides - it could be summed up as a complete servo / receiver management system.

At that time all the top European pilots were still flying their models with four-cell or five-cell NC batteries, or the then new NiMH packs, but in the USA many leading flyers were already using Li-Ion batteries made by the renowned battery manufacturer DuraLite. It was inevitable that Emory Donaldson, Manager of Duralite, would be present at the TOC, and he showed great interest in the type of power supply represented by the **PowerBox Professional**. There and then - in Las Vegas - he granted us a contract to develop a power supply system for DuraLite Li-Ion batteries, which have a voltage curve similar to the LiPo types now in common use (max. 8.4 Volts).

In April 2003, at the "Joe Nall" event in Greenville, USA - only six months later - we were able to present him with a power supply system which contained linear voltage regulators - a completely new in-house development - electronic switches, voltage monitor etc.
(Registered design DE 203 13 420.6)

This ultra high-performance linear voltage stabilisation circuit has been employed unchanged in all our "regulated" battery backer systems and switches since 2003. All the companies which produce competing products have copied this idea, and fitted their battery backers not only with a regulated voltage circuit, but also the original **PowerBox** stabilisation circuit.

For us and for our customers this is reassuring, and ample evidence of the rightness of our concept, since good ideas and innovative electronics always find their way to the front!

2. Product description

The **PowerBox Gemini** is a new kind of power supply system which contains all the latest electronic components which are necessary to provide power to high-performance servos and receivers. Basically, all the essential components, ICs, electronic circuits and programs required for a reliable power supply system are **duplicated**!

This is in **direct contrast** with other manufacturers' products which are powered by two batteries, and therefore give the impression of a dual power supply, but which contain no duplicated components - as required for a truly secure system. You have selected a product which offers genuine duplication of systems (system redundancy) in the interests of your safety. We believe it is important to emphasise this particular point, as we and most serious modellers accept it as a fundamental necessity that any device which is responsible for safety in an aircraft should always be present in a duplicated, or redundant form. This is precisely the approach taken by the **PowerBox Gemini**.

The backer (battery change-over switch) function is based on an extremely high-performance **12 Amp Dual Schottky diode**; both diodes are housed in a single case. This diode arrangement ensures that voltage losses in operation are extremely low (0.25 Volt).

If both batteries are in good condition, both contribute to the receiving system's power supply. This means that each battery only bears half the total load, and both are recharged to the same level during the charge process. This arrangement avoids premature damage to your battery cells, and extends the useful life of your receiver packs significantly.
During the charge process you will find that slightly more capacity can be charged into one battery, and slightly less into the other. This is normal, provided that the difference stays within the tolerance range of the components: after several flights this may be up to 100 - 150 mAh.

This is the reason for the possible discrepancy:
The **PowerBox Gemini** is fitted with two independent IC-controlled voltage regulators, i.e. one regulator for each battery. This duplication is known as redundancy. However, electronic components - like any other technical parts - are never 100% identical, i.e. all components are manufactured to a certain tolerance. We do take the greatest trouble to select components for our products which exhibit the tightest tolerances according to the manufacturer's data sheets, but we cannot completely avoid minor deviations. Neither are all batteries 100% identical, so it is not possible to eliminate the problem just by the selection process.

This means that a slight difference in the capacity of your batteries after several flights actually constitutes proof that your **PowerBox Gemini** contains two independent systems. We are aware that other systems always feed absolutely identical capacities into the batteries. We therefore ask you to consider for a moment whether this could really occur if - as claimed - the system contained two completely independent systems. Our experience obliges us to conclude that these alternative systems actually contain no duplicated circuitry - apart from the two batteries. Both batteries are simply discharged via one regulator, which provides power to the servos and the receiver.

In our opinion a process of this type does not represent a system with redundancy, as required for valuable model aircraft and for safe modelling in general.

Naturally all our PowerBoxes are protected against **reverse voltage** which can be generated by servo motors.

This measure is necessary because there are servos available on the market fitted with electronic circuitry which does not prevent reverse voltage.
The situation is exacerbated by the existence of receivers which are not adequately protected against reverse servo voltage.

If you use our PowerBoxes you can be certain that it is safe to use all servos and receiver systems currently available.

The **PowerBox Gemini** is equipped with two independent IC-controlled voltage monitors whose task is to check the performance of the two power sources. The two multi-colour LEDs in the housing of the **PowerBox Gemini** and the two ultra-bright red LEDs in the SensorSwitch indicate the voltage of each battery separately. The multi-colour LEDs indicate the voltage level in **four stages: green, orange, red, and flashing red**. Under normal circumstances the ultra-bright red LEDs in the SensorSwitch flash briefly every two seconds. If their flashing frequency rises to a high level, this indicates that the corresponding battery is flat or almost flat. For this reason we recommend that you install the SensorSwitch and the **PowerBox Gemini** in your model in such a position that you can clearly see these voltage monitor LEDs.

Please believe what the voltage display tells you!

You should check **before** every flight - by “stirring the sticks” - that the voltage of both batteries remains stable. If the batteries in your model are too “weedy” for the application, i.e. of inadequate capacity, this check will immediately show up the shortcoming. In general terms, small batteries of high capacity are not suitable for use as receiver power supplies because they have very high internal resistance; this means that their current delivery capacity is often inadequate for powerful, high-speed digital servos.

For even better monitoring of the power sources, the battery backer also features a minimum value memory (**low voltage memory**) for both packs. This memory records all voltage collapses during the flight.

This is a very important feature, as it provides you with important information regarding battery performance. You can now check the state and capability of your batteries in a long-term test (over the full duration of the flight) as well as in a brief pre-flight test.

After each flight you can call up the minimum voltage memory by **simultaneously** “pressing” both sensor buttons **before** switching the system off.

The memory is reset when you switch off the power supply system; the recording process begins anew when you next switch the system on.

The voltage display is not linear, but matched to the discharge curve of today’s Nickel-Cadmium (**NC**), Nickel-Metal-Hydride (**NiMH**) and Lithium-Polymer (**LiPo**) cells. It is not possible to make general predictions regarding useful battery operating times, because this varies according to the battery capacity, the number of servos, the type of servos, and the frequency of control commands.

3. Connections, controls

The two receiver batteries are connected via the pair of integral Uni / JR sockets. In theory the **PowerBox Gemini** will also work with a single battery, but if you do this you forfeit the extra security of a dual-battery power supply. In principle you could connect one battery to both battery inputs using a Y-lead, in which case both switches and both regulators would be active. This arrangement would also allow the full regulator power of the **PowerBox Gemini** to be exploited.

If you have to make up your own battery connecting leads, please take great care to avoid reversed polarity, as this would immediately destroy the battery backer's linear regulators.

Power is fed to the receiver and all the servos via the two servo leads (0.34 mm², blue / red), which should be connected to the socket on your receiver marked "B" (battery) and any other vacant channel output socket.

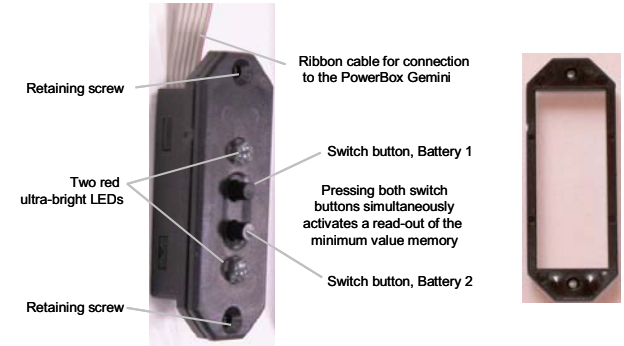
Connect the third servo lead (orange / red / brown) to the receiver output which controls the gyro and the associated gyro servo. The **PowerBox Gemini** only picks up and passes on the signal from this channel; at the other end of the unit you will find the socket for the gyro immediately adjacent to the red connector for the SensorSwitch. The signal picked up from the receiver is present at this socket, as is the second voltage level, which is set to 5.3 Volts.

Of course, it is possible to connect two separate receivers to this battery backer. If you wish to do this be sure to observe the information supplied by your RC manufacturer concerning the use of two receivers in a model, otherwise there may be problems with interaction between the two units (minimum physical separation 20 cm).
Power is supplied to each receiver by one of the two integral servo leads.

4. The Sensor-Switch

The purpose of the **SensorSwitch** is to provide external control of the integral electronic switches in our **PowerBox Gemini**. The **SensorSwitch** does **not** switch the current for the servos and receiver. The actual switching process is carried out by the two completely independent electronic switches inside the battery backer.

The switch plate houses two push-buttons and two ultra-bright red LEDs. The switch features two countersunk holes through which the retaining screws are fitted. The mounting bezel supplied provides a means of mounting the switch in the model securely without having to add an additional glued-in plate.



The pair of push-buttons is used to switch both power circuits on. This method of operation enables you to **check individually** each power circuit or battery.

The method of using the buttons to switch on or off is always the same: hold the button pressed, and wait until the LED on the SensorSwitch lights up red, then release the button and press it briefly a second time.

The LED flashes red every two seconds if this was the power-on procedure, or goes out if it was the power-off procedure.
To check the two power circuits, switch on only one battery and watch the corresponding LED on the **PowerBox Gemini** to see whether and to what extent the battery voltage collapses when you “stir the sticks”. If everything is in order, switch this first battery off (**LED goes out**) and switch on the second battery. If everything is again in order, switch the first battery on again (**both LEDs light up green**). You have now checked both power systems.

This new switch system provides you with an ultra-high level of security!

The two ultra-bright red LEDs in the SensorSwitch provide the opportunity to monitor the batteries in flight: they flash at a very fast rate when the batteries are flat. If everything is working properly, these LEDs flash briefly every two or three seconds. If one battery is flat, the corresponding LED flashes very brightly and at a very rapid rate.

When the unit is switched off, the **“Standby”** circuit of the electronic switches draws an idle current of around 5µA. This equates to a fraction of the self-discharge rate of normal batteries.

The red plug on the ribbon cable attached to the **SensorSwitch** should be plugged into the red multi-pin socket on the right-hand side of the backer. Note that the switched state of the backer is not affected if the **SensorSwitch** is accidentally disconnected or comes adrift for any reason!

Please take the trouble to **deploy the ribbon cable** in such a way that it is **not subject to vibration!**

Don’t just let it dangle in the fuselage, and avoid placing it under strain. A small piece of double-sided foam tape between cable and fuselage is often all that is required.

5. Setting the battery type

The **PowerBox Gemini** is switchable to suit different battery types, i.e. you can switch the unit from five-cell **NC** to two-cell **LiPo** batteries yourself.

The default setting is for LiPo batteries. If you wish to switch the unit for use with NC batteries, please use this procedure:

Connect the two five-cell NC batteries to the unit; both LEDs now flash red, as the voltage monitor is set to LiPo by default.

If you wish to reset the voltage monitor, please note that both monitor circuits have to be switched over separately using the two sensor buttons of the **SensorSwitch**.

Simply hold the sensor button pressed in until the correct setting appears on the LED in set-up mode. **This is the key**:

- **LED flashes green once: two-cell LiPo battery**
- **LED flashes green twice: five-cell NC battery**

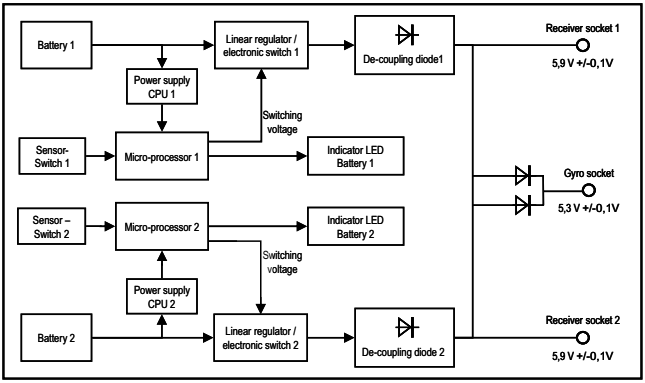
Now we come to the method of setting the voltage monitor:

- Hold one of the sensor buttons pressed in.
- After about one second the colour of the LED changes to orange.
- After a further three seconds the colour of the LED changes to red.
- After a further five seconds the LED goes out briefly; **now take care:**

- The LED flashes green once; if you release the button now, the voltage monitor is set to two-cell LiPo.
- If you continue holding the button, the LED flashes green twice; release the button now, and the voltage monitor is set to five-cell NC or NiMH.
- Repeat the procedure with the second button; both LEDs will now glow green - assuming that both NC batteries are fully charged.

6. PowerBox Gemini block circuit diagram

The block circuit diagram printed below is intended to clarify the function of the **PowerBox Gemini**. It represents the functional sequence of the individual components in graphic form:



7. Specification

Operating voltage:	4.0 to 9.0 Volts
Power supply:	Two 5-cell NiCd or NiMH batteries Two 2-cell LiPo batteries, 7.4 Volt
Current drain:	approx. 30 mA
Voltage drop:	approx. 0.30 V
Max. receiver current:	2 x 4 A (stabilised)
Servo supply voltage:	5.9 Volt
Gyro supply voltage:	5.3 Volt
Max. continuous current:	10 A
Temperature range:	-10°C to +75°C
Dimensions:	72 x 28 x 14 mm (L x W x H)
Weight:	32 g including all leads
SensorSwitch:	12 g

8. Operating the unit, safety notes

It is essential to use low-resistance batteries of the best possible quality to supply your receiving system. Don't be tempted to use receiver packs of inadequate capacity, as just one of them will have to power the whole system on its own if one battery should fail in flight. We recommend that you use NC packs of at least 1700 mAh capacity, and for large-scale models batteries of 3000 mAh or more are appropriate. You can use either Nickel-Cadmium (NC) batteries or Nickel-Metal-Hydride (NiMH) packs.

If you decide to use modern, lightweight **LiPo** batteries, we recommend the **PowerBox Battery 1500** and **PowerBox Battery 2800** from our own range.

These LiPo batteries currently represent the safest, most reliable battery packs available, as they contain a balancer and a low-voltage monitor as well as complete charge and security electronics.

Charging these batteries is as simple as charging a mobile phone!
Naturally, each battery set includes a practical mount and accessories.

Install the battery backer in the model aircraft with adequate vibration protection, as used for the other components of the receiving system.

Take care not to cover the heat-sink area.

Please don't just throw away the inner packaging, as it includes a template for marking the aperture for the SensorSwitch. Cut or saw **clear of the marked line**, as shown in the photo.

Even though our products are very well protected from the effects of vibration, the switch should always be mounted in a part of the model relatively low in vibration.

Please note that the GRP fuselage sides of a large power model are not suitable, as they are always subject to considerable vibration. You can remedy the situation by cutting a ply plate (2 - 3 mm thick) about 3 cm larger than the switch aperture, and gluing it in the appropriate place, as shown in the photo. The plate absorbs much of the vibration.

The **battery backer fulfils the EMV protection requirements**, entitling it to bear the **CE symbol**. However, please note that the unit is designed and approved solely for use in modelling applications, and may only be used in radio-controlled models.

It must never be connected to a mains PSU!

9. Guarantee conditions

During the production process each battery backer undergoes a series of tests. We take the maintenance of the highest quality standards very seriously, and that is why we are able to grant a **24 month guarantee** on all our battery backer systems, valid from the initial date of purchase. The guarantee covers proven material faults, which will be corrected by us at no charge to you. We wish to emphasise expressly that we reserve the right to replace the unit if a repair is impossible for economic reasons.

Proof of the commencement and progress of this guarantee period is the purchase receipt. Repairs which our Service Department carries out for you do not extend the guarantee period. Misuse and maltreatment, such as reversed polarity, excessive voltage and the effects of damp, invalidate the guarantee. The same applies to faults due to severe wear or excessive vibration. The guarantee does not cover any additional claims, such as consequent damage.

We expressly deny liability for damages which are caused by the device, or arise through the use of the device.

Liability exclusion:

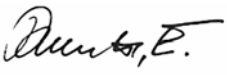
We are unable to ensure that you install and operate the battery backer correctly, nor that the entire radio control system has been maintained properly.

For this reason we are unable to accept liability for loss, damages or costs which result from the use of the backer, or are connected with its use in any way.

Unless otherwise prescribed by binding law, our obligation to pay compensation, regardless of the legal argument employed, is limited to the invoice value of that quantity of our products which was immediately and directly involved in the event which caused the damage.

We wish you every success using your new battery backer, and hope you have loads of fun with it.

Donauwörth, March 2007



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