

BalancePro HD Pack specifications

As of June, 2005. Check www.fmadirect.com for the latest products and specifications.

	Capacity mAh	Voltage Volts	Current Amps	Max. Output Current Amps	Dimensions (in)			Dimensions (mm)			Wt g
					L	W	T	L	W	T	
3200mAh cells											
1 SVKOK3200-20C-1P2S	3200	7.4	64	60	5.30	1.90	0.70	135	48	18	205
2 SVKOK3200-20C-1P3S	3200	11.1	64	60	5.30	1.90	1.05	135	48	27	292
3 SVKOK3200-20C-1P4S	3200	14.8	64	60	5.30	1.90	1.40	135	48	36	378
4 SVKOK3200-20C-1P5S	3200	18.5	64	60	5.30	1.90	1.75	135	48	44	465
5 SVKOK3200-20C-1P6S	3200	22.2	64	60	5.30	1.90	2.10	135	48	53	552
6 SVKOK3200-20C-2P2S	6400	7.4	128	60	5.30	1.90	1.40	135	48	36	378
7 SVKOK3200-20C-2P3S	6400	11.1	128	60	5.30	1.90	2.10	135	48	53	552
8 SVKOK3200-20C-2P4S	6400	14.8	128	60	5.30	1.90	2.80	135	48	71	725
9 SVKOK3200-20C-2P5S	6400	18.5	128	60	5.30	1.90	3.50	135	48	89	898
10 SVKOK3200-20C-2P6S	6400	22.2	128	60	5.30	1.90	4.20	135	48	107	1071
11 SVKOK3200-20C-3P2S	9600	7.4	192	60	5.30	1.90	2.10	135	48	53	552
12 SVKOK3200-20C-3P3S	9600	11.1	192	60	5.30	1.90	3.15	135	48	80	811
13 SVKOK3200-20C-3P4S	9600	14.8	192	60	5.30	1.90	4.20	135	48	107	1071
14 SVKOK3200-20C-3P5S	9600	18.5	192	60	5.30	1.90	5.25	135	48	133	1331
15 SVKOK3200-20C-3P6S	9600	22.2	192	60	5.30	1.90	6.30	135	48	160	1591
2000mAh cells											
1 SVKOK2000-15C-1P2S	2000	7.4	30	30	3.13	1.65	0.73	80	42	19	135
2 SVKOK2000-15C-1P3S	2000	11.1	30	30	3.13	1.65	1.10	80	42	28	186
3 SVKOK2000-15C-1P4S	2000	14.8	30	30	3.13	1.65	1.47	80	42	37	237
4 SVKOK2000-15C-1P5S	2000	18.5	30	30	3.13	1.65	1.83	80	42	47	289
5 SVKOK2000-15C-1P6S	2000	22.2	30	30	3.13	1.65	2.20	80	42	56	340
6 SVKOK2000-15C-2P2S	4000	7.4	60	60	3.13	1.65	1.47	80	42	37	237
7 SVKOK2000-15C-2P3S	4000	11.1	60	60	3.13	1.65	2.20	80	42	56	340
8 SVKOK2000-15C-2P4S	4000	14.8	60	60	3.13	1.65	2.93	80	42	75	443
9 SVKOK2000-15C-2P5S	4000	18.5	60	60	3.13	1.65	3.67	80	42	93	545
10 SVKOK2000-15C-2P6S	4000	22.2	60	60	3.13	1.65	4.40	80	42	112	648

Note: All weights and dimensions are approximate.



BalancePro HD Packs

Unitized Lithium Polymer batteries
for high current RC aircraft applications



About BalancePro HD Packs

- Built from lightweight Super High Discharge Lithium Polymer Cells that deliver high continuous current.
- Part of a complete system that extends pack life and maximizes flight times by preventing overcharging and overdischarging.
- Works with both brushed and brushless ESCs.

Kokam/FMA Direct Lithium Polymer cells are the next-generation replacement for NiCd, NiMH and Lithium Ion cells. This unique power technology offers high energy density, low weight, long life, safe operation and environmentally-friendly chemistry. FMA Direct offers a full line of LiPo cells, packs and compatible electronics at www.fmadirect.com. LiPo technical and application information is available in the Support section of the Web site.

Precautions

- Follow all instructions in this manual to assure safe operation.
- Before charging through a BalancePro HD 6s CPM, allow packs to cool for one hour. During discharge, inner cells become hotter than outer cells. If a pack is charged when hot, cells will be damaged because their different temperatures result in different charge rates. (Packs can be charged sooner with a BalancePro HD 6s Charger because its cell monitoring compensates for temperature differences.)
- Always watch LiPo packs while they are charging. Never leave LiPo packs unsupervised during charging.
- BalancePro HD Pack wiring limits continuous output to 60 Amps from each pack, even though the cell configurations may be rated higher.

WARNING! Maximum Charge Rate 3C. Charge this battery pack using only... 1) the BalancePro HD 6s charger from FMA Direct or 2) any charger designed for lithium batteries in conjunction with the FMA Direct BalancePro HD 6s Charge Protection Module (SV6S-CPM). FMA, Inc. will not be liable for damages that result from improper use of this product. **This product may ignite under certain conditions. Read all safety precautions completely before using this product!**

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About the BalancePro HD system

Your airborne power supply will be made from two kinds of components:

- **BalancePro HD Pack(s).** Each pack has a special connector that enables the BalancePro HD 6s Charger and BalancePro HD components to monitor and control the voltage of individual cells within the pack.
- **BalancePro HD 6s Discharge Protection Module (DPM)** for each BalancePro HD Pack. During discharge (flying), the BalancePro HD 6s DPM monitors individual cells within the connected pack and pulses the motor when voltage gets low. A complex algorithm determines when the first cell reaches a preset voltage. At this time, the BalancePro HD 6s DPM works with your existing ESC to cut voltage to the motor.

For charging you'll need one of the following:

- **BalancePro HD 6s Charger**, which automatically balances each cell and prevents overcharging. Besides providing fast charging, this charger enables BalancePro HD Packs to deliver longer life, as well as longer and more consistent flight duration.
- or
- **Other LiPo charger and BalancePro HD 6s Charge Protection Module.** This setup prevents overcharging, but cannot perform cell balancing. Over time, the pack may become unbalanced, gradually reducing flight duration. Also, charge rate is limited to 1C.

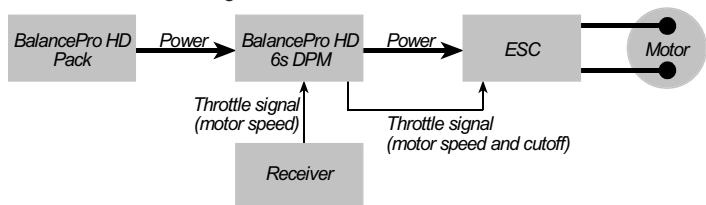
Discharge protection

You must electrically protect each BalancePro HD Pack with a BalancePro HD 6s Discharge Protection Module (DPM). The BalancePro HD 6s DPM prevents a pack from overdischarging. Overdischarge prevention maximizes run time, extends pack life and eliminates cell damage that would otherwise be caused by running voltage too low. The BalancePro HD 6s DPM works with 1s through 6s packs.

Two DPM models are available:

- **SV6S-DPM-BEC** works with a conventional ESC equipped with a Battery Eliminator Circuit (BEC). The receiver's throttle channel connects to the SV6S-DPM-BEC, which in turn connects to the ESC's throttle input. This connection also provides power from the ESC to the receiver. Note, however, that interference generated by the ESC and/or motor can propagate into the receiver through the throttle connection, which may cause the receiver to operate erratically.
- **SV6S-DPM-OPTO** works with an ESC having optical isolation in the throttle circuit, which prevents interference from propagating back into the receiver via the throttle connection. You can also use this model with a BEC ESC if you need optical isolation for the throttle. Note that this configuration requires a separate battery to power the receiver and servos.

This simple diagram shows how components are connected in the aircraft. Details are in the BalancePro HD 6s DPM user's guide.



Pack selection guidelines

FMA recommends that you read all three sections of the *LiPo Handbook*, available in the Support section of the FMA Direct Web site (www.fmadirect.com).

Use FMA's LiPo Calc II to preview LiPo pack configurations based on your motor operating and flight parameters.

LiPo Calc II is available on the FMA Direct Web site (www.fmadirect.com). Click the LiPo Calc II button on the home page. There is also a link on the site's Kokam USA battery page.

LiPo Calc II is driven by the wattage required to fly the model and the watt-hours needed to fly for an expected period. Be aware that LiPo Calc II does not take into account the fact that cells lose capacity, therefore run time, with increasing current draw.

To use LiPo Calc II, fill in the fields at the top, then click the Update Values button. LiPo Calc II fills in the table, providing a lot of data to help you choose an appropriate pack configuration. Click a column heading for an explanation of the data in that column. Complete instructions are in the LiPo Calc help file ("Click here for help").

FMA Direct

LIPO CALC II

Cell Series: 3

Amps: 12

Throttle: 60

Update Values

Fresh Charge (VDQ): 12.6

Cut off Voltage (VDQ): 9

= Editable Fields

Click HERE for HELP

Click Column Heading for a Description

FMA Base PN	Nominal Cell Capacity (mAh)	Battery "C" Rating	Full C Discharge Rating	Parallel Requirement	Configuration	Total mAh	Full C mah (per cell)	Time @ Full Capacity (Minutes)	Time @ Discharged Capacity (Minutes)	cell Weight (gms)	Total Weight (gms-Cells Only)	Total Cells
Standard Discharge Type												
KOK20	20	3	100%	200	3s20p	4000	4000	33:19	20:00	1.0	600	600
KOK1020	1020	3	100%	4	3s4p	4080	4080	34:00	20:23	20.50	246	12
KOK3270	3270	3	100%	2	3s2p	6540	6540	54:29	32:41	64.00	384	6
High Discharge Type												
KOK145	145	8	75%	11	3s11p	1595	1196.25	13:17	05:58	3.50	115.5	33
KOK700HC	700	6	85%	3	3s3p	2100	1785	17:30	08:55	16.00	144	9
KOK1500HC	1500	8	82%	1	3s1p	1500	1230	12:30	06:09	32.50	97.5	3
Super High Discharge Type												
KOK340SHC	340	20	90%	2	3s2p	680	612	05:39	03:03	9	54	6
KOK2000-15C	2000	15	90%	1	3s1p	2000	1800	16:39	09:00	51	153	3
KOK2100-20C	2100	20	90%	1	3s1p	2100	1890	17:30	09:27	68.5	205.5	3
Customer Defined (Allows you to enter custom data)												
N/A	1500	15	90%	5	3s5p	2500	2250	20:50	11:15	115	225	15

Current rating. BalancePro HD packs are rated for 15C or 20C continuous discharge rates (depending on model). However, battery life will be significantly shortened if you operate at these rates throughout an entire flight. Compare these two situations:

- Running a 20C pack at 20C continuously with corresponding temperature rise to >150°F may reduce life to as few as 25 charge/discharge cycles.
- Running a 20C pack at 10C (50%C) continuously should provide at least 200 cycles.

When calculating battery requirements, a 50%C average discharge rate is a good starting point. This allows for short periods of high discharge for take off and aerobatic maneuvers, with moderate discharge for the rest of the flight.

Replacing another brand of LiPo pack. To achieve high discharge current, other LiPo brands must parallel multiple cells, and each cell is limited to a 12C (or less) discharge rating. In contrast, individual Cellpro cells are capable of 15C or 20C (depending on model). If the packs you are replacing have three or four cells in parallel (3p or 4p), you should need only a 1p or 2p Cellpro configuration. With Cellpro Packs, you'll not only lower your power system weight, but you'll also spend less.

Charge protection

LiPo cells and packs can be destroyed during charging by applying a voltage that's too high. What happens when charge voltage is too high? With as little as 10 minutes of overvoltage (6V per cell), the cell envelope begins to expand, which severely damages the cell. Continued overvoltage causes the envelope to swell from increasing internal gas pressure. Under extreme conditions, the envelope may vent (open) in less than 20 minutes. This destroys the cell. If supply current is high, venting may be accompanied by flames. For these reasons, **charge protection is required when charging BalancePro HD Packs.**

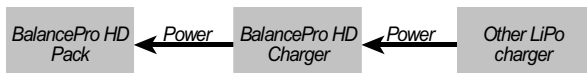
Two charge protection options are available:

- **BalancePro HD 6s Charger.** Charge protection is built into the BalancePro HD 6s Charger. Charging is simply a matter of plugging your BalancePro HD Pack into the BalancePro HD 6s Charger as shown below (other important operating details are in the BalancePro HD 6s Charger user's guide). With this arrangement, each cell is individually charged to the optimum 4.2V. When the process is complete, the pack is not only charged, but balanced (all cells in the pack are within 10mV).



You can safely and reliably fast-charge BalancePro HD Packs with the BalancePro HD 6s Charger. The maximum charge rate is 3C (that is, 3 times the pack capacity). This is possible only because the BalancePro HD 6s Charger carefully and accurately monitors individual cell voltages during charging. However, use a 1C charge rate when you have the time. At 1C, a fully depleted pack will charge to 90% in one hour (versus 20 minutes at 3C).

- **Another LiPo-compatible charger and a BalancePro HD 6s Charge Protection Module (CPM).** The BalancePro HD 6s CPM monitors individual cell voltages and cuts charging power to the pack when the first cell reaches 4.2V. Unlike the BalancePro HD 6s Charger, the BalancePro HD 6s CPM does not balance packs. When charging BalancePro HD Packs using a BalancePro HD 6s CPM, **never exceed a 1C charge rate.**



Each BalancePro HD 6s CPM handles charging for one BalancePro HD Pack. BalancePro HD 6s CPM units can be wired together for charging multiple BalancePro HD Packs from one charger (the BalancePro HD 6s CPM user's guide provides a two-unit wiring example).

WARNING: You **must** charge BalancePro HD Packs with a BalancePro HD 6s Charger, or with a BalancePro HD 6s Charge Protection Module and another LiPo-compatible charger. Charging under any other conditions voids the BalancePro HD Pack warranty.

FMA limited warranty for BalancePro HD Packs

FMA, Inc. warrants this product to be free of manufacturing defects for the term of 90 days from the date of purchase. Should any defects covered by this warranty occur, the product shall be repaired or replaced with a unit of equal performance by FMA or an authorized FMA service station.

Limits and exclusions

This warranty may be enforced only by the original purchaser, who uses this product in its original condition as purchased, in strict accordance with the product's instructions. Units returned for warranty service to an FMA service center will be accepted for service when shipped postpaid, with a copy of the original sales receipt or warranty registration form, to the service station designated by FMA.

This warranty does not apply to:

- Consequential or incidental losses resulting from the use of this product.
- Damage resulting from accident, misuse, abuse, neglect, electrical surges, reversed polarity on connectors, lightning or other acts of God.
- Damage from failure to follow instructions supplied with the product.
- Damage occurring during shipment of the product either to the customer or from the customer for service (claims must be presented to the carrier).
- Damage resulting from repair, adjustment, or any alteration of the product by anyone other than an authorized FMA technician.
- Installation or removal charges, or damage caused by improper installation or removal.

Call (301) 668-7614 for more information about service and warranty repairs.

Removing heat shrink tubing voids warranty.

Installation guidelines

Temperature limitations and cooling. BalancePro HD Packs perform best and last longest when their operating temperature is kept below 135°F. In no case should temperature exceed 150°F. If pack temperature exceeds 180°F, pack life will be severely shortened.

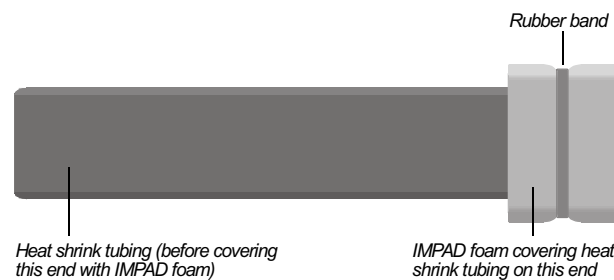
CAUTION: Pack temperature will exceed 150°F if the pack is operated at its maximum discharge rate for more than 60 seconds without adequate cooling.

To maintain optimum temperature, your aircraft must provide cooling air to the pack(s). The best way to force air over the pack(s) is to add an air inlet scoop (to force cool air into the battery compartment) and an exhaust vent (so warm air can exit the battery compartment).

Check pack temperature after flights until you are certain cooling air is doing its job. Each BalancePro HD Pack has temperature indicators to help you determine whether it is running too hot (see "Checking operating temperature," below). For more accurate measurements, use a hand-held non-contact infrared thermometer. Note that inner cells will become hotter than outer cells. This is unavoidable, but emphasizes the need for forced-air cooling.

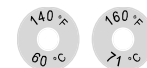
Vibration and impact protection. Do not fully cover BalancePro HD Packs in foam. The packs must have cooling air flowing over their surfaces. Covering a pack's entire surface would trap heat, causing temperature to rise too high, and ultimately shortening pack life.

Use FMA's IMPAD foam to isolate BalancePro HD Packs from vibration. (IMPAD is a special shock-absorbing foam that protects RC electronics and batteries much better than standard foams.) Cut an IMPAD sheet into 1" to 1-1/2" wide strips. Wrap the strips around the heat shrink tubing on each end of the pack, and secure the strips with rubber bands.



Checking operating temperature

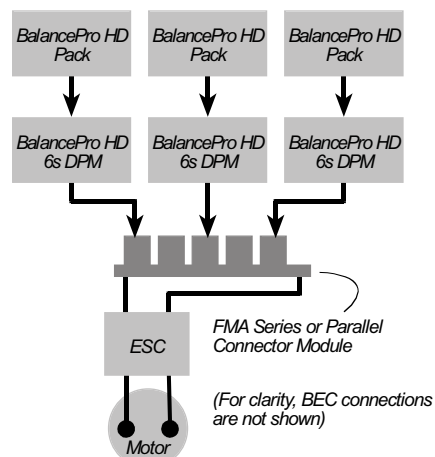
Two temperature indicators on the outside of each BalancePro HD Pack help you determine whether a pack is operating in its optimum temperature range.



1. Fly moderately during the pack's first flights.
2. After each landing, examine the 140°F indicator. If its center is black, the temperature exceeded 140°F, so the pack is not able to supply sufficient power for your propulsion configuration. Install a different propeller or a larger capacity battery pack. Remove the 140°F indicator and place a new one on the pack (spares are included with the pack).
3. Fly again, then repeat step 2. When the 140°F indicator's center remains white, and you are flying your normal style, the pack is matched to the aircraft.

Note: If the 160°F indicator turns black, the pack is operating much too hot. Replace the pack with a larger capacity one.

Wiring. Many FMA LiPo packs can be easily combined into higher voltage and capacity configurations by plugging them into FMA Series and Parallel Connector Modules. BalancePro HD Packs aren't directly compatible with the Modules because the Modules don't support the cell node wires that allow the BalancePro HD system to monitor individual cells within the BalancePro HD Pack. However, you can plug multiple BalancePro HD 6s DPMs into Series and Parallel Modules for expanded configurations. The diagram at right shows three BalancePro HD 6s DPMs plugged into a Module.



In high current systems, you must use wire and connectors rated for (at least) the expected maximum current. Select wire based on its current-carrying capacity and wire length.

Consult American Wire Gauge (AWG) tables for guidance. All BalancePro HD Packs are manufactured using 12AWG wire (capable of 60A continuous current) for the main power connections, and POWERLINE high-strand-count 22AWG (capable of 7A continuous current) for the node wiring used for cell-balance charging and cell voltage monitoring.

The widely-used Deans Ultra connector handles up to 60A and accepts up to 12AWG wire. You may use other connectors, as long as they are rated for the expected current, and as long as the propulsion system does not exceed the 60A limit for individual BalancePro HD Packs. In general, minimize the use of connectors and keep power wires short to reduce power circuit resistance.

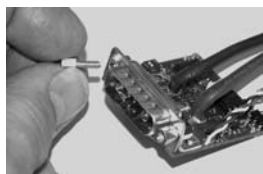
There is another reason for using a Deans Ultra connector at the ESC input (you'll see why in the next paragraph). Noise reduction capacitors at the motor draw extremely high currents when battery voltage is applied to the ESC. This current typically causes arcing at the pins of the connector completing the circuit. Here's the correct procedure for powering up the ESC:

1. Disconnect the Deans Ultra connector between the BalancePro HD 6s DPM and the ESC.
2. Connect the BalancePro HD Pack to the BalancePro HD 6s DPM.
3. Connect the Deans Ultra connector to complete the circuit. Arcing may occur at this connector.

While this procedure doesn't eliminate arcing, it assures that it happens at the Deans Ultra connector. Eventually, repeated arcing will degrade the connector and you'll need to replace it. That's not a bad thing, as the Deans Ultra is both inexpensive and easy to replace.

Recommended: secure the connectors

After installing FMA's connector hardware kit (available separately), you can screw the BalancePro HD DPM and BalancePro HD Pack connector shells together so they won't separate in flight.



Install two threaded standoffs on DPM connector shell

Two sets of hardware for BalancePro HD Pack connector



Slide keepers onto Pack shell, then thread screws through them

Flying with BalancePro HD Packs

The BalancePro HD 6s DPM provides a warning when cells in its connected pack approach the preset low voltage cutoff. When the first cell reaches the preset voltage, the BalancePro HD 6s DPM pulses voltage to the ESC (soft cutoff) so you can prepare for landing. Soon after, the motor will stop (hard cutoff). After the hard cutoff, you may be able to reset the BalancePro HD 6s DPM by pulling the throttle low and advancing it again. Restarts are possible, but the number depends on how fast the cell with the lowest voltage recovers above the minimum operating voltage. When the pack is fully exhausted, there will be no power to the motor.

The amount of time available near the end of a battery run is dependent on several factors, including:

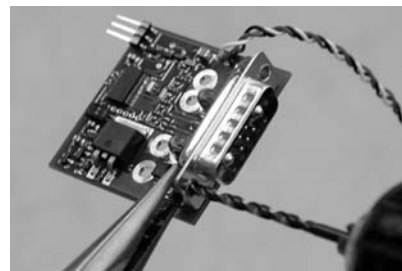
- Pilot flying style.
- Throttle setting. (Pulsing, cutoff and the number of restarts may be greater if the initial warning occurs at a high throttle setting.)
- Ambient temperature.
- Battery temperature.
- Capacity difference between cells in the pack. (If all cells in a pack are close to the same capacity, warning and restart times will be shorter. Conversely, if cell capacities vary more widely, warning and restart times will be longer.)

Just remember, when the motor starts pulsing, immediately throttle back and prepare to land. After the initial warning pulses, a low throttle setting gives you the longest remaining motor run time.

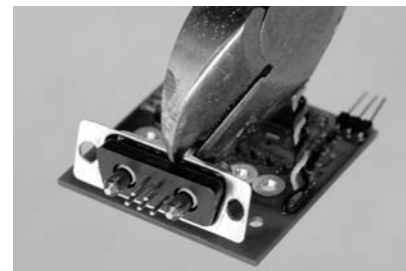
It's a good idea to ground-test the entire propulsion system before flying with it. Take it through a full run and keep pushing it until the motor won't restart. You'll get a feel for flying time, and gain hands-on experience with end-of-run motor behavior.

Reducing BalancePro HD 6s DPM weight

To reduce flying weight, you can remove the metal shell from the DPM's connector. However, this eliminates the option to secure the two connectors (see previous page, bottom).



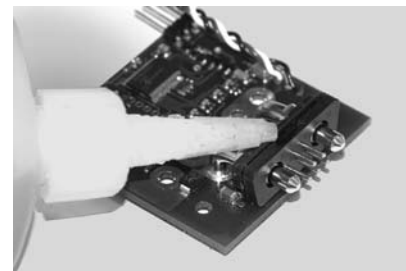
1. Drill out rivets securing shell halves.



2. Remove front shell half. Clip rear shell half with diagonal cutters.



3. Remove rear shell half.



4. Apply CA between plastic plates.