

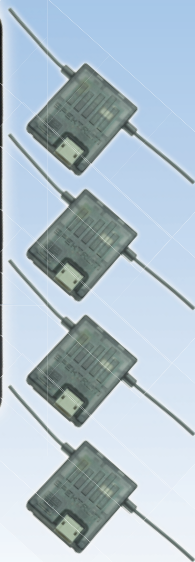
Instruction Manual

PowerBox Systems

World Leaders in RC
Power Supply Systems

PowerBox Royal

SPEKTRUM



Dear customer,

We are delighted that you have purchased the **PowerBox Royal Spektrum** battery backer from our range.

We wish you many seasons of pleasure and successful flying with your **PowerBox Royal Spektrum**.

1. Product description

The **PowerBox Royal Spektrum** is the latest innovation from the PowerBox Systems stable. The unique feature of this unit is that for the first time it includes an integrated receiver module. This saves space, weight and connecting leads, which always represent a potential source of errors. The technology employed is the **Spektrum™ 2.4 GHz DSM2®**. The system offers the option of connecting a maximum of four satellite receivers, providing four-way redundancy of the radio link, which in turns means maximum possible transmission security. As with all PowerBox products, all the components, ICs, micro-controllers and electronic circuits required for a reliable power supply system are duplicated!

Features:

- Integral **Spektrum™ 2.4 DSM2®** twelve-channel receiver
- 2048-step resolution
- Double-regulated output voltage
- 5 match-channels for a total of 20 servos
- Signal amplification for a total of 12 channels and 28 servos
- Integral Flight Logger for assessing reception quality
- Selectable servo voltage of 5.9 V or 7.0 V
- LCD screen for comprehensive battery monitoring
- Energy consumption display in mAh for both batteries
- Regulator monitor on the LCD screen
- Minimum value memory displays voltage collapses in flight
- Supports three battery types: LiPo, NiMH / NiCd, LiFePo
- Extra-large heat-sink area for even higher performance
- Suppression of servo feedback currents

These functions make the **PowerBox Royal Spektrum** ideal for large models of 2.6 to 3.5 m wingspan, as well as model jets, helicopters and gliders.

2.Controls:

The pictures below show the essential control elements:



Five match-channels

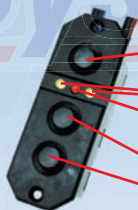
28 Servo outputs

Sockets for external LEDs

Battery sockets

Input for binding plug

Inputs for four satellite receivers



Activation button, battery type setting

Power status LEDs

LED for activation and battery type setting

Switching buttons for battery I and II



SensorSwitch - connect as shown

3. First steps, operating the unit

a) Connecting

- First connect all four satellite receivers. At least three receivers must be connected, otherwise the system will not start. This is a security measure, and takes into account possible error sources - such as a defective connecting lead - at the outset. If a receiver should fail in flight, this has no effect, as adequate reception is always available with a minimum of two satellite receivers.
- Plug all the servos into the backer; the channel sequence is stated on the case. **CAUTION:** do not plug in unmatched servos at this stage: see set-up note f) !
- Now connect the SensorSwitch to the appropriate socket. Note that the ribbon cable must face up when connected. If your model is subject to severe vibration, we recommend supporting the ribbon cable at a minimum of one point to avoid the risk of the connector falling out. This would have no effect on the switched state of the backer, but would prevent you switching the system off.
- Connect the LCD screen to the appropriate socket. Position the connector straight and "square", do not angle it or force it in; press the right and left latches in until they engage. The LCD screen can also be plugged in when you wish to read out post-flight data, or set up the match-channels. The values are always stored in the backer itself.
- If you wish, the external ultra-bright LEDs can now be connected. We strongly advise you to connect these, and mount them in the fuselage side, as they alert you to battery problems in flight.
- The batteries are connected to the backer's integral MPX sockets. We recommend the use of PowerBox Systems batteries, which are available with capacities of 1500, 2800 and 4000 mAh. If you prefer to use batteries of another make, or packs you have made up yourself, please take very great care over polarity; check twice to be on the safe side. Connecting a battery with reversed polarity will instantly ruin the backer's regulators. In order to minimise power losses the circuit does not include reverse polarity protection. The + indication is printed on the case cover.

b) Switching on and off

The method of switching on and off is very simple, and effectively prevents the user switching the system accidentally. This is the procedure:

Locate the SET button on the SensorSwitch and hold it pressed in until the centre LED lights up red. Now press buttons I and II in turn. The battery backer is now switched on.

The system is switched off using exactly the same procedure: press the SET button, wait until the centre LED glows red, then press buttons I and II.

One more point concerning the switched state of all PowerBox products: the backer's switched state is stored every time it is changed, i.e. if you switch the backer off, it remains permanently switched off. If you switch the backer on, this state is also stored. This means that the backer always stays on once switched on, even if an intermittent contact occurs in one or both batteries, or if a break in the current flow occurs.

c) Setting the battery type and match-channel E

By default the backer is set up to suit Lithium-Polymer batteries, and match-channel E is set to AUX3. For all other battery types or channel assignments please use the following procedure:

- Plug in the LCD screen.
- Switch both batteries on.
- Hold the SET button pressed in for about ten seconds until the screen changes. You should now see the following display:



- You can now set the battery type using the two buttons I and II.
- Press the **SET** button to confirm your choice, and the cursor will move to the setting for match-channel E.
- Now you can use the two buttons I and II to select whether channel AUX1 or AUX3 is to be "matchable". Many transmitters only offer limited facilities

for reprogramming the output sequence, and this function offers greater flexibility.

- Press the SET button again to confirm your choice; this takes you back to the main screen display.

Your selected setting is stored permanently in the EEPROM.

d) Binding the receiver and transmitter:

To ensure that the receiver only responds to the signals broadcast by its own transmitter, it must be programmed to recognise the transmitter's GUID. This procedure "teaches" the receiver a code which is unique in the world. During the binding procedure the servo Fail-Safe positions are also stored. Spektrum systems provide two types of "Fail-Safe"; the procedure is the same for all Spektrum receivers:

1. Binding using the SmartSafe system:

If a fail-safe event should occur, this option sets all control surfaces to Hold, while the throttle channel runs to the Idle or Off position:

- Switch the backer off, and connect the binding plug to it.
- Switch the backer on: the LEDs on all four satellite receivers must now flash at a high rate.
- Locate the binding knob on the transmitter and hold it pressed in while you switch the transmitter on.
- Hold the knob pressed in until the LEDs on all the satellite receivers glow constantly.
- Remove the binding plug.

2. Binding using the PreSet FailSafe system:

This option sets fail-safe positions for all the control surfaces during the binding procedure, and transfers them to the receiver. If a fail-safe event should occur, the receiver sends these signals to the servos:

- Switch the backer off, and connect the binding plug to it.
- Switch the backer on: the LEDs on all four satellite receivers must now flash at a high rate.
- Remove the binding plug.
- Move all the transmitter sticks and switches to the desired fail-safe positions.
- Locate the binding knob on the transmitter and hold it pressed in while you switch the transmitter on.
- Hold the knob pressed in until the LEDs on all the satellite receivers glow constantly.

Check all the fail-safe servo positions by first switching the transmitter and the backer on, and then switching off the transmitter only.

e) Range-checking

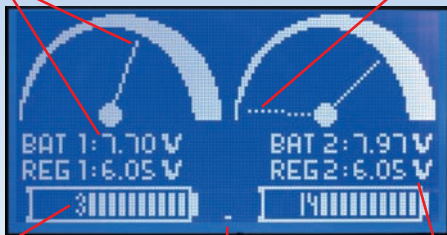
We recommend that you carry out a range-check at the start of every day's flying session, and whenever you are about to fly any new model for the first time. With 35 MHz systems the range-check represented a simple method of picking up a broken aerial or similar fault, but in the case of 2.4 GHz systems such damage is not always straightforward to detect. To carry out a range-check, hold the binding knob of your Spektrum transmitter pressed in, and walk away from the transmitter. All the control surfaces should function perfectly up to a range of at least 25 metres.

f) Main screen display

The main screen display appears every time you switch the system on, and shows you the essential battery information at a glance. The values displayed are always those which currently apply:

Voltage, battery 1

Minimum value, battery 2



Consumed capacity, battery 1

Output voltage, regulator 2

Current drain

1 bar = 2 A

2 bars = 4 A

3 bars = 6 A

etc.

g) BlackBox flight recorder display - battery information

The BlackBox flight recorder enables you to read out various states which developed during the previous flight. This information includes the power-on time, the energy consumption in mAh, the minimum battery voltage and the maximum current which has been drawn. If a low minimum value is recorded, the culprit could be momentarily binding control surfaces, stiff linkages, or simply batteries collapsing under load, i.e. they are not suitable for the model and type of servo. We strongly advise that you make it a matter of routine to read out this BlackBox flight recorder after every flight.

This is the procedure for calling up the function:

After the flight, hold both switch buttons Battery I and Battery II pressed in simultaneously. The following display now appears on the screen:



The image shows a monochrome LCD display with a blue background and white text. The display is titled 'BLACK BOX FLIGHT RECORDER' at the top. Below the title is a table with four rows of data. The first row shows 'TIME 2:21', 'BAT1', and 'BAT2'. The second row shows 'CONSUMPTION mAh', '3', and '14'. The third row shows 'min. VOLTAGE V', '7.69', and '0.61'. The fourth row shows 'max. CURRENT A', '00.2', and '00.2'. At the bottom of the display, the text 'POWERBOX-SYSTEMS' is visible.

BLACK BOX FLIGHT RECORDER		BAT1	BAT2
TIME	2:21		
CONSUMPTION mAh		3	14
min. VOLTAGE V		7.69	0.61
max. CURRENT A		00.2	00.2

POWERBOX-SYSTEMS

h) BlackBox flight recorder display - receiver information

The recorded receiver information can be read out by briefly pressing both switch buttons I and II simultaneously a second time:



The image shows a monochrome LCD display for a BlackBox flight recorder. The display is divided into two columns. The top of the screen shows 'BLACK BOX' on the left and 'FLIGHT RECORDER' on the right. The left column displays 'ANTENNA FADES' at the top, followed by four rows of 'REMOTE RX' data: '1 : ---', '2 : 043', '3 : 043', and '4 : 043'. The right column displays 'TIME 2:41' at the top, followed by 'LOST FRAMES 000' and 'RECEIVER HOLDS 001'. The display has a blue background with white text.

BLACK BOX FLIGHT RECORDER	
ANTENNA FADES	TIME 2:41
REMOTE RX 1 : ---	LOST FRAMES
REMOTE RX 2 : 043	000
REMOTE RX 3 : 043	RECEIVER HOLDS
REMOTE RX 4 : 043	001

Key to the individual data values:

- Antenna fades:

The associated satellite receiver failed to pick up a data packet correctly, and a different satellite received the information. This number may be several hundred per flight for each satellite.

- Lost frames:

One data packet was not received by any of the satellites. Since the data is renewed at the rate of about once every 20 ms, this loss will not be detected by the pilot, but in any case the value should not be above 20.

- Receiver Holds:

A "Hold" corresponds to a "fail-safe event", and occurs when more than 45 data packets are not picked up by any of the satellites.

CAUTION: if more than twenty Lost Frames or Holds occur, it is imperative that you check your receiving system: carry out a range-check, examine the satellite cable connections, or re-locate the satellite receivers.

NOTE: if you find after a flight that the LED on one or more satellites is flashing, this means that battery voltage fell to a dangerous level, or the cable connection failed briefly. If this should occur, please read out the Flight Recorder data, and check the connection to the appropriate satellite receiver.

i) Servo-matching

The servo-matching procedure is very simple, and designed to be extremely user-friendly. This is the sequence of events:

Important: at the start of the set-up process the backer must be “taught” the stick end-points and centre positions of your radio control system transmitter for all five match channels. This is essential in order to obtain maximum precision in the settings. This is the procedure:

- Disconnect the control surface linkages from the servos to avoid high forces acting upon the as yet unmatched servos.
- Connect the adaptor board to the backer; the LCD screen now switches to the set-up display:



The picture shows the screen display after initialisation

- Use the channel select switch to set the desired channel.
- Move the servo select switch to the “**RESET**” position.
- Press the **+ button** and the **- button** simultaneously. The red LED now lights up for this channel.
- Locate the transmitter stick for the channel to be adjusted, and leave it at centre. Now press the **+ button**.
- Move the stick to one end-point and hold it there; press the **+ button**.
- Move the stick to the opposite end-point and hold it there; press the **+ button** once more.
- Store the initialised settings by moving the servo select switch to the “**SAVE**” position and pressing the **+ button**. The red LED now goes out, a tick should appear after INIT, and the LCD screen displays your initialised settings.

Now you can make a start with the actual servo adjustment. To simplify the procedure we will describe a typical example, e.g. an aileron with two servos working in parallel:

- Connect one aileron servo to the control surface linkage. We recommend that you now adjust this servo both mechanically and electronically (at the transmitter) in such a way that:
 - the zero (neutral) point is correct;
 - the appropriate maximum travel is set;
 - the Expo functions are set.
- Now select the second servo on the adjustor board and hold the pushrod against the aileron horn (don't connect it at this stage).
- Leave the aileron stick at centre. Press the + or - button on the adjustor board to bring the pushrod to exactly the right position. The red LED will light up to indicate that the current servo position is not yet stored.
- Move the stick to one end-point and hold it there. Hold the pushrod against the horn as before, and move the servo to the correct position using the + or - button.
- Move the aileron stick to the opposite end-point and again use the + or - buttons to move the servo to the correct position.
- To save these settings move the servo select switch to **"SAVE"** and press the + button; the red LED now goes out, and a tick appears on the screen after **"SAVED"**. The two aileron servos are matched, and the settings are permanently stored in the backer's memory.

Example: channel E has been adjusted for the left-hand stick end-point:



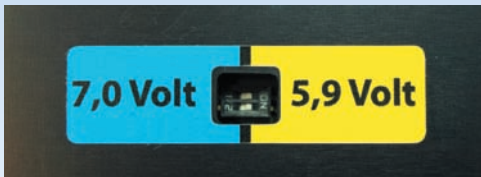
Additional hints and tips:

- In the case of large ailerons in particular, it can be advantageous **not** to match the servos with 100% accuracy. If the servos are precisely matched, gearbox play in the servos may allow aileron flutter to develop. You can eliminate this danger with a highly precise offset: first match the servos exactly to each other, and then offset the servos against each other by pressing the + or - button two or three times briefly - just sufficiently to compensate for the lost motion in the servo gearbox.
- The initialisation procedure only has to be carried out once. Even if you wish to correct the settings at some later time, you will not need to repeat the initialisation process.
- To revert to the factory default settings, select the appropriate channel, move the servo select switch to the “**RESET**” position, then press both buttons + and - simultaneously; this resets the initialisation **and** the settings.

j) Setting the voltage of the servo power supply

If you wish to use high-voltage servos (8.4 V), with the **PowerBox Royal Spektrum** you have the option of operating your servos on 7.0 V instead of 5.9 V. The advantage of a regulated 7.0 V supply is that the voltage is always maintained at a constant level. This means that your servos always run at the same speed and with the same torque. If the LiPo batteries were to be wired directly to the servos, they would behave differently when the batteries were full from when they were half-full.

A further important advantage of 7.0 V regulation is the considerable increase in the servos' useful life.



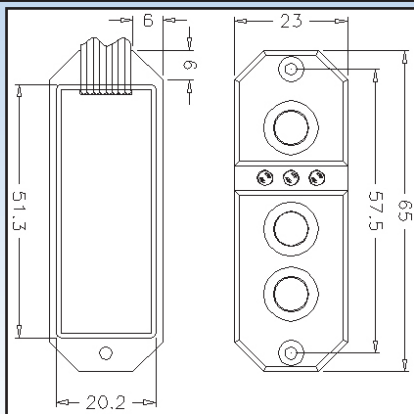
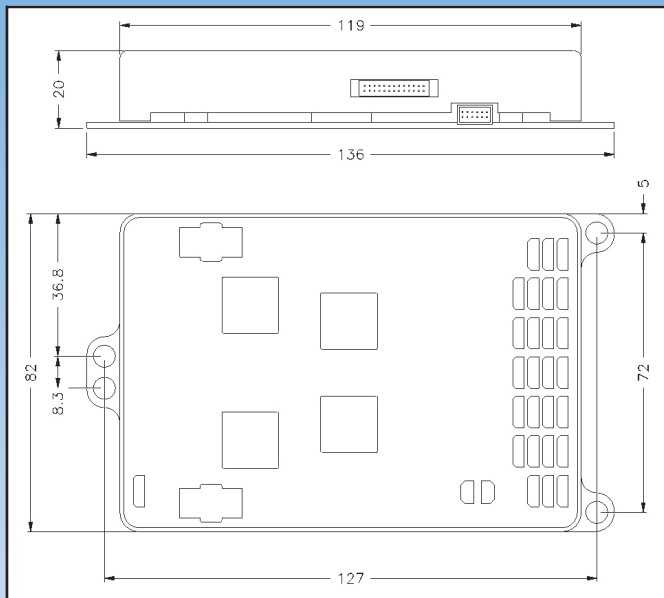
If you wish to change the output voltage, first switch the backer off. Take a pointed instrument (pin or small screwdriver) and move both DIP switches to the desired position.

4. Specifications

Operating voltage:	4.0 Volt to 9.0 Volt
Power supply:	2 x 2-cell LiPo batteries, 7.4 Volt, 2 x 5-cell NiCd or NiMH batteries, 2 x 2-cell LiFePo batteries (A123)
Current drain:	Power-on state, complete with four satellite receivers and LCD screen: approx.280 mA Power-off state approx. 2 x 15 μ A
Drop-out voltage:	approx. 0.25 V
Max. servo current :	2 x 10 A (stabilised) according to cooling peak 2 x 20 A
Receiver type:	Spektrum DSM2 2.4 GHz, 12 channels
Modulation type:	DSSS
Servo sockets:	28 servo sockets, 12 channels
Match-channels:	5 channels, 20 servos
Temperature range:	-20°C to +75°C
Dimensions:	136 x 82 x 20 mm (incl. base plate)
Weight:	165 g
SensorSwitch:	15 g
LCD screen:	80 g
EMV approval:	EN 55014-1:2006
CE approval:	2004/108/EG
Protected design:	DE 203 13 420,6
U.S. Patent:	7,931,320
FCC ID:	BRWDASRX10

The battery backer fulfils the EMV protective requirements, EN 55014-1:2006, with certificate dated 10 February 2009. EMC approval 2004/108/EG.

The unit must not be connected to a mains PSU.



5. Set contents

- PowerBox Royal Spektrum
- 4 satellite receivers, including connecting leads
- LCD screen
- SensorSwitch
- Binding plug
- Two external LEDs
- Four rubber grommets and brass tubular spacers, pre-fitted
- Four retaining screws
- Operating instructions

6. Guarantee conditions

We take the maintenance of the highest quality standards very seriously, and that is why **PowerBox Systems GmbH** is currently the only RC electronics manufacturer which has been awarded certification to the **DIN ISO 9001:2000** industrial norm.

Our stringent quality management, which applies both to development and production, is the reason why we are able to grant a **36 month guarantee** on our products, 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 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 this battery backer correctly, nor that the entire radio control system has been maintained properly.

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

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



Donauwörth, April 2009



PowerBox Systems

*World Leaders in RC
Power Supply Systems*

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