

**PowerBox Systems**

*World Leaders in RC  
Power Supply Systems*

# PowerBox Evolution

40/16

## Operating Instructions



Double voltage stabilisation with  
linear regulation and double battery monitor,  
double signal amplification for each channel,  
twin electronic safety switches (SensorSwitches)  
petty patent no.: 203 13 420.6



**Dear customer,**

We are delighted that you have decided to purchase the **PowerBox 40/16 Evolution** 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. This battery backer also features integral double servo signal amplifiers for each of five receiver channels, making it a straightforward matter to connect multiple servos (up to four) to one input.

The battery backer also provides a **stabilised** power supply (**linear stabilisation**) of 5.90 Volts for the receiver and servos. Although the unit is simple to operate, you do need to understand certain points if you are to exploit its advantages to the full. Please read through these instructions attentively before using the power supply system for the first time; this will ensure that you quickly feel “at home” with your new equipment.

We hope you have many years of pleasure and success with your **PowerBox 40/16 Evolution**.

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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). Only five months later, in April 2003, we were able to present him with a power supply system which contained a linear voltage regulator - a completely new in-house development - two electronic switches, double voltage monitor etc. (registered design DE 203 13 420.6).

This linear voltage stabilisation circuit supplies a constant 5.9 Volts and offers a particularly high performance; it 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. From the outset we decided on a constant voltage of 5.9 Volts for receivers and servos, not least because that was the preferred voltage of many competition pilots, and this voltage value has been adopted as a standard by other manufacturers. 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 40/16 Evolution** is a modern power supply system which contains all the electronic components which are necessary for modern servos and models. Basically, all the essential components, ICs and electronic circuits required for a reliable power supply system are **deduplicated!**

This is in **direct contrast** with other manufacturers' products which contain no duplicated components - as required for a truly secure system - even though they are powered by two batteries. 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 40/16 Evolution**.

The **PowerBox 40/16 Evolution** also provides you with "**remote access**" for up to five channels from the receiver. We have coined this term because we are absolutely convinced - and countless tests have confirmed our conviction - that not all receiver channels should be operated using an external power supply. Why should that be? Well, there is nothing fundamentally wrong with the standard receiver sockets, and they are always adequate for certain servos and model functions. Even so, there are particular applications in model aircraft for which it is not good practice to use the standard receiver connections.

That is why we recommend that you set up "remote access" to certain channels from the receiver; the channels concerned are these:

1. Channels which are required to control multiple servos (several servos per control surface; hence integrated signal amplification required);
2. Channels which are operated using very long servo leads (more than 60 cm; hence integrated servo signal amplification, also RF suppression);
3. Channels which have to supply extremely powerful, high-performance servos with correspondingly high current drain (digital servos, Jumbo servos, Power servos), in order to reduce the load on the receiver;
4. Channels which require special interference suppression measures (RF suppression of long servo leads, turbine electronics, flasher units, throttle servo, ignition servo, and many more);
5. Channels which are operated constantly when a normal model is in flight, e.g. aileron, elevator and rudder; this reduces the load on the receiver.

All the other servos of your receiving system (flaps, retracts, aero-tow release etc.) can be connected to the appropriate receiver socket in the usual way. Which of the channels you "**access remotely**" from the receiver is up to you, but it is usually those mentioned above.

The backer (battery change-over switch) function is based on an extremely high-performance **40 Amp Dual Schottky diode**; both diodes are housed in their own 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 200 - 250 mAh.

This is the reason for the possible discrepancy:

The **PowerBox 40/16 Evolution** 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 have 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 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.

The **PowerBox 40/16 Evolution** is equipped with two independent IC-controlled voltage monitors whose task is to check the performance of the two power sources. Each monitor is assigned three coloured LEDs which indicate the actual voltage of the batteries, i.e. one green, one orange and one red LED indicate the voltage of each battery separately. For this reason we recommend that you install the **PowerBox 40/16 Evolution** in your model in such a position that you can clearly see these voltage monitor LEDs.

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.

### **Please believe what the voltage display tells you!**

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 - separately for each battery - 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 “pressing” both sensor buttons I and II simultaneously **before** switching the system off.

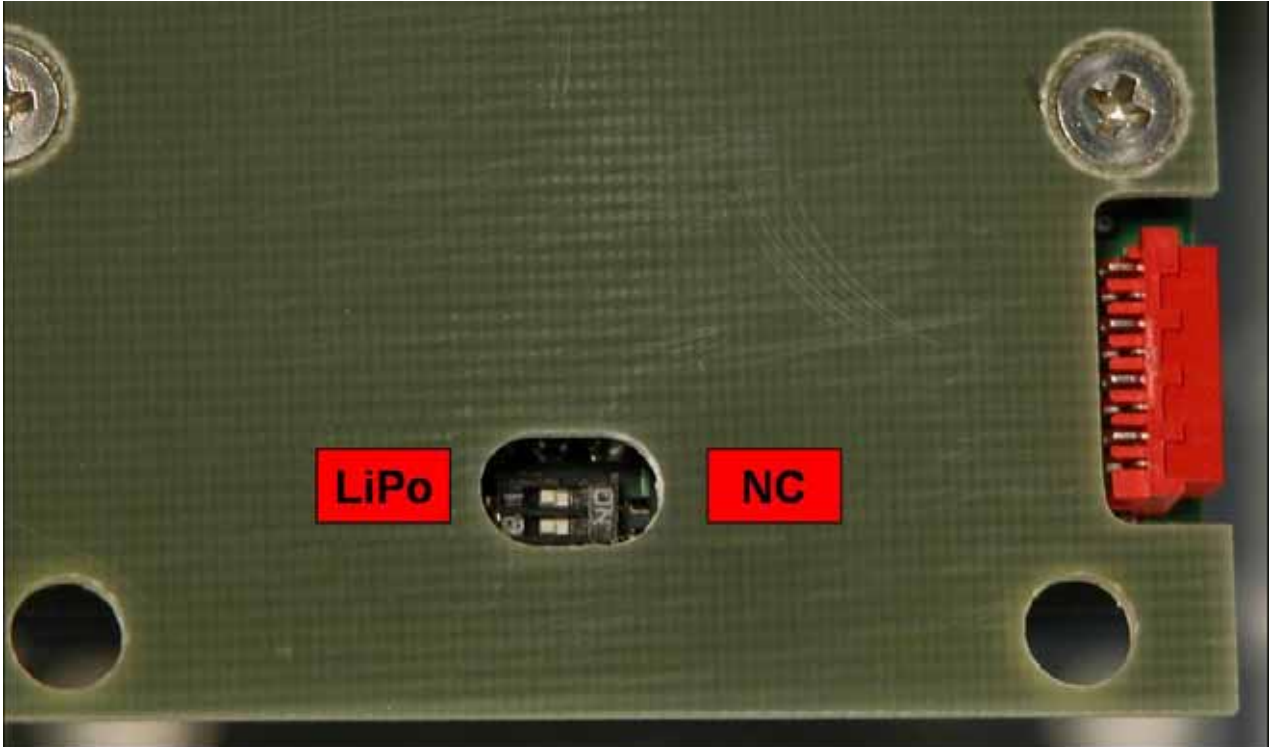
The memory is reset when you switch off the power supply system; the recording process begins anew when you switch on again.

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.

The **PowerBox 40/16 Evolution** is switchable to suit different battery types, i.e. you can switch the unit from **NC** to **LiPo** batteries yourself.

The default setting is for LiPo batteries. If you wish to switch the unit to suit NC batteries, first disconnect the two power supply batteries from the PowerBox.

You can now move the two micro-DIP switches to the opposite end-point using a small, pointed screwdriver. Caution: very little force is required for this, and you can easily damage the switches if you use too coarse an instrument.



Now connect the batteries you wish to use to the PowerBox.

The **PowerBox 40/16 Evolution** is equipped with five **stabilised** two-way signal amplifiers, i.e. a separate amplifier for each channel. In our opinion this additional complexity is definitely worthwhile.

It completely eliminates the problem of “crosstalk” between the different channels, which can occur when only one IC is used for this purpose. The signal amplitude is maintained exactly at a constant 5.0 Volts: another feature which is only found in our systems. Many servos do not respond correctly to signals which fluctuate in voltage.

These modern, short circuit-protected signal amplifiers are also necessary in order to block out interference which could penetrate the system via the servo leads connected to the unit.

Naturally all our PowerBoxes are protected against **reverse voltage** which might 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.

Certain receiver types are also not protected against this potential problem.

The design of our PowerBoxes ensures that you can use any type of servo and receiving system.

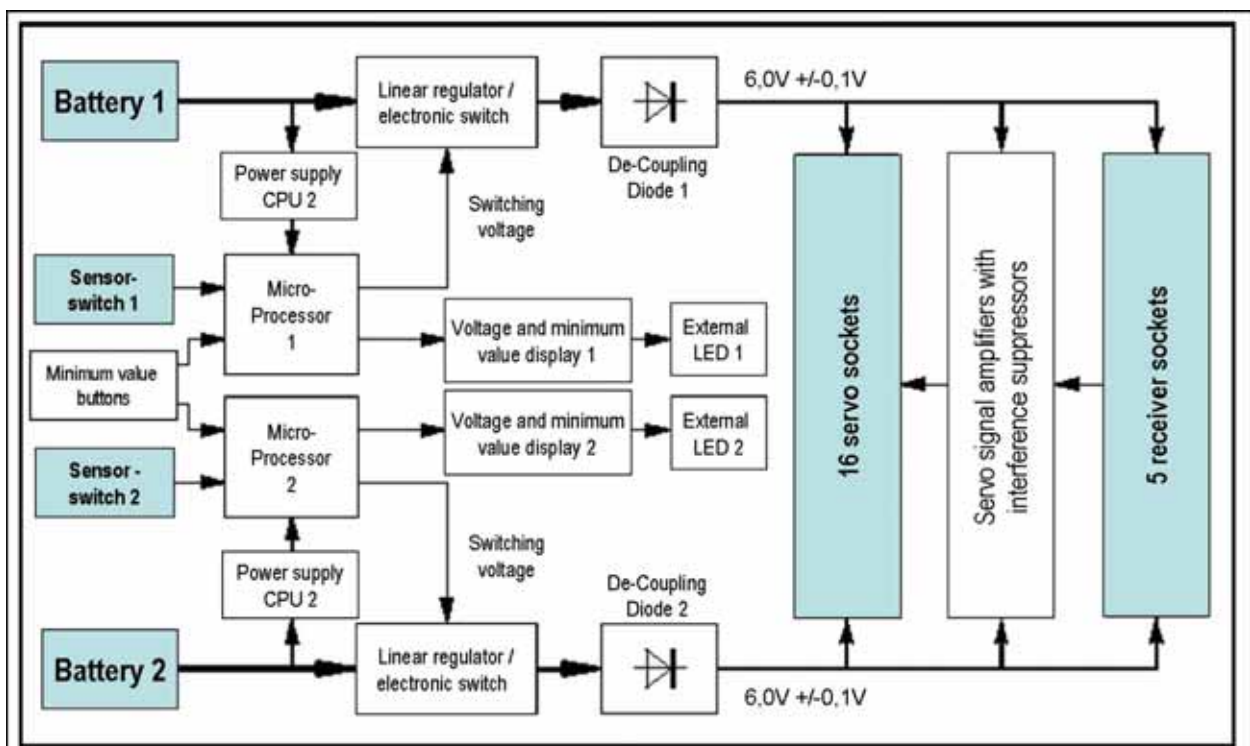
In this case the ferrite rings fitted to the backer cables are not only designed to provide additional RF suppression, since the integral servo signal amplifiers already fulfil this task reliably. The ferrite rings de-couple the earth (ground) between receiver and backer. This ensures that the operating conditions for the receiver are exactly the same as those for which the radio manufacturer originally set up the unit.

In practical terms the receiver's earth surfaces represent the earth base, i.e. the counterbalance to the aerial.

The earthing conditions should not be altered by more than a particular amount, because this would have an adverse effect on the optimum tuning of the receiver. That is the reason why each connecting lead of our battery backer systems is fitted with a ferrite ring.

### 3. PowerBox block circuit diagram

The block circuit diagram printed below is intended to clarify the function of the **PowerBox 40/16 Evolution**. It represents the functional sequence of the individual components in graphic form:



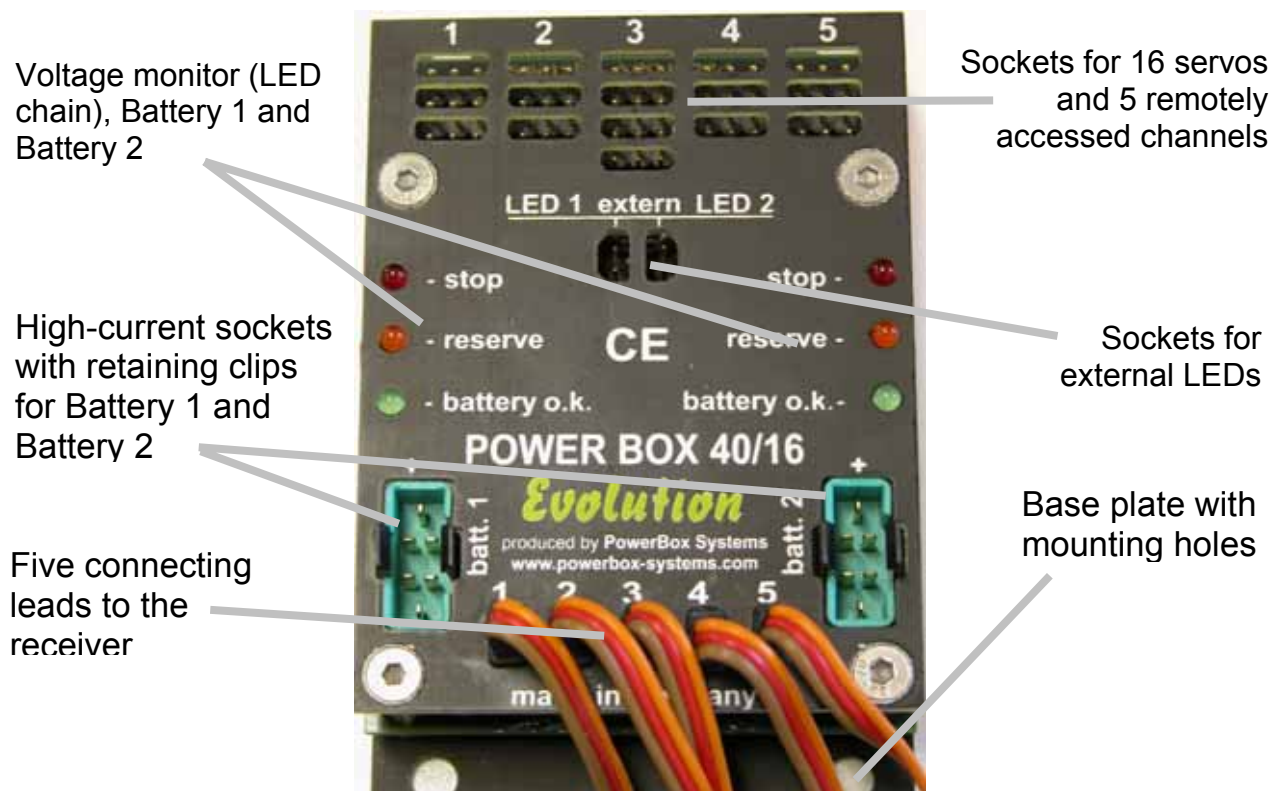
**4. Specification**

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. 70 mA
Voltage drop:	approx. 0.25 V
Max. receiver current:	2 x 10 A (stabilised)
Servo sockets:	16 sockets, 5 channels
Max. continuous current:	20 A
Temperature range:	-10°C to +75°C
Dimensions:	91 x 65 x 19 mm (incl. base plate)
Weight:	100 g
SensorSwitch:	15 g

**5. Connections, Controls**

The two receiver batteries are connected via the pair of integral high-current sockets. In theory the **PowerBox 40/16 Evolution** will also work with a single battery, but if you do this you forfeit the extra security of a dual-battery power supply.

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 voltage monitor circuits.



Power is fed to the receiver and all the other servos via all five servo leads, which should be connected to the channel sockets of your receiver; the socket marked “B” (battery) should be left unused.

**All connecting leads at the receiver can be connected in any sequence.**

The only requirement is that the assignment number at the PowerBox input must be identical to the channel number of the PowerBox output; these are therefore numbered from 1 to 5.

## 6. 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 pack should fail in flight. We recommend that you use batteries 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.

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 the receivers via the five servo leads of the **PowerBox 40/16 Evolution**.

In the centre of the top panel of the **PowerBox 40/16 Evolution** you will find two polarised sockets. To each of these you can connect an ultra-bright red LED for each battery via the extension lead; the LEDs are supplied in the accessory pack. These LEDs can be mounted in the fuselage side of your model. When the aeroplane is in the air, these LEDs provide you with a visual warning if one or both batteries should run flat, or if some other fault should occur in the power supply system.

If you see the LEDs light up, please land the model immediately. We recommend that you install both LEDs as close together as possible, as this doubles the effective strength of the light output, making it easier to pick out in the air.

Install the battery backer in the model aircraft with adequate vibration protection, as used for the other components of the receiving system. You will find that the mounting plate with its four screw-holes makes it easy to install the backer.

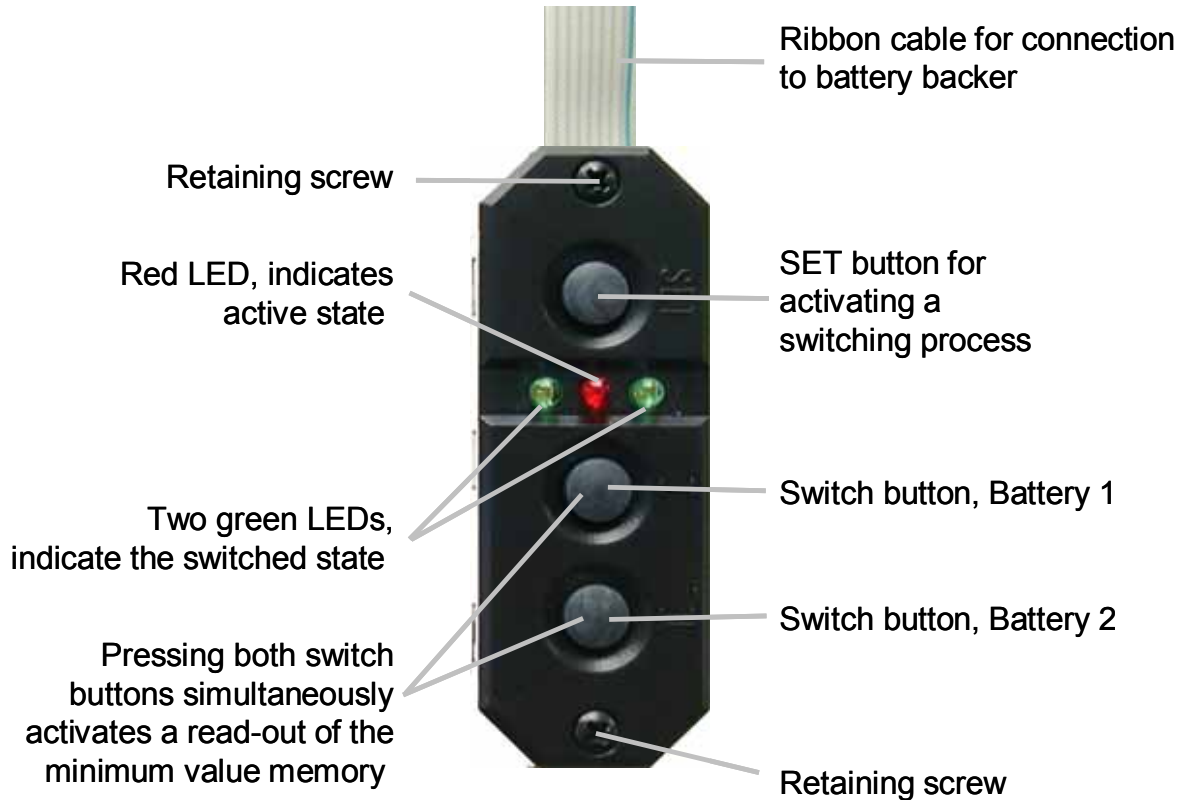
### **7. The SensorSwitch**

The purpose of the **SensorSwitch** is to provide external control of the integral electronic switches in our **PowerBox 40/16 Evolution**.

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 three push-buttons and three LEDs: two green, one red. The switch is mounted on the model using two retaining screws (supplied). The plate features two countersunk holes through which the retaining screws are fitted.

The push-buttons are marked "**SET**", "**I**" and "**II**".



The **SET** button is slightly recessed, and its purpose is to prepare and carry out a switching process. Holding the **SET** button pressed in “arms” (activates) the switches: after about one second the red LED lights up. This indicates that the electronic switches are armed, and ready to be switched.

Now the two power circuits can be switched using the two other push-buttons “**I**” and “**II**”. This method of operation enables you to **check** each power circuit or battery **individually**.

This is done by switching on only one battery (first **green LED** on the switch **glows**): check by glancing at the corresponding LED chain whether and to what extent the battery voltage collapses when you “stir the sticks”. If everything is in order, press the SET button again, switch this first battery off (**green LED goes out**) and switch on the second battery (second green LED on the switch glows) using the second push-button. If everything is again in order, press the SET button once more and switch the first battery on again (**both green LEDs light up**). You have now checked both power systems.

To switch the battery backer off, hold the SET button pressed in once more to “arm” the sensor. The two batteries can now be switched off by pressing the “**I**” and “**II**” buttons.

This new switch system provides you with the highest level of security ever offered!

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

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 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 don't place it under any strain. A small piece of double-sided foam tape between cable and fuselage is often all that is required.

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



Even though our product is 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, and at the same time provides plenty of “meat” for the switch retaining screws to bite into.

The **SensorSwitch** is available in the colours **black** or **grey**, and one or other version is very likely to blend inconspicuously with the colour scheme of your model.

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.

The unit should only be used with a Direct Current (D.C.) power supply corresponding to an NC or NiMH battery consisting of five cells, or a two-cell LiPo pack.

**It must never be connected to a mains PSU!**

## **8. 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, December 2006

A handwritten signature in black ink, appearing to read "Peter E." with a stylized flourish at the end.

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