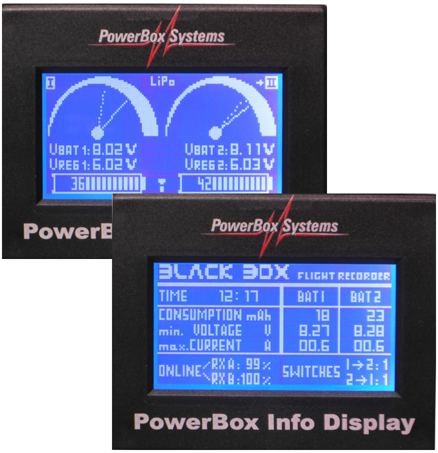
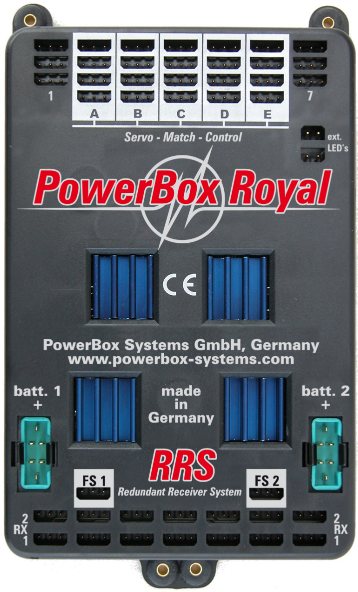
PowerBox Systems

World Leaders in RC Power Supply Systems

PowerBox Royal





Operating Instructions for the PowerBox Royal

- with double voltage stabilisation, linear regulation,
- backlit **LCD screen**, integral PowerBox **RRS** system
- **20** individually adjustable servos on **5** channels (**Servomatch)**
- and electronic safety switches (**SensorSwitch**)

Registered Design DE 203 13 420.6

Dear customer,

We are delighted that you have decided to purchase the **PowerBox Royal** from our range; this is the latest generation of RC power supply systems, and represents an absolute High-End product in this field.

You are now the owner of a power supply system for your valuable model aircraft which offers the highest performance currently available anywhere in the world. In addition to the facility to couple two modern LiPo batteries, the system includes many components which serve to enhance safety: a **backlit LCD screen** which displays all the important information, and allows you to read off the essential stored data from the last flight **(Flight Recorder)**; a genuine redundant receiver system **(PowerBox RRS)**; individual adjustment facilities for twenty separate servos on five different channels (**Servo Match Control),** and - of course - signal amplification, RF interference suppression and much more besides.

This RC power supply system provides you with a **linear stabilised** power supply voltage of **5.90** Volts **or** - if desired - of **7.0** Volts (switch-selectable) for the servos. The two receivers are always fed exactly 5.0 Volts from two independent, redundant Low-Drop-Out regulators. Although we have made this RC power supply system simple to operate, its use does require some knowledge on your part. These instructions are designed to ensure that you quickly become familiar with your new device. We ask you to read through the operating instructions attentively before attempting to use your new power supply system for the first time, as this will ensure that you reach this point of competence quickly and without problems.

In its default state the complete **PowerBox Royal** consists of the following components:

- **PowerBox Royal**, mountings and metal sleeves pre-fitted
- Backlit **LCD screen**
- **Adjustor board** with connecting lead
- **16 patch leads** for connecting two receivers
- Accessory pack
- Operating instructions

We wish you many hours of pleasure and success with your PowerBox Royal!

Contents

1. History of PowerBox Systems voltage-stabilized 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 form of receiving system power supply installed in his Katana; a type 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 two linear voltage regulators - 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, developed by **PowerBox Systems**, offers extremely high performance and has been employed unchanged in all our regulated battery backer systems and switches since the year 2003. Many thousands are now in use all over the world. All companies known to us which produce competing products have fitted their battery backers not only with a regulated voltage circuit, but also the original **PowerBox Systems** 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 Royal** is currently the most up-to-date RC power supply system available anywhere, and contains all the electronic components which are necessary for modern servos and models. Basically, all the essential components, ICs, electronic circuits and control programs required for a reliable power supply system are **duplicated**! As in all PowerBox systems we take the term “dual power supply” very seriously.

You have selected an overall design which is far more than a simple two-battery power supply: in fact all the safety-relevant components are duplicated, i.e. the system has built-in redundancy. This product gives you safety through genuine redundancy. We feel obliged to emphasise this point in particular, as it is vitally important, and is required and expected by us and by most of our customers. No modeller should install in his models a device responsible for electronic safety which is not secured by system redundancy. This means: secured as it would be by a **PowerBox Royal**!

The **PowerBox Royal** also provides up to seven channels which can be "**remotely accessed**" 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? After all, the standard receiver sockets are in no way sub-standard, 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 as follows:

1. Channels which are required to control multiple servos (several servos per control surface, integrated signal amplification);
2. Channels which are operated using very long servo leads (more than 60 cm, integral signal amplifiers, RF interference suppression);
3. Channels which have to supply extremely powerful, high-performance servos drawing correspondingly high currents (digital servos, Jumbo servos, Power servos);
4. Channels which require special interference suppression measures (RF suppression of long servo leads, turbine electronics, flasher units, throttle servos, ignition servos, and many more);
5. Channels which are operated constantly during normal flight, e.g. aileron, elevator and rudder, in order to reduce the effective load on the receiver
6. Channels which are required to control multiple servos, where the servos must be adjustable individually in order to ensure exactly synchronous servo travel (**Servo Match Control**, present in the **PowerBox Royal** for five channels);
7. Channels which operate servos with different tasks, i.e. which may rotate in opposite directions and require different travels (Servo Match Control);
8. Channels which are so important that for safety reasons they must be backed-up by a second receiver when the model is in the air (**RRS system**).

All the other servos connected to your receiving system (flaps, retracts, aero-tow release, smoke pump valve etc.) can be connected to the appropriate receiver sockets 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**; this is ample for all types (powers) of servos and applications, including a 100% reserve. Both diodes are housed in their own case to ensure extremely low resistance. This diode arrangement provides for ultra-short paths inside the component, guaranteeing that voltage losses in operation are extremely low (0.25 Volt).

If both batteries are in good condition, both contribute **simultaneously** to the receiving system’s power supply. This means that each battery only bears half the total load at any one time, and the system as a whole has twice the performance capacity when required. Both batteries 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.
If you have decided to use our **PowerBox Battery** LiPo packs, you can leave them connected to the **PowerBox Royal** during the charge process.

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 150 - 200 mAh.

This is the reason for the discrepancy:
As mentioned earlier, the **PowerBox Royal** is fitted with two independent, redundant voltage regulators, i.e. one regulator for each battery, and it also features two Low-Drop-Out regulators for the two receivers. This duplication provides what is known as redundancy. However, electronic components - like any other technical parts - are never 100% identical, i.e. all components have a certain tolerance. For our products we do take the greatest trouble to select parts which exhibit the tightest tolerances according to the manufacturer’s data sheets, but we cannot completely avoid minor deviations. Nor are all batteries 100% identical, so it is impossible to eliminate the problem just by the selection process.

In fact, a slight difference in the capacity of your batteries after several flights actually constitutes proof that your **PowerBox** contains two completely independent systems. We are aware that other systems always feed absolutely identical capacities into the batteries.

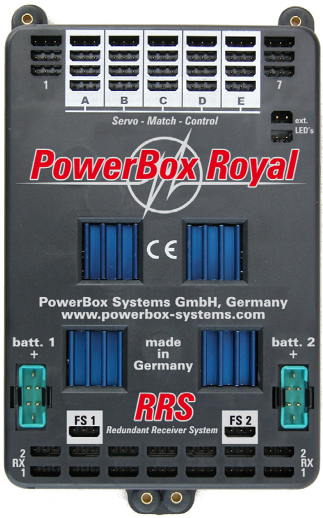
This is “curious”: we ask you to consider for a moment whether this could really occur if - as claimed - the system contained two completely independent systems.

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. That’s not redundancy.

In our opinion circuits of this type do not represent genuine redundant systems, as required for valuable model aircraft and for safe modelling in general.

3. Powering up your PowerBox Royal:

Connect the SensorSwitch to the left-hand side; this is used for switching the two power circuits on and off, and for activating the BlackBox function (Details see following description)



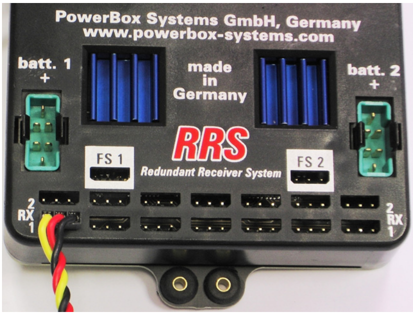
Plug the LCD screen into the right-hand side; the adjustor board is also connected here when required (Details see following description)

Connect both batteries to the battery ports Make sure to connect the red to positive and black to negative or you will burn the PowerBox.

Brief instructions:

1. Connect switch and LCD to the PowerBox
2. Connect both batteries to the battery ports
3. Turn on the switch by holding the SET button until the red light comes on, then press the I button and after that the II button to have both batteries turned on. Same way you can turn them off.

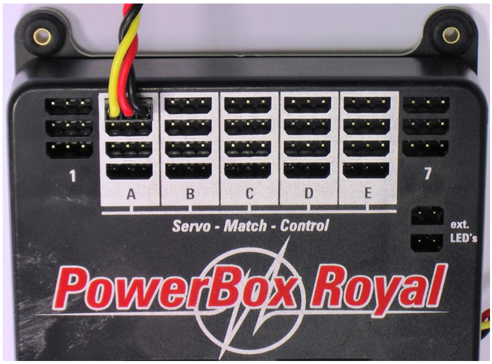
4. Your PowerBox has been initialized at this point. You can proceed with connecting servos and connect to receivers following below instructions.



The two receivers are connected to the sockets marked RX 1 and RX 2 using the patch leads supplied in the set. Note that the channels of the two receivers must be connected **in the same sequence**, i.e. channel 1 of receiver 1, and channel 1 of receiver 2.
(Details see following description)

The servos should be plugged into the upper bank of sockets.

Check the polarity of the servo connectors: the socket guides feature a bevel to indicate correct polarity: the signal contact is always on the left, black wire on the right, as shown in the photo.



The connector for the LCD screen is plugged into the appropriate socket on the right-hand side of the **PowerBox Royal**. Note that in this case the ribbon cable must be **at the bottom** (red wire on the left).

Always use **thumb and finger** to remove the connector. Locate the retaining clips on the right and left sides and squeeze them together gently. This disengages the connector, which can then be withdrawn from the **PowerBox Royal** without difficulty.

4. The SensorSwitch

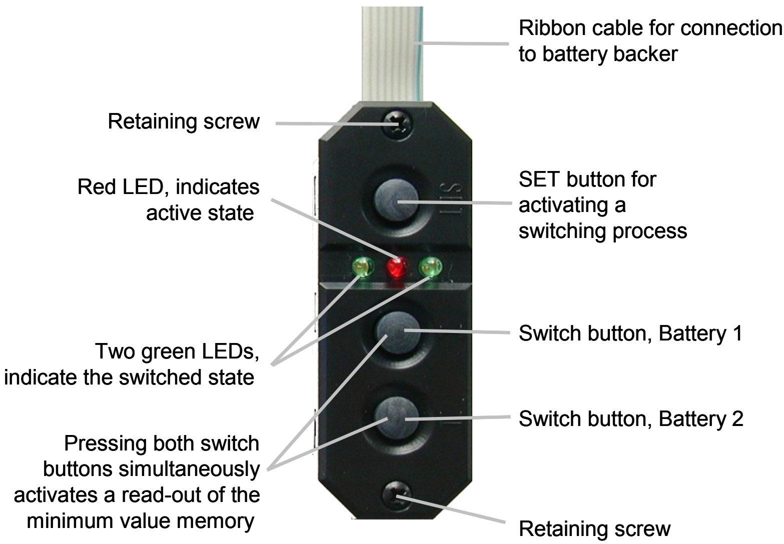
The **SensorSwitch** can now be connected to the appropriate socket on the left-hand side of the **PowerBox Royal**. In this case the ribbon cable must be **at the top.**

The purpose of the **SensorSwitch** is to provide external control of the integral electronic switches in the **PowerBox Royal**.

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 housed inside the battery backer. If you pull off the **SensorSwitch** unintended, the switching state off the **PowerBox Royal** is not affected!

The switch plate houses three push-buttons and three LEDs: two green, one red. The switch is attached to 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.

The two power circuits can now 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 accomplished by switching on only one battery (**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 the second battery on (second green LED on the switch glows) using the other 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 **“stand-by”** circuit of the electronic switches in the **PowerBox Royal** draws an idle current of around 5μA. 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 - for any reason - the **SensorSwitch** is accidentally disconnected or comes adrift!

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

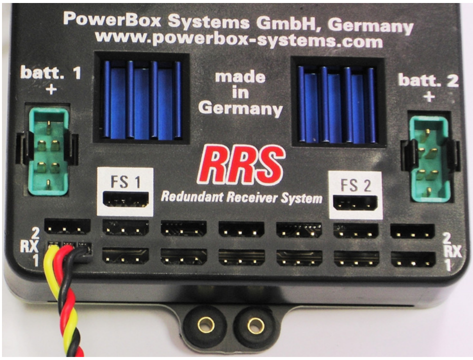
Don’t just let it dangle in the fuselage, and never place it under any strain. A small piece of double-sided foam tape between cable and fuselage is often all that is required.

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 which is relatively low in vibration.

Tip:
Please note that the bare **GRP** fuselage sides of a large power model are not suitable for mounting a switch, as they are invariably 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. The plate absorbs much of the vibration, and at the same time provides plenty of “meat” for the **SensorSwitch** retaining screws to bite into.

5. Description of the RRS (Redundant Receiver System) in the PowerBox Royal

It is perfectly possible to operate the **PowerBox Royal** with a **single** receiver. However, we recommend that you use two receivers in order to exploit the full capabilities of the **PowerBox Royal**, as this doubles your safety margin in terms of radio reception.



If you wish to use only one receiver, you must always use the servo sockets of the socket bank marked RX 1.

The facility to use a second receiver transforms the **PowerBox Royal** into an integral high-security high-performance receiver backer for your valuable model aircraft; a system which we and our pilots have tested thoroughly over a long period. In addition to coupling two trusted receivers of your choice, the unit provides constant monitoring of both receivers using the LCD screen.

Many years of development, with ultra-precise measurements of reception conditions in model flying, have resulted in this system.

A feature shared by all products from **PowerBox Systems** is their great ease of use, and the **RRS** section of the **PowerBox Royal** is no exception. Creating devices which are easy for the operator to use can often be just as difficult as developing the electronic components and software required to make them work as we want them to.

Although we have made this receiver backer simple to operate, its use does require some knowledge on your part. These instructions are designed to ensure that you quickly become familiar with this section of the **PowerBox Royal**.

Description of the integral RRS - Which considerations resulted in the RRS (Redundant Receiver System)?

Of course, redundant receiver systems are nothing new; they have actually been employed in satellites and other military applications for several decades. In terms of receiver backers for use in models, we must mention one name here: C. Nicollet from Paris. His receiver backers were designed in the 1990's, and were based on the electronic components of the period. These backers, which we think of as "**Nicollet system**" units, were primarily installed in French large-scale model aircraft, as were flown every year at La Ferté Alais - probably Europe's most famous model flying event.

However, since that time the original technology has been superseded almost completely by more modern components; the biggest difference being that current electronics can now be controlled using contemporary, tailor-made software. All receiver backer products currently sold for modelling purposes are based on the **"Nicollet system"** principle.

Practical considerations relating to radio reception:
Model pilots have actually managed well with just one receiver ever since the first radio-controlled model aircraft were flown. Originally this unit was equipped with an aerial which was deployed outside the model's fuselage, usually tensioned to the fin. In later years, receiver technology has continued to develop from the early AM on to FM, then IPD, PCM, SPCM and lately 2.4 GHz technology. The receivers available became steadily better at rejecting interference, and their effective range increased.

Even today, most large models - including model jets - are still flown without problem using a single receiver, even though nowadays the receiver and its associated servos are generally fed current by a sophisticated power supply system, which itself provides a further improvement in the overall margin of safety. Within the typical radius of operation in which these models are flown, problems occur relatively seldom - **provided** that all the installed systems are working perfectly.

Current "Diversity" systems - twin-aerial arrangements - are now often claimed to offer the maximum possible security, but honest research has shown that one receiver and one aerial actually provide just as good a performance, with the proviso that the equipment must be of the latest design and construction, and that all the systems are efficiently installed. Companies which promote these systems tend to ignore the factors of **transmitter**, **transmitter power** and **frequencies**, despite the fact that it is the **transmitters** which are actually the decisive factor in obtaining an effective, reliable radio link, i.e. full working range!

Why then the development of the PowerBox RRS module?
We have been testing the predecessor of the system - the **PowerBox RRS** module - for a period of almost two years in conjunction with virtually every **modern** receiver and transmitter available commercially today. During this test programme we discovered again and again that absolutely no reception problems occur within a radius of up to about 500 m, provided that the conditions for radio transmission are ideal. Potential “problems” in the vicinity, including power lines, radio masts, radio relay systems and much more, may cause a significant reduction in the theoretically possible radio range.

In contrast, **greater distances**, unfavourable aerial positions relative to the transmitter, and severe local circumstances often result in fail-safe phases (lasting two to five seconds) during many test-flights.

The effective radio range diminishes drastically if the model carries airborne “interference generators” in the shape of engines with ignition systems, poorly suppressed magnetic valves, inadequately suppressed smoke pumps, electric power systems and much more besides.

From these findings we offer one serious piece of advice: when purchasing electronic accessories please select top-quality manufacturers only, and always buy properly suppressed products!

We developed the **PowerBox RRS** module with the aim of protecting your model when it is flying close to the limits of good reception. (Naturally the protection is also effective against total failure of one receiver; more on this later.)

If the model’s receiver switches briefly into fail-safe mode due to an unfavourable flight attitude relative to the transmitter, and **if** the second receiver currently offers better reception, then the integral **RRS** system is immediately able to switch over to the second unit. In fact, provided that the two aerials are deployed differently, the alternative aerial will momentarily be at a different position relative to the transmitter, and it is safe to assume that it will therefore have better reception.

There is no point in deploying the two aerials parallel to each other, as this offers no advantages.

Please note that the “dual-aerial theory” only offers positive benefits when the model is flying close to the limits of range, as described above.

Why does the **RRS** section of the **PowerBox Royal** only switch seven channels simultaneously?

The first and crucial reason is once again: safety. Safety is not assured by senselessly inflating the number of supplementary functions, especially as they can be shown in practice to be unnecessary; the bedrock for real safety is often created by restricting the number of components and functions in a sensible manner.

As initially mentioned, countless tests have shown that what we term fail-safe events are invariably relatively brief. If one of the receivers goes into fail-safe mode, in most cases it is for a period of between two and five seconds. The second receiver is effortlessly capable of bridging this period, and the pilot is completely unaware of the problem.

Seven control channels enable a pilot to launch, fly and land any model aircraft in safety. Very few models are flown actively using more than seven channels simultaneously, and this is most certainly the case if your model is fitted with a **PowerBox Royal**; if you are using one of these power supply systems, five channels can be set up to control twenty servos individually. If you are using a power supply system which does not offer this facility, several transmitter channels usually have to be sacrificed just so that you can adjust the neutral position and end-points of individual servos.

Channels which operate auxiliary functions (wheel brakes, aero-tow release, valves, smoke system, landing lights) can simply be connected to one of the two receivers directly, or shared out amongst the two receivers. When the system is operating, all the functions of both receivers work simultaneously, including those functions which are not controlled via the **RRS** system.

Now back to the real world:
Let us assume that receiver 1 is currently active when a brief fail-safe phase occurs, due to great range and unfavourable flight attitude relative to the transmitter. Within a period of 60 milli-seconds (msec) the **RRS** system switches to the second receiver. In our experience this fail-safe event will usually last no longer than two to five seconds, and you, as pilot, will be utterly unaware of the fact that the circuit has switched receivers to cope with it. Let us imagine that you have connected the auxiliary functions ‘wheelbrakes’ and ‘landing lights’ to the first receiver - the one which is in fail-safe mode for a few seconds - while the other receiver has been assigned the ‘smoke pump’ and ‘retracts’ functions.
In practice the situation is as follows: during this brief fail-safe period of two to five seconds, the wheel brakes and the landing lights will not work, although

the other auxiliary functions connected to receiver 2 - smoke pump and retracts - will operate properly even for these two to five seconds, because the fail-safe of this receiver has not been triggered.

Now we ask you to consider whether it makes sense to manufacture the **RRS** system with a capability to switch, say, fourteen or more channels, simply in order to ensure that the model's wheel brakes (for example) still function properly for three seconds of a flight when the model is 500 metres away and 200 metres up. As mentioned earlier, we believe that a good starting point for safety is to restrict components and functions; and in any case the seven functions which are crucial for controlling the model are always active.

Auxiliary functions are simply connected directly to the two receivers. Please note: if you assign a function to channel 9 of one receiver, channel 9 of the other receiver remains free, and is not used.

In practice, if you use today's modern receivers - especially PCM units - you will soon find that the **PowerBox Royal's** screen shows that relatively little switching occurs between the two receivers. As mentioned earlier, this is simply due to the fact that a good receiver with a sensibly deployed aerial is perfectly adequate under normal circumstances. If you find that the module has switched receivers five, eight or even more times during a typical flight, then you should consider this to be a warning: check the electronics, the receivers, the aerial locations in the model, **and don't forget to check the transmitter output power.**

Of course, the **RRS** system also provides a margin of safety if one receiver should fail completely. For these reasons it is our firm opinion that the ingenious receiver-switching technology of the **RRS** system integrated into the **PowerBox Royal** provides a more capable performance overall than a pure "twin-aerial **receiver** system".

When a "Diversity reception" system is used, the input signals are co-ordinated, and the signals may be complementary to each other. Coupling two receivers together may be of benefit to the input stage of the receivers. However, no servos can be controlled using this input signal alone. It is only at this point that the receiver starts processing the signal; the decoder and the output drivers eventually feed a usable signal to the receiver servo sockets, and only then can the servos be controlled.

Our long years of experience have convinced us that it is not receiver input stages alone which are susceptible to faults; we have often been asked to check a faulty receiver which turned out to have quite excellent reception, but the model has crashed due to faults in the decoder or the output drivers.

In contrast, the **RRS** system checks and assesses the receiver in its entirety.
The **RRS** system works by analysing the signals (> 0.8 msec. and < 2.2 msec.) which are really, actually, present at the receiver output for controlling the servos, and switches receivers if those signals are not valid; alternatively it uses the fail-safe signal generated by your individual receivers as the trigger. This principle means that the checking process assesses the receiver as a whole - not just the signal the receiver picks up. The module analyses the actual signal quality which the receiver generates for controlling the servos, not just the signal at the aerial input - which the servos are unable to use in any case.

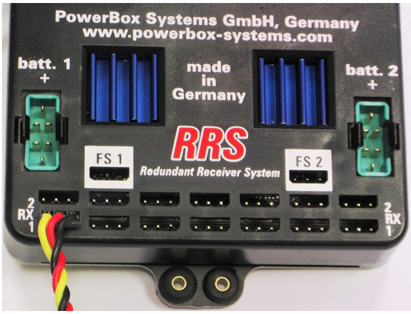
If both receivers are operated in PCM mode, the task of the **RRS** system in assessing the receiver's function is particularly easy. Every receiver manufacturer, whether Futaba or JR, has defined the minimum reception standard for all that company's PCM receivers, and the receiver switches to fail-safe mode if this bottom limit is reached. The actual trigger point is specific to each receiver, since the effective range of one may be greater than the other. If used with PCM receivers, the **RRS** circuit exploits these values for switching receivers, as defined by the manufacturer.

For this reason one free channel of each PCM / IPD receiver must be programmed to respond to a fail-safe event. If the receiver switches into its own fail-safe mode due to a momentary difficulty in reception conditions, the module instantly switches to the second receiver, without any further checking of the servo signal, **provided** that the second receiver is still supplying a valid signal. This checking occurs within a period of about 60 msec.

Important electronic considerations:
The electronic components of the **RRS** module contained in the **PowerBox Royal** are designed in such a way that the servos are **always** controlled by one receiver. At any one time one receiver is **always** selected, i.e. the servos are **never** supplied signals from both receivers simultaneously.
If the circuit detects a defective receiver, it **only** switches over to the second unit if the latter is working faultlessly. If both receivers are supplying an invalid signal, no switching takes place between them.

In contrast to other systems, the **RRS** system in the **PowerBox Royal** is able to switch to and fro between the two receivers within a **very short time-span.**
The two receivers in the system are always considered of **equal value** by the **RRS** system; it does not differentiate between a "main" and a "back-up" receiver. The active receiver always remains active until such time as it no longer delivers a usable signal.

Connecting the RRS system of the PowerBox Royal using the sixteen patch leads included in the PowerBox Package:



Front row RX 1:
Sockets for seven patch leads from receiver 1 (RX 1), Servo signal input from receiver 1, sockets 1 to 7

The seven receiver channels can be selected without restriction, i.e. they do not need to comply with the receiver channel numbering.

For example, if you consider that receiver channel 8 is vital to the safe operation of your model, then you can simply choose to pass this channel through the RRS system, and connect another channel, e.g. channel No. 6, directly to one of the receivers in its place.

Another example for using JR-Receivers: If you connect the rudder to channel No. 1 of the PowerBox Module, the No. 1 of the RRS-Module needs to go to channel No. 4 of your receiver. Other brand receivers may have a different port assigned for rudder.

Please note that you do not need to connect all seven of RX 1's inputs, but **the servo sockets of the RX 1 socket bank must always be used!**

The fail-safe channel (FS 1) **must** be occupied if you are using a PCM or IPD receiver, and this channel **must** also be programmed correctly to fail-safe.

Important: The sequence of all the channels of both receivers must be identical in numerical terms, i.e. channel 1 of receiver "RX 1" must also be channel 1 of receiver "RX 2".

Second row RX 2:
Sockets for seven patch leads from receiver 2 (RX 2) / Servo signal input from receiver 2, sockets 1 to 7
The seven channels of receiver 2 must correspond to the channels of receiver 1, i.e. channel 1 of receiver 1 must also be channel 1 of receiver 2, etc.

The fail-safe channel (FS 2 socket) **must** be occupied if you are using a PCM or IPD receiver, and this channel **must** also be programmed correctly to fail-safe.

A small tip for robbe / Futaba customers using the Futaba G3 receiver: do not forget to synchronise the second receiver to your transmitter, as described in the Operating Instructions supplied with your T 14 or FX 40 system; the system works perfectly provided that you expressly set up the transmitter to work with a second receiver.

Like PCM receivers, Multiplex (MPX) IPD receivers feature a programmable fail-safe system which you must use.

As already mentioned, the **PowerBox Royal** module should be connected to the control functions you wish to switch using the patch leads supplied. It is up to you to select the channels for the appropriate functions in your model, although they would usually be the primary functions such as elevator, aileron, rudder, throttle, landing flaps, retractable undercarriage. Auxiliary functions such as smoke system, wheelbrakes and landing lights can be left connected directly to the receivers.

Bear in mind that the **PowerBox Royal** provides five channels to which you can connect four servos each, and adjust each servo individually. We recommend that you use sockets 2, 3, 4, 5 and 6 for this. These channels can now be adjusted using the **PowerBox Royal** Adjustor Board.

A typical application would be a rudder and steerable nosewheel operating in parallel; this facility eliminates the need to sacrifice two channels at the transmitter and receiver for adjusting the servo travels and directions: with the **PowerBox Royal** you can do all this with just one channel.

Similarly, the airbrakes of your glider now need only a single channel, as the two servos can be adjusted accurately for true synchronous running using the “Match Channel” facility of the **PowerBox Royal**.

6. Programming a free control channel to fail-safe when using PCM or 2,4 GHz receivers:

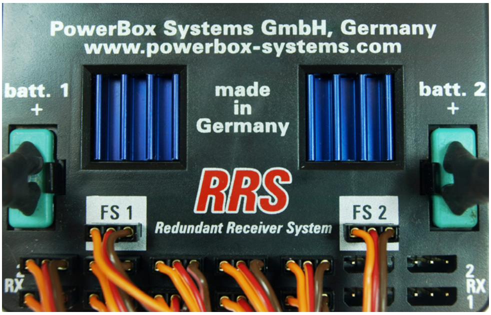
At the transmitter you should select a vacant channel, i.e. one which is **assigned to no other function**, and program it to fail-safe.
It is essential to program this fail-safe channel in such a way that it switches from 0% to -100%, **or** from 0% to +100% (half servo travel), when fail-safe is triggered.

For information regarding the correct method of fail-safe programming, please refer to the operating instructions supplied by your RC system manufacturer.

You can use the following **test** to check that the fail-safe programming is correct: connect a servo to the appropriate channel, then switch the transmitter off. If the channel is correctly programmed, the servo should now move to half its full travel, e.g. from centre to one end-point. In this way you can easily check visually that the receiver is generating the correct fail-safe signal.

One minor additional tip: if you were obliged to define a switch at the transmitter for the fail-safe programming (FX 40 / TZ 14, MPX), you should first complete the programming and then disable the switch again (i.e. switch the appropriate transmitter control off). This ensures that the receiver switching process occurs automatically, without requiring the deliberate operation of a switch.

Checking the receiver switching process with PCM receivers:



If you are using PCM receivers, you can check that the unit switches between them correctly by disconnecting first one of the “FS” plugs, then the other.

For example, if you see that receiver “2” is currently active, you should withdraw the “FS 2” plug. If the fail-safe system is set correctly, the arrow should now skip to Receiver “1”. Now re-connect the “FS 2” plug and remove the “FS 1” plug instead. The arrow should now skip back to Receiver “2”. That’s all there is to it.

You can also check this process using the BlackBox: 100% should not appear for both receivers; instead the figure should be lower, taking into account the period of the check, and the screen should show one switching process for each receiver.

Please note, AR 7000 receivers can not be programmed as redundant system with this PowerBox. You need to use AR9000 if you want to have receiver redundancy. It is OK to use DX7 transmitter with AR9000 receivers to be able to set up redundant receiver system.

7. Using the PowerBox Royal with two PPM receivers

If you connect the unit to **PPM** receivers, the receiver switching process is controlled by an internal program developed in-house by **PowerBox Systems**.

Note: This does not apply to IPD receivers, which must also be programmed using the fail-safe channel.

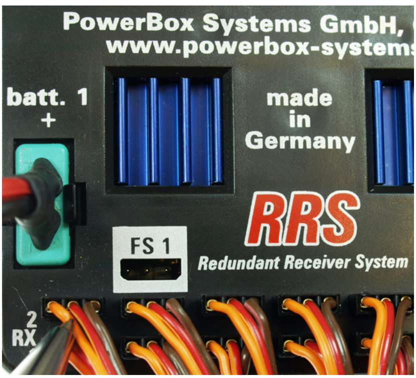
In the case of PPM receivers the integral **RRS** module assesses the validity of the servo signal generated by both receivers.
The pulse width of a valid servo signal generated by the receiver lies between 0.9 and 2.1 ms.

If the pulse width is less than 0.8 ms or greater than 2.2 ms, if the interval between the signals is excessive, or if no signal at all is present, then the **RRS** module judges this to be an unusable (invalid) servo signal.

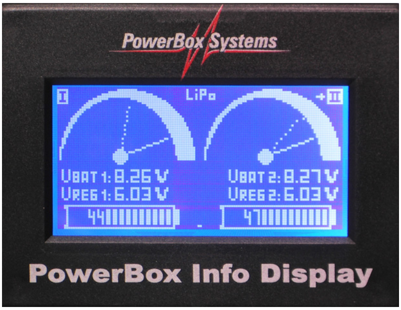
Assuming that the second receiver is still delivering valid servo signals, the **RRS** module now switches over to that receiver.

Important: Using PPM receivers you should not program FS1 and FS2, but you will have to use port No. 1, because this port is programmed to identify the signal strength in case of PPM-Receivers.

Checking the receiver switching process with PPM receivers:



If you are using **PPM** receivers (not IPD types), you can check that the **RRS** module is working properly by disconnecting **Channel "1"** from one of the receivers or from the **PowerBox Royal** (the sockets "**FS1**" and "**FS 2**" **must** be left **vacant**): in so doing you generate an invalid signal.



Now look at the screen: you should see a black arrow in front of one of the two numerals “**I**” or “**II**”.
Re-connect **Channel “1”** of receiver RX 1, and repeat the checking procedure with **Channel “1”** of receiver RX 2.

You can also check this process using the BlackBox: 100% should not appear for both receivers; instead the figure should be lower, taking into account the period of the check, and the screen should show one switching process for each receiver.

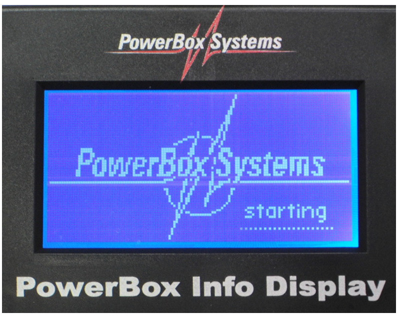
At this stage you should carry out a careful, conscientious check of all the control surfaces. Make certain that they all work correctly, and ensure in particular that they deflect in the appropriate directions.

Important! If the arrow next to one receiver was present for previous flights, but now suddenly disappears, you must assume that the corresponding receiver is faulty, or that the fail-safe programming is incorrect. Check the crystal, the aerial, the receiver and the programming!

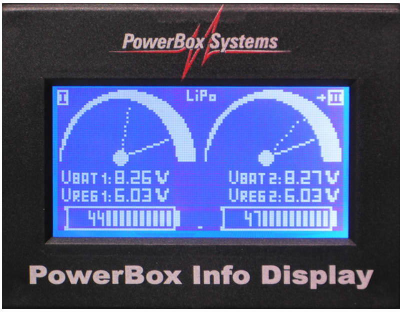
What will I see on the screen?

Wire up the complete redundant receiving system, ready for use, then switch the transmitter on, followed by the receiving system.

The **PowerBox Royal** greets you with the following display:



In the standard menu the LCD screen provides the following monitor displays:



Top left-hand corner:
"**I**" is the indicator for receiver RX 1.
The Roman figure "**I**" **must** have a white background; this means that the receiver is working properly and is generating valid servo signals. If you see only the "**I**", i.e. **without** the white background, then this receiver is not producing a valid signal.

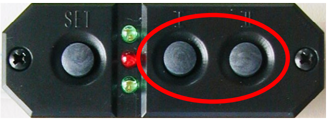
Top right-hand corner:
"**II**" is the indicator for receiver RX 2.
If there is an arrow in front of **I** or **II** (as here before "**II**"), this indicates that the servo signals from this receiver (RX 2) are presently being used.
The two graphic meters indicate the voltage of **Battery 1** and **Battery 2**; the voltage is shown increasing to the right, and diminishing to the left. The meter display also includes a background needle, which is shown dotted: this indicates the minimum value for that battery. In the photo you can see that the left-hand battery (1) has suffered a considerable voltage collapse, and that the voltage of the right-hand battery (2) has also fallen, but not to such a serious extent. If a complete failure of the power supply from one battery occurred during the period the system was switched on, the background needle will be at the far left, i.e. indicating a value of zero.

The next line provides information about the voltage of batteries 1 and 2 in numerical form. In this case the voltage of battery 1 is 8.26 Volts, that of battery 2 is 8.27 Volts.

The line below this informs you of the regulated voltage generated by the two voltage regulators. Since the voltage is measured immediately downstream of the regulator, the voltage present at the servos will actually be slightly lower. If you wish to determine the exact value, you must deduct the voltage loss due to the Dual Schottky diode (0.25 Volts).
If you switch the regulated servo voltage to 7.0 Volts, you can also read off the new set voltage at this point.
If one of the regulators is faulty, it will be obvious from this line.

The rectangular fields below this line show the energy consumption in mAh. In the present example the value shown for the left-hand battery is 44 mAh; that for the right-hand battery 47 mAh.

Calling up the BlackBox function:
You can use the **SensorSwitch** to select the next on-screen menu. This action calls up the **PowerBox Royal's BlackBox** after a flight, and displays it on the screen.



This is done - before you switch the system off - by pressing both of the **SensorSwitch** buttons simultaneously.

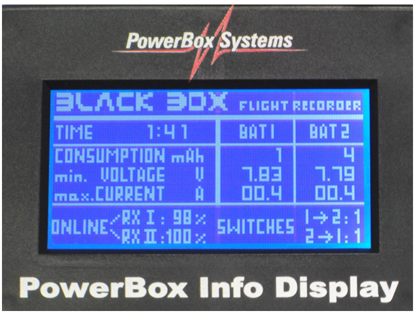
Important data relating to the last flight is now available for you to read out and analyse.

The first line shows the **TIME** parameter: in this case the period the system was switched on was 12 minutes and 17 seconds. Next to this you will see the 'Bat 1' and 'Bat 2' column titles.

The next line reads "**Consumption mAh**" followed by the corresponding values for Battery 1 and Battery 2: in this case 18 and 23 mAh at the time the data was called up.

The BlackBox displays only a **summary** of data relating to the **preceding** activity. The data is **not** updated in this on-screen display.

The screen also contains important information relating to the integral **RRS** module. The bottom two lines of the screen allow you to check the values for both receivers.

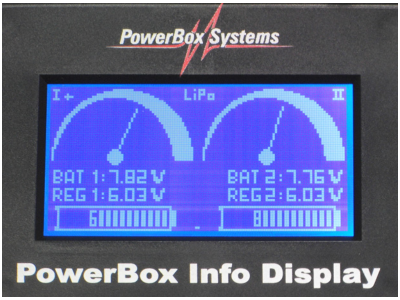


As you can see in the screen-shot, RX "I" was "on-line" for 99% of the last flight, while the figure for RX "II" was 100%.

'Switches' indicates the number of times the unit switched between the two receivers during the last flight.

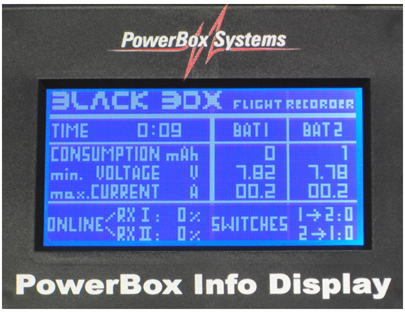
In the screen-shot you see Receiver 1 to Receiver 2: one switching process. Receiver 2 to Receiver 1: also one change-over.

If the standard screen display shows the two numerals “I” and “II” **without** a white background, then you need to clarify the following questions:



- Are both receivers set to the same channel as the transmitter?
- Are the crystals, receivers and transmitter in full working order?
- Have you entered the fail-safe settings correctly?

The fail-safe programming is really the most likely problem. Carry out a fail-safe test with one servo connected to the fail-safe channel, as described earlier, so that you have a visual check of the fail-safe function.



This BlackBox screen-shot also shows that both receivers had 0% reception, and that no switching between the receivers has taken place.

If one of the two receivers should show a relatively low value of, say, 70%, then there could be various reasons for this which you should investigate:

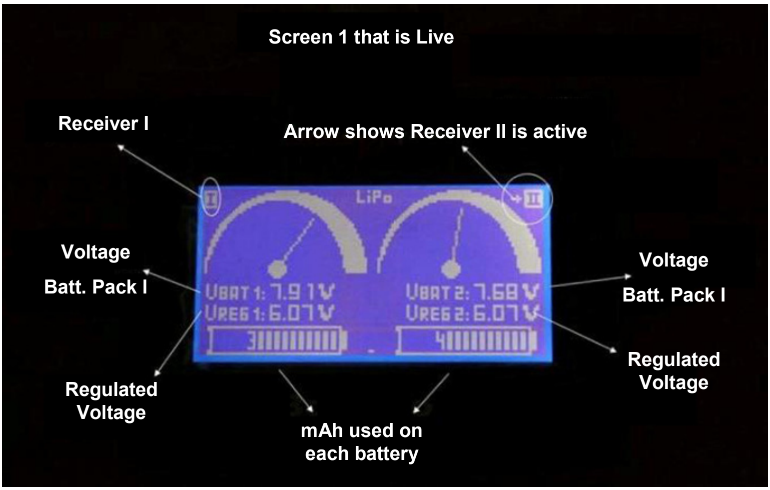
- The receiver aerial deployment may not be optimum. Try a different aerial position, and if the displayed value is better after the next flight, then you are on the right track. We recommend that you install one whip aerial and a second aerial in the wing. Two aerials set up as vertical whips in the same plane are not an efficient arrangement.
- Ensure that you do not screw the whip aerial down onto carbon reinforcements. You will often find that the two shells of a moulded fuselage are joined or reinforced with carbon fibre tape. Before you drill the hole for the whip aerial socket, it is essential to sand away the carbon fibre material

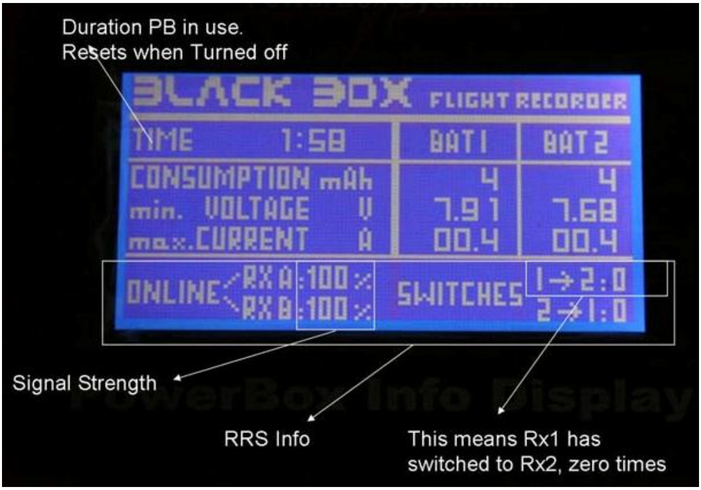
around the hole over an area at least 5 cm in diameter. Carbon fibres are conductive!
- The receiver has poor reception performance. Replace the receiver, or send it to the manufacturer for checking.

Important! The percentage figure after RX “I” and RX “II” always indicates the proportion of the last flight for which the receivers were operating fully. To clarify this: your flight might have lasted ten minutes, and afterwards RX “I” shows 100%, while RX “II” shows 90%. This means that receiver 2 was inactive for 10% of the flight, i.e. for one minute it was not delivering usable reception, or was in fail-safe mode. If the screen shows 99% for both RX “I” and RX “II”, but also indicates that five switching events took place between the receivers, this means that both receivers suffered brief fail-safe phases, but that they only lasted a few seconds - since the switching events had no significant effect on the percentage time values.

Note: the integral **RRS** module is also an excellent choice for use with two receivers on two different frequencies or frequency bands. This arrangement allows genuine two-channel operation in conjunction with double RF modules in the transmitter, and also wireless Trainer or Co-Pilot operation with two transmitters.

Some more screens with description:





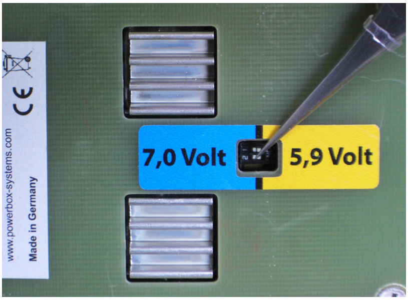
8. Switchable stabilised servo voltage:

Before every flight you should check - 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. You will see a “background” needle shown dotted on the screen, and this indicates the voltage drop and therefore the minimum voltage of the batteries during the last flight. A slight voltage fall is normal, but if the background needle shows a substantial collapse, i.e. it is much lower than the “real” needle, then you should read out the BlackBox data in order to obtain more accurate information.

By default the **PowerBox Royal** is set up for use with 7.4 Volt LiPo batteries. The stabilised voltage at all 26 servo sockets is set to **5.9** Volts.

On the underside - only visible from the bottom - are two DIP switches. They can be used to change the stabilised voltage if required (default setting: 5.9 Volts).
Regardless of the **servo** voltage you have set, the stabilised voltage to the two receivers is always 5.0 Volts.

This means that you can continue to use your existing servos and auxiliary electronic functions for your model even if they are not designed to accept 7.0 Volts. For example, the servos for choke, throttle, valves etc. can be left connected directly to the receivers, where they will be fed 5.0 Volts in the usual way.



These two micro-DIP switches can be moved to the opposite end-point using a small, narrow-bladed screwdriver or a pair of tweezers. Take care: force is not required, and the switches can easily be damaged if you use too coarse a tool.

Please note the switch direction, which is printed on the case.

This question is often put to us: why do we at **PowerBox Systems** stabilise the voltage to a maximum of 7.0 Volts; why is the voltage not left open at the top end? We have to admit that this solution would be simpler and much cheaper to implement. So why did we choose the complicated route of including a second stabilised voltage?

We would like to explain our reasoning here:
The voltage of a freshly charged two-cell LiPo / Li-Ion battery pack is 8.40 Volts. If several servos are operated simultaneously, the voltage fluctuates constantly between 7.0 and 8.0 Volts. The result of these variations is that the connected servos run relatively irregularly, i.e. servo transit speed and servo power fluctuate constantly according to load.

For the average pilot this might not even be perceptible, but for countless competition pilots who have been using our systems for years, this is a very important reason behind their decision to purchase: under contest conditions the servos always run the same, i.e. with unvarying speed and power, no matter what manoeuvre is being flown.

This sophisticated voltage stabilisation really is the key feature that has made it possible for top pilots to perform consistently well in competition.

A tip for pilots who do not necessarily require the last ounce of power from their servos:
If you are using 7.4 Volt servos but operate them at a voltage of only **5.9** Volts, their useful life will be extended by **at least** 50%, whereas their performance is usually reduced only by a moderate 10 to 20%. For many model applications it makes absolutely no difference whether the servo pulls 25 kp or only 20 kp.

9. Important for competition pilots:

If, on the other hand, you are flying a big F3A-X model fitted with a very large number (10 to 20) of powerful 25 kp servos, and if you are using the aircraft to fly freestyle aerobatic manoeuvres, we recommend that you set the servo voltage to 7.0 Volts, **provided that this is permissible for the servos in the model**. The fact that the two linear regulators in the **PowerBox Royal** only have to regulate the voltage down to 7.0 Volts, and not right down to 5.9 Volts, doubles their performance capacity!

10. Servo settings, programming the servo parameters:

Servo programming on channels A, B, C, D and E is only possible using the Adjustor Board for the **PowerBox Royal**, which is supplied in the set.

Up to four servos can be adjusted individually for each of these channels; it makes no difference what type of servo is used.

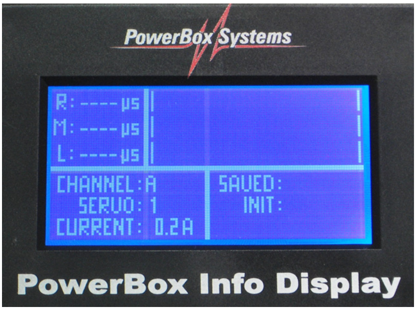
The adjustor board can be used to program the servo centre, right and left end-points, travel and reverse. Each servo can be programmed to completely different settings from the others, i.e. the settings are independent. The servo data you set is stored directly in the **PowerBox Royal**.

This feature takes into account the special safety and longevity requirements of your servos. In designing and developing the unit we have considered the findings of our many years of experience with the **PowerBox Champion**.

As with the **PowerBox Champion**, we continue to take the totally safe route, even though it is inevitably more difficult and expensive: each variable channel has its own controller, its own program, and its own dual power supply!

Connect the adjustor board to the right-hand side of the **PowerBox Royal**. Ensure that the ribbon cable is at the top, as shown in the photo.

The LCD monitor is now set up in such a way that it **does not** display the BlackBox data.



When the adjustor board is connected, the LCD monitor switches automatically to the servo set-up display.

The screen shows that the rotary switches on the adjustor board are set to channel "**A**" and servo **1**.
Under "**Current**" we can now read off the current drain of the system as 0.2 A, or 200 mA.

It is also possible to read off the current drain while you are adjusting the servo. If several servos are connected to a single control surface, then the current drawn by each of the servos should be approximately the same. If one servo always consumes more current than the others, then you should check the mechanical linkage or the servo itself.

Initialising:

Before we can start adjusting the servos, the **PowerBox Royal** must "learn" the characteristics of the transmitter and receivers to which it is connected; this measure is an essential prelude to setting the servo parameters accurately. The process is known as "initialisation", and without it your servos can never be set to reliably reproducible travels.

There are inevitably small variations between transmitters and transmitter stick potentiometers, i.e. they are not identical. Without initialising the transmitter channels, the use of different transmitters would result in different servo travels. The initialisation process must be carried out to ensure that you can use any transmitter, regardless of type. This procedure is very important, and for this reason the servo adjustment process does not work at all unless you have completed the initialisation procedure properly.

If the initialisation process is to be carried out successfully, the basic requirement is always a completely “plain”, untouched channel.

It is therefore best to initialise the system before you set up your transmitter to suit the model: no mixers should be set, and all servo travels should be left at or set to the default settings, in order to avoid falsifying the initialisation.

The adjustor board is fitted with a connecting lead about one metre long, which makes it possible to reach the servos to be adjusted even when they are installed in the model.

Once you have completed the servo adjustments, the adjustor board can be disconnected from the **PowerBox Royal** again. In our opinion it makes a considerable contribution to reliable operation if these controls (i.e. the adjustor board) are not an integral part of the power supply unit, not least because such components are always vulnerable to vibration damage. Further advantages are that the adjustment operation is much safer, and - in particular - can be carried out by the pilot himself, i.e. without the aid of a second person. If the servos to be adjusted are installed in the wings or tail surfaces, i.e. away from the fuselage, it can be very difficult to adjust them accurately when working from the fuselage; however, they are easy to set up using the plug-in adjustor board of the **PowerBox Royal**.
The adjustor board works with all **PowerBox Royal** units, so you do not need to purchase another device when you purchase additional **PowerBox Royal** systems.

11. Initialising the five Match channels:

As already mentioned, you must initialise the system before you use the **PowerBox Royal** for the first time. This process compensates for any inaccuracies or wear in the transmitter stick potentiometers.

How to do:

- Connect both batteries to the backer, taking care to maintain **correct polarity**
- Select the servos to be adjusted, and connect them to the appropriate sockets
- Switch the transmitter on, followed by the receiving system. Set the travel adjustment on your radio to 125% - 150% - no limits
- Connect the switch, the adjustor board and the LC-Display to the **PowerBox Royal**
- Switch the PowerBox on, all lights on the programmer are going on

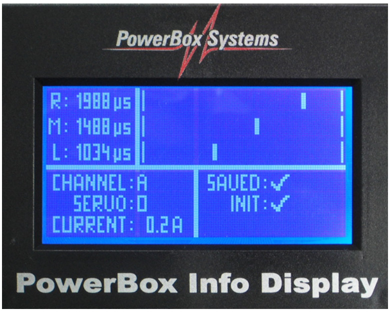
Take a little time to familiarise yourself with the controls on the adjustor board:

- The upper rotary knob is the channel select switch
- The lower rotary knob is the servo select switch
- The lower rotary knob is also used for “reset” and “save”
- The servo travels are adjusted using the two push-buttons marked ‘+’ and ‘-’
- The five red LEDs indicate that the last process has yet to be saved (stored)

The initialisation process has to be carried out separately for each of the five variable channels. This is the initialisation procedure:

1. Set the channel select switch to “**A**”.
2. Move the servo select switch to the “Reset” position.
3. Start with the transmitter control channel which you wish to use to control socket bank “A” on the PowerBox Royal.
4. Ensure that this channel is not influenced by any mixers or servo travel limits.
5. Move the transmitter trim to “Centre” !
6. Now press both knobs - Plus and Minus - simultaneously. This action erases all the values for this channel, and prepares it for re-initialisation.
7. Check that the transmitter stick associated with that channel is at centre, then press the Plus button to store the Centre value; the LCD screen responds by displaying a bar in the middle line.
8. Move the transmitter stick to the left-hand end-point, then press the Plus button again. This action stores the left-hand servo travel, and a bar appears in the top line of the LCD screen.

9. Move the transmitter stick to the right-hand end-point, and press the Plus button once more: this action stores the right-hand servo travel, and a bar appears in the bottom line of the LCD screen.
10. The initialisation procedure for that channel is now complete, and the LCD screen confirms this with a tick next to the word “INIT:”.
11. Now turn the lower select knob to the “Save” position.
12. Press the Plus button: the LCD screen confirms that the initialisation data has been stored by displaying a tick next to the word “SAVED:”.
13. The red LED marked “A” on the adjustor board now goes out.
14. The initialisation procedure has to be carried out separately for each of the five channels; you can use the same transmitter channel for each one.

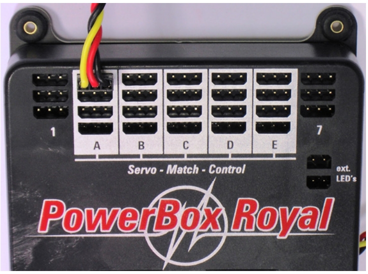


Brief instructions:

1. Set channel select switch to ‘**B**’
2. Set servo select switch to ‘**Reset**’
3. Stick centre, trim centre, press Plus **and** Minus buttons simultaneously: red LED glows
4. Stick centre, press Plus button
5. Stick left, press Plus button
6. Stick right, press Plus button
7. Servo select switch to “Save”, press Plus button - job done!

If you make a mistake, set the servo select switch to “**Reset**” and press the Plus and Minus buttons simultaneously: this action resets the values for the associated channel, and you can enter the settings for this channel once more.

Servo adjustments:
This is the procedure for optimising the servo parameters for one of the five channels:



Set the adjustor board to the appropriate socket bank (A, B, C, D, E). Use the servo select switch to choose the servo you wish to adjust. The servo socket at the outside top edge of the **PowerBox Royal** is servo ‘1’; the inside servo of the bank of four is servo ‘4’.

The servo shown in the photo is servo 1 of socket bank **“A”.**
You can now adjust the centre, the right-hand servo end-point or the left-hand servo end-point. To set the end-points you must hold the appropriate transmitter stick in the corresponding direction, then use the ‘+’ and ‘-’ buttons to set the servo travels exactly.

Note that it is also possible to set asymmetrical values. For major changes you can hold the buttons pressed in: the servo then moves constantly in the corresponding direction. Press the button briefly for accurate fine-tuning.

12. Reversing servos:

To reverse a servo, hold the corresponding transmitter stick at one end-point, then press one of the buttons: the servo now runs slowly to the opposite end-point. This process may take up to thirty seconds, so that you can observe it. Now move the stick to the opposite end-point, and press the other button; the servo now runs to the opposite end-point.

The servo travels can be set to any value you wish. However, please be careful, as not every servo is designed mechanically to cope with abnormal angular travels. The safe way to avoid the gearbox or potentiometer running beyond the servo end-stop is **always to reduce the value of servo travel by about 10% after determining the maximum travel.**

You may well find that the maximum angular travel of certain servo types is only 140° (this is not the same as the percentage values programmed at the transmitter); on the other hand there are many servos which can produce 180° travel without difficulty. If you set excessive servo travel, with the result that the servo runs beyond the maximum possible potentiometer travel, disconnect the servo and turn the servo output arm back again by hand.

Don't forget to reduce the servo travel **before** you plug the servo in again, otherwise it will immediately run past its end-point once more.

You must save (store) the programmed data once you have completed the servo adjustments. If the associated red LED is glowing, the data has not been saved. To store the data, rotate the servo select switch to '**Save**' and press the Plus button. The red LED goes out, and the data is now transferred to the **PowerBox Royal's** memory.

If you have connected several servos to a single channel and wish to set them up to run exactly synchronously - perhaps because they are connected to a shared control surface - the correct procedure is first to set the common centre, then the common right-hand end-point, and finally the common left-hand end-point.
Prepare the servos and complete the control surface linkages. Adjust one servo, then adjust the others to match the first.

It is quite likely that you will need to adjust these settings during the course of a typical flying season. This is not a fault in the **PowerBox Royal**; it simply reflects the varying rates of wear in the servos, e.g. gearbox, potentiometer and motor.

The great advantages of setting up multiple servos to run exactly in parallel are as follows: the current drain of the servos is substantially reduced, premature servo wear - especially to the motor and potentiometer - is avoided, the useful life of the servos is significantly extended, and - above all - the potential performance of the coupled servos can be exploited to the full.

Installing a **PowerBox Royal** can certainly save one or two control channels when you are setting up the transmitter. For example, one popular application is the airbrake set-up on a model glider. If you need to fine-tune the two airbrake servos, you will need to assign two control channels at the transmitter. With the **PowerBox Royal** you assign both servos (right and left airbrake) to one channel, and adjust the two servos at the backer, rather than at the transmitter, using just one channel.

In a similar way you can combine steerable nosewheel and rudder on a single channel, and set up the servos with different travels and directions. The same applies to two landing flaps, and many other systems.

13. Specification:

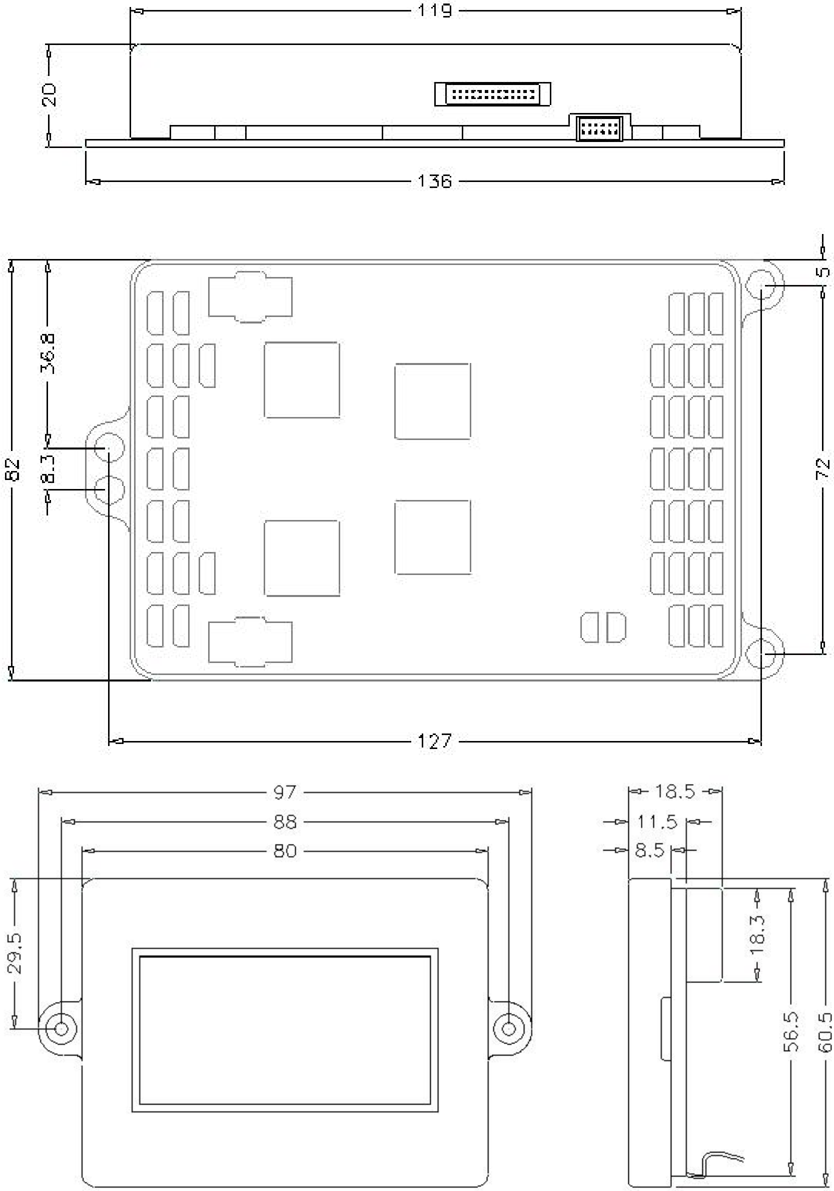
Operating voltage:	4.0 Volts to 9.0 Volts
Power supply:	2-cell LiPo battery, 7.4 Volts
Current drain:	approx. 30 mA
Current drain incl. screen:	approx. 200 mA
Voltage loss:	approx. 0.25 V
Max. receiver current:	2 x 1.5 A
Receiver voltage:	5.0 Volts, stabilised
Max. servo current:	2 x 20 A
Servo voltage:	5.9 V or 7.0 V, selectable, stabilised
Servo sockets:	26 sockets, 5 match-channels
Programmable servos:	20
Programmable parameters:	Servo travel left, right, centre, direction of rotation
Redundant receiver system:	7 channels
Suitable types of modulation:	PPM, IPD, PCM, SPCM, A-SPCM
Suitable frequency bands:	35, 40, 72 MHz, 2.4 GHz, Spectrum, FASST
Temperature range:	-10°C to +75°C
Dimensions:	91 x 65 x 19 mm (incl. base plate)
Weight:	133 g
SensorSwitch:	15 g
Weight of LCD screen:	80 g

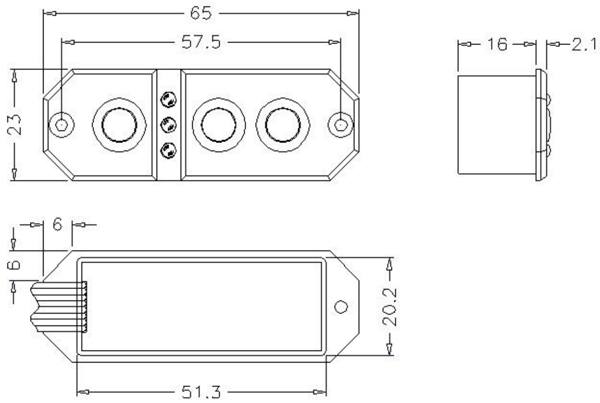
Naturally all our **PowerBoxes** - regardless of type - are protected against **reverse voltage** which might be generated by servo motors.

This measure is necessary because there are servos available on the market fitted with electronic circuitry which does not prevent reverse voltage.

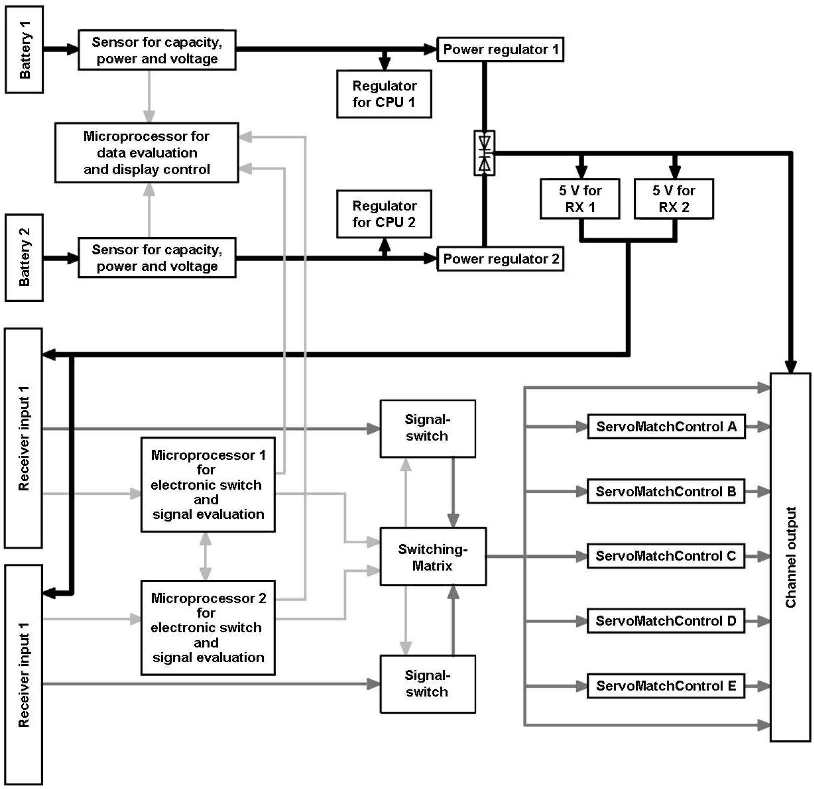
It is also true that certain types of receiver are not protected against this potential problem.
The design of our **PowerBoxes** ensures that you can use any type of servo and receiving system.

14. Installed dimensions of the PowerBox Royal, LCD-Screen and SensorSwitch:





15. Block circuit diagram, PowerBox Royal:



16. Battery and external LED connections, Operating and safety notes:

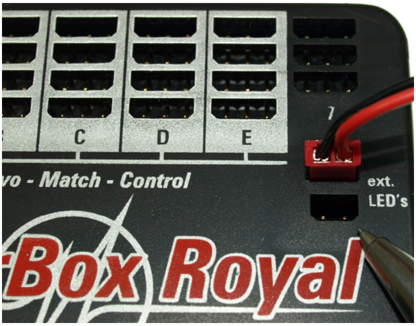
The two batteries should be connected to the pair of integral high-current sockets.

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.

If you decide to use modern, lightweight **LiPo** batteries, we recommend the **PowerBox Battery 1500, PowerBox Battery 2800** and **PowerBox Battery 4000** 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.



In the top right-hand corner of the **PowerBox Royal** you will find two polarised sockets; to each of these you can connect an ultra-bright red LED for each battery. The LEDs are supplied in the accessory pack.

We recommend that you mount these LEDs in the fuselage side of your model.

When the aeroplane is in the air, the LEDs provide you with a visual warning if one or both batteries should run flat, or if some other fault occurs in the power supply system.

If you see the LEDs light up, please land the model immediately!

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.

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 employed in radio-controlled models.

The unit should only be used with a Direct Current (D.C.) power supply corresponding to a two-cell LiPo pack.

It must never be connected to a mains PSU!

17. Guarantee conditions:

During the production process each **PowerBox Royal** undergoes a series of comprehensive tests. As you will know, we take the maintenance of the highest quality standards very seriously, and that is why we are able to grant a **36 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, which was given to you when you bought the device. 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 not in a position to ensure that you install and operate the **PowerBox Royal** correctly, nor that you have maintained the entire radio control system properly.

For this reason we are unable to accept liability for loss, damages or costs which result from the use of the device, 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 power supply system from the **PowerBox Systems** range, and hope you have loads of fun with it!

Donauwörth im Januar 2008

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