PowerBox Systems

World Leaders in RC
Power Supply Systems

Instruction Manual

PowerBox Sensor


PowerBox Systems

Dear customer,

Congratulations on your choice of the **PowerBox Sensor** from our range of products.
This innovative device was introduced by **PowerBox Systems GmbH** in 2003, and was the world's first and most modern multi-function switching system designed for model applications.
The original idea was to integrate two independent systems in a single, lightweight, secure, space-saving switch case: two systems with two linear regulators, two electronic self-latching switches, two four-stage voltage monitors for both batteries, two minimum value (low voltage) memories, all coupled with a high-performance battery backer. A supplementary SET button is used to execute all switching processes, as with all our larger systems. The recorded minimum value memory for both batteries can be read out after each flight by pressing buttons 1 and 2 simultaneously.

Although this switch system is very simple and safe in operation, you do need to understand how it works in order to use it properly. Please take the time to read right through these instructions, so that you become familiar with the unit.
We hope you have many years of pleasure and success with your **PowerBox Sensor.**

Applications:

The **PowerBox Sensor** is primarily intended for the following applications:
- Small and medium-sized model aircraft with six or seven standard-size servos, or up to ten servos in gliders with wingspans up to about 5.0 metres.
- The unit is very popular for use in models with wingspans up to about 2.20 m.
- Model helicopters with a maximum rotor diameter of 1.5 m and up to six servos.
- Model boats of all kinds.
- Ignition systems for four-cylinder petrol engines with dual ignition circuits; this provides redundancy for both ignition systems.

- Redundancy for two receivers in conjunction with the **PowerBox RRS module**.
- Ideal for use with ACT Diversity receivers

Product description:

The **PowerBox Sensor** provides a linear stabilised voltage of exactly 5.9 Volts as power supply for your receiver and servos. To special request we can also supply the **PowerBox Sensor** set to 5.5 Volts; this version is equipped with MPX-PIK connectors. These output voltages conform exactly to the specifications of all RC manufacturers, who generally state the maximum permissible voltage for their RC system components as 6.0 Volts.
Because the linear voltage regulation is accurate and ultra-stable, we recommend the **PowerBox Sensor** without reservation for use with all makes of 2.4 GHz receiver. All 2.4 GHz receivers share one rather unfortunate “feature”: if the power supply should fall below the nominal voltage, even for a fraction of a second, an internal system reset takes place, which can last a fairly long time - in some cases up to four seconds. The two high-performance regulators in the **PowerBox Sensor** prevent this occurring, provided that the two batteries you are using are of appropriate capacity and in good order.
The pioneering circuit design enables you to use modern, lightweight Lithium-Polymer cells, Li-Ion cells and even Li-Fe cells without exceeding the maximum voltage of 6.0 Volts, as well as the five-cell NC and Hydride batteries which are still in common use.

Construction:

Extremely robust plastic case (30% glass fibre content), 0.34 mm² conductor cross-section for all connecting leads, silicone cables, leads soldered “straight-through” (no change of angle) to broad solder pads, every cable protected with a strain-relief at the case exit point, all soldered cable joints protected from

vibration fracture using a special support adhesive. Two double-sided circuit boards of SMT construction, program-controlled switching process. Blue-eloxided aluminium heat-sink, all electronic circuitry duplicated: two linear voltage regulators, two electronic switches, two voltage monitors, two minimum value memories, variable voltage monitor (can be set to five-cell NC or two-cell LiPo batteries), one SET button for executing all switching processes, servo feedback voltage protection.

The control panel consists of three push-buttons, two green LEDs and one red LED.

Operating the PowerBox Sensor:

The **PowerBox Sensor** is controlled using three sensor-buttons.
These sensor buttons do **not** switch the current for the receiver and servos. All they do is trigger the actual switching process carried out by the ICs.

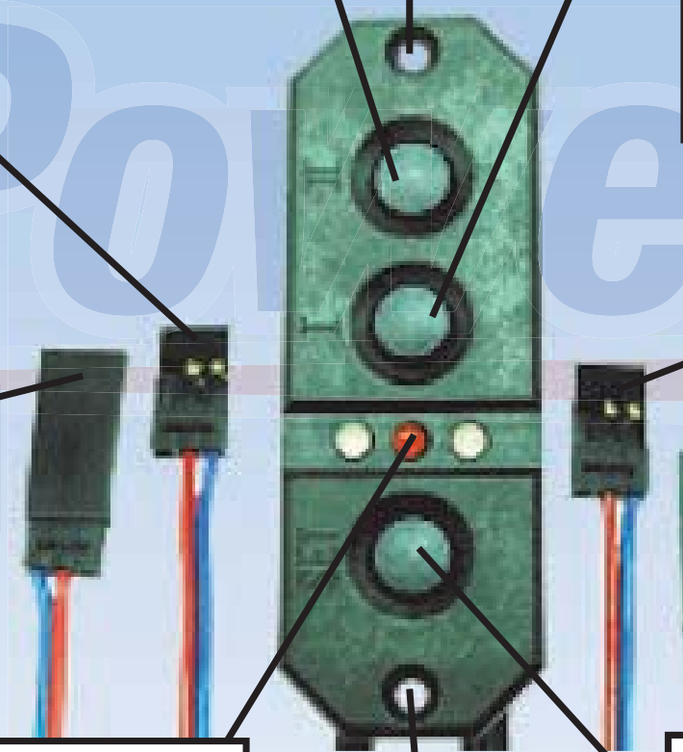
The push-buttons are marked **“SET“**, **“I“** and **“II“**.

The slightly recessed **“SET“** button is used to prepare and execute a switching process. The two internal switches are “armed“ when you **hold** the **“SET“** button **pressed in for about one second**. The red LED now lights up.

At this point both power circuits can be switched on individually using the two remaining push-buttons **“I“** and **“II“**. This method of operation enables you to check each power circuit or battery separately.

To switch the **PowerBox Sensor** off again, first **hold** the **“SET“** button **pressed in**. You can now switch the two batteries off using the buttons **“I“** and **“II“**.

This new switch system, developed by **PowerBox Systems**, offers you the highest possible standard of security.



Sensor button for switching battery 2

Sensor button for switching battery 1; reads out minimum value if 1 and 2 are pressed simultaneously

Four-stage voltage indicator for battery 2, also power-on signal

Screw hole

Voltage indicator for battery 1; also power-on signal

1st connecting lead to receiver

2nd connecting lead to receiver

Connecting lead for battery 2

Connecting lead for battery 1

Red LED indicates that the SET button has enabled the switching process; also indicates battery selection

Screw hole

SET button for executing the switching process, also for selecting the battery

The switch is designed to be installed in the model using a pair of screws (supplied) fitted through the two countersunk holes.

Using the switch for the first time:

Locate the two battery connecting leads (terminating in polarised universal connectors), and connect each to a two-cell Lithium-Polymer battery (8.40 Volts) or a **five-cell NC** / **NiMH** battery. In either case take care to maintain **correct polarity**.

Caution ! connecting the batteries with reversed polarity invariably destroys the regulator IC in the switch!
The switch is not approved for use with mains PSUs.

If the **PowerBox Sensor** was switched off when you connected the batteries, it remains switched off when you connect them. If the **PowerBox Sensor** was switched on when you connected the batteries, it remains permanently switched on - even if you disconnect the batteries, or if an interruption (long or short) occurs in flight. This is the principle of “self-latching“ electronic switches. Once switched on, the only way of interrupting the current is to switch it off with the push-buttons using the defined procedure.
If you have set the correct voltage monitor level and the batteries are fully charged, both LEDs will light up green. At this point we strongly recommend that you use the voltage monitor facility for a “pre-flight check“. “Stir“ both transmitter sticks so that the most important servos are in constant and simultaneous motion. If the batteries have sufficient performance for your particular model, if both are sufficiently charged, and if all the connecting leads and connectors are in good order, then both LEDs will continue to glow green. If the colour changes from green to orange or even red, then this is a warning that you should check all the above-mentioned points, and eliminate any defects.

Please believe and trust the LED indicators!

In its default state the **PowerBox Sensor** is set up to work with **LiPo** and **Lilo** batteries. If you are using these types of battery, you do not need to change any settings. If you prefer to use five-cell **NC** or **NiMH** packs or two-cell **LiFe** (A123) cells, then you will need to change the voltage monitor setting.

You may well find that your batteries accept slightly different capacities (this might be 150 to 200 mAh after several flights) once you have completed a series of flights and recharge processes. This actually represents proof that your **PowerBox Sensor** really is equipped with two independent systems. With other makes of system we are aware that exactly identical capacities are always charged into the batteries. This is curious, and we suggest that you ask yourself if that could really happen if two independent safety systems were actually present. In fact, we know that our competitors' systems feature no duplicated parts with the exception of the two batteries, as mentioned above. All these units do is discharge both batteries simply and cheaply through a single regulator, with the result that your complete RC system is solely dependent on this one component. Please bear in mind that the electronic components of regulators are not immune to failure, and that no serious electronics designer could claim that the components he uses could never fail, and therefore do not need to be duplicated.
We do not consider circuits of this type to be redundant systems in the true sense of the term.

Minimum value memory:

To help you monitor the condition of the two airborne batteries accurately, we provide an additional **minimum value memory (low voltage memory)** for both batteries.

This **minimum value memory** records all voltage collapses of both batteries during the last flight.

After the flight you can call up the minimum value memory by **simultaneously** pressing both sensor buttons “I“ and “II“ **before** you switch the system off.

Switching off the power supply system resets both memories; the recording process re-commences when you next switch the system on.

Setting the voltage monitor to the battery type you are using:

- Connect the two batteries you intend to use.
- Switch the PowerBox Sensor on.
- The SET button is used to select the setting for the two batteries.
- There are only two options, which you now need to remember:
- One red flash means LiPo / Li-Ion.
- Two red flashes mean NC / NiMH, or two-cell LiFe battery.
- Hold the SET button pressed in until the red LED flashes.
- Release the SET button when the LED flashes red once: the switch is set to LiPo / LiIo.
- Alternatively wait until the LED flashes red twice, then release the SET button: the switch is set to NC / NiMH or LiFe.
- If the setting matches the battery type, both LEDs will glow green.

All done.

A popular application for the **PowerBox Sensor** is two-metre class model aircraft, such as the Katana 120 shown here. This model features a cut-out in the fuselage specifically designed for the **PowerBox Sensor**, and the same applies to the Sukhoi 140. Model jets and gliders up to 5.0 metres span are also an ideal choice for this switch unit.

In this application you can rely on the servos having absolutely constant running characteristics, i.e. torque and transit speed, thanks to the very high performance of the unit's integral voltage stabilisation circuitry. The result is totally consistent servo response through all aerobatic manoeuvres.
This is one of the fundamental requirements for successful aerobatic flying.

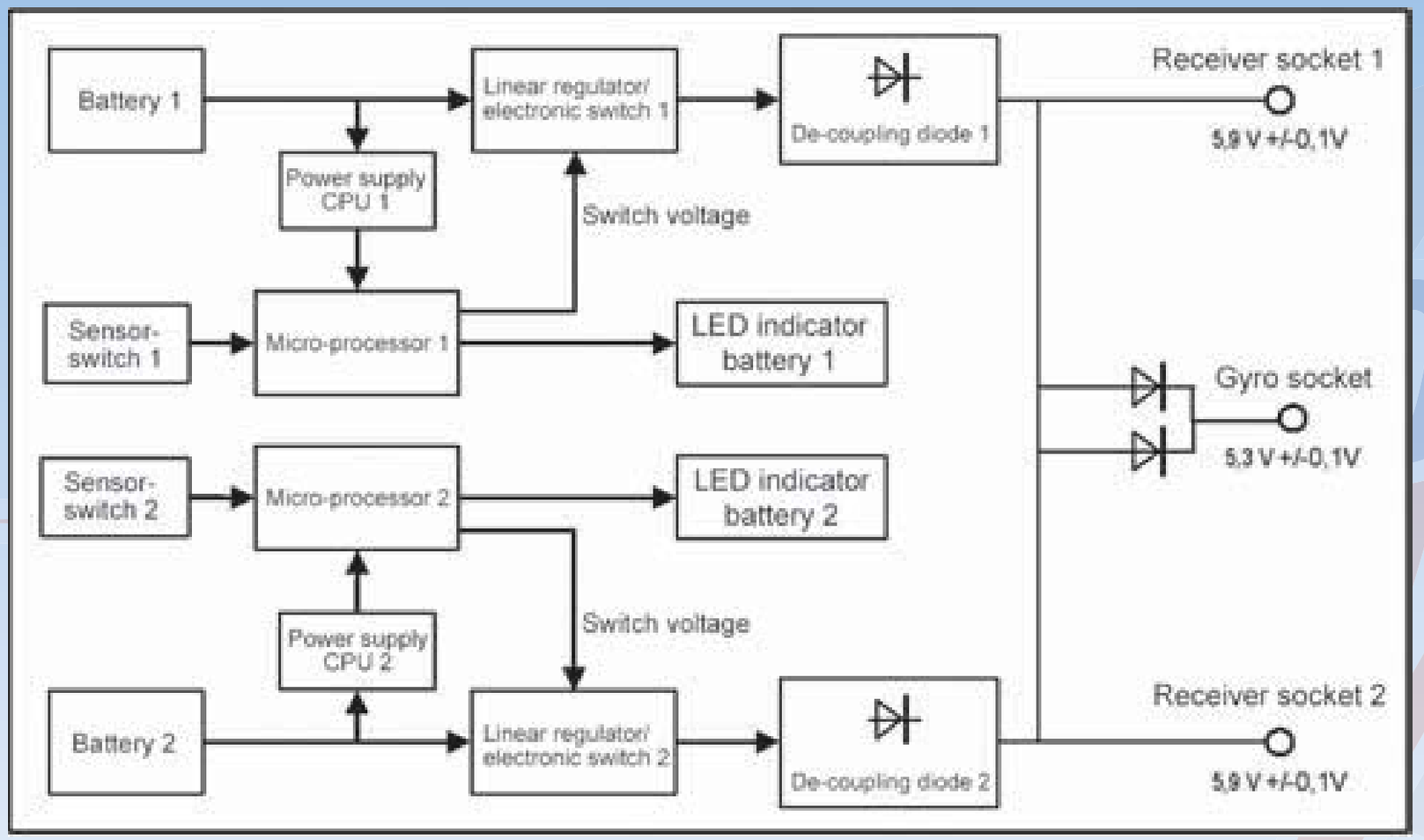
The maximum capacity of the **PowerBox Sensor** is stated in the Specification (3 to 5 A), but please note that this does not refer to the maximum performance of the **PowerBox Sensor's** voltage regulator, as it varies according to the efficiency of the cooling measures. To achieve good cooling (and therefore high performance) we have fitted a sophisticated blue-eloxided heat-sink on the back of the **PowerBox Sensor**.

The heat-sink is recessed into the switch case to ensure that this component cannot be completely covered even if the switch is not mounted in an unfavourable position.
Please ensure that waste heat can be dissipated freely via this heat-sink.
The electronic components are designed for a maximum regulator capacity of up to 12 A. If this level is exceeded, the **PowerBox Sensor** does not switch itself off; instead it by-passes the voltage regulator. The same applies if the voltage of the batteries falls below 5.9 Volts; this also does not cause the **PowerBox Sensor** to switch itself off.
The remaining voltage available is always passed through to the receiving system. The electronics continue to function down to below 2.5 Volts!

If you notice that the **PowerBox Sensor** becomes hot in use (above 60° Celsius), this is a reliable indication that the servos you are using are consuming a disproportionate amount of energy (power). Please check your servos, pushrods, linkages etc. If the receiving system is in good condition, you can remedy the situation either by re-positioning the **PowerBox Sensor** in a location with a better air-flow, or by replacing the unit with a **PowerBox Gemini**, which is designed for higher-current applications.

The unit features double battery and receiver cables, each with **0.34 mm²** conductors. This means that any voltage drop in the cables is very slight even at maximum load.

The schematic circuit diagram printed below is intended to clarify the inter-related functions of the **PowerBox Sensor**. It shows in graphic form how the individual components are linked together.



The **PowerBox Sensor** satisfies the strict **EMV protection requirements** in accordance with EN 55014-1 and EN 55014-2, which entitles it to bear the CE symbol. The CE symbol guarantees that the device fulfils the statutory

regulations for interference-free operation. This includes tests for interference radiation and interference rejection. The **PowerBox Sensor** causes no interference to other apparatus (e.g. receiver, servos).

All devices manufactured by **PowerBox Systems GmbH** are checked by an independent testing institute. If you are interested in the details of the test report about the **PowerBox Sensor** you can view it on our website.

The report can be accessed as follows: **www.powerbox-systems.com**, then “Downloads“ and then “Certifications and test reports“.
The same applies to the CE declaration of certification which is based on this test report.

Please note: we know of no other manufacturer operating in the model sector who has his products subjected to such complex and expensive testing.
PowerBox Systems GmbH is currently the only supplier of electronic model apparatus that is **certificated according to ISO 9001:2000 !** We are proud of this, as it proves that even our development and production departments fulfil the highest standards of quality.

Additional technical information:

If the batteries are left connected to the **PowerBox Sensor** when the system is switched off, what is known as a **“stand-by“** circuit remains active, and this draws an idle current. The idle current is around 5.0 microA, which is less than the rate of self-discharge of the batteries. However, we still recommend that you disconnect the batteries if you do not intend to operate the model for a long period.

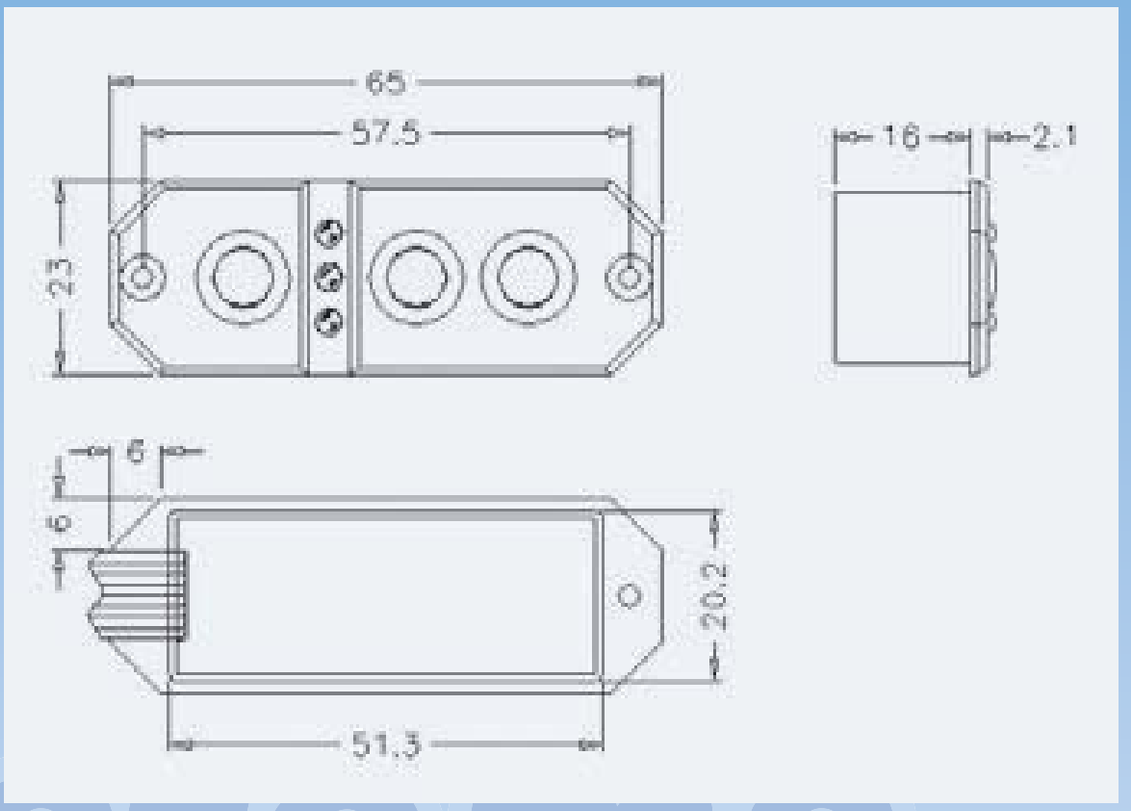
Please don't throw away the inner packaging, as it includes a template for marking the switch aperture. Cut or saw out the opening just **outside the marked line** (photo).
The PowerSwitch is virtually impervious to vibration, but it is still good practice to mount the unit in an area of the model where vibration levels are low.

Please note the following point:

The GRP fuselage sides of a power model are actually unsuitable for mounting any kind of switch, as they are always subject to considerable vibration.
You can remedy the situation by cutting a ply plate (2.5 - 3 mm thick) about 2 - 3 cm larger than the switch aperture, and gluing it in the appropriate position.
The plate damps the vibration, and at the same time provides plenty of "meat" into which the switch retaining screws can "bite".

We recommend that you use **our own make of LiPo battery packs**: **PowerBox Battery 2800, 4000** or **PowerBox Battery 1500**, all of which feature integral monitor and security electronics to guarantee safe charging. All these packs are supplied complete with practical mounting frames. Order your batteries with the appropriate connecting leads. **PowerBox Sensor** series with JR connectors.

Installed dimensions:



Guarantee conditions:

During the production process each **PowerBox Sensor** undergoes a series of tests. We take the maintenance of the highest quality standards very seriously, and this also applies to all bought-in components. This enables us to offer a **36 month** guarantee on all our battery backer and switch systems. The guarantee covers proven material faults, which will be corrected by us at no charge to you.
Misuse and maltreatment, such as **reversed polarity**, excessive voltage, the effects of damp, severe external mechanical influences or damage (crash-damage) invalidate the guarantee. The same applies to faults which are due to excessive vibration.
Additional claims, e.g. for consequent damages, are excluded. We do not accept liability for the device or the use of the device, as we are not in a position to ensure that the product or products are correctly installed and operated.

Specification:

Voltage range:	Two-cell LiPo battery, max. 8.40 Volts
	Five-cell NC / NiMH battery, approx. 6.8 Volts
Output voltage:	Double stabilised at 5.90 Volts
Voltage monitor:	3 three-colour LEDs for each battery
	Four-stage: green, orange, red, flashing red
Regulator capacity:	3 to 5 Ampere, depending on cooling efficiency
Connectors:	Duplicated JR plug and socket to receiver
Conductor cross-section:	All connecting leads 0.34 mm², silicone cable
Control elements:	Sensor buttons
Weight:	34 grammes incl. all leads
Temperature range:	-10°C to +75°C
EMV testing:	EN 55014-1 and EN 55014-2. CE-tested, certificated

Accessories:

- Retaining screws
- Installation template

Order No.: 6310 with 0.34 mm² leads and JR connector system
6320 with 0.34 mm² leads and MPX-PIK connector system

We wish you much pleasure and success with your **PowerBox Sensor**!

Donauwörth, August 2008

PowerBox-Systems GmbH

Certificated according to ISO 9001:2000

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