Power 90 Brushless Outrunner Instructions

Thank you for purchasing the E-flite Power 90 Brushless Outrunner Motor. The Power 90 is designed to deliver clean and quiet power equivalent to or surpassing the power of a 90-size 2- stroke glow engine for sport and scale airplanes weighing 8- to 13-pounds (3.6- to 5.9-Kg), 3D airplanes up to 10-pounds (4.5-Kg), or models requiring up to 1800 watts of power. It will provide excellent 3D performance for the Hangar 9 Frenzy 100 ARF, ShowTime 4D 90 ARF, FuntanaX 100 ARF and other similar class models. The Power 90 also provides great power and performance for the Seagull Ultimate Bi-Plane 90 ARFs.

Power 90 Brushless Outrunner Features:
• Equivalent to or surpassing the power of a 90-size 2-stroke glow engine for 8-13 lbs (3.6-5.9 Kg) airplanes
• Ideal for 3D airplanes up to 10 lbs (4.5 Kg)
• Ideal for models requiring up to 1800 watts of power
• High torque, direct drive alternative to inrunner brushless motors
• External rotor design for better cooling
• Includes mount and mounting hardware
• High quality construction with ball bearings and hardened 6mm steel shaft
• Includes two 10mm prop shaft adapters tapped out for 8-32 threads

Power 90 Specifications
Diameter: 56mm (2.20 in)
Case Length: 52mm (2.00 in)
Weight: 450g (15.8 oz)
Shaft Diameter: 6mm (.24 in) (Includes two 10mm prop shaft adapters)

EFLM4090A
Kv: 325 (rpms per volt)
Io: 2.00A @ 10V (no load current)
Ri: .02 ohms (resistance)
Continuous Current: 50A*
Max Burst Current: 65A*
Watts: up to 1800
Cells: 6S-8S LiPo or 18-26 NiMH/NiCd
Recommended Props: 16x8 – 18x8
Brushless ESC: 85A High Voltage

* Maximum Operating Temperature: 220 degrees Fahrenheit
* Adequate cooling is required for all motor operation at maximum current levels.
* Maximum Burst Current duration is 15 seconds. Adequate time between maximum burst intervals is required for proper cooling and to avoid overheating the motor.
* Maximum Burst Current rating is for 3D and limited motor run flights. Lack of proper throttle management may result in damage to the motor since excessive use of burst current may overheat the motor.

Determine a Model's Power Requirements:
1. Power can be measured in watts. For example: 1 horsepower = 746 watts
2. You determine watts by multiplying 'volts' times 'amps'. Example: 10 volts x 10 amps = 100 watts

Volts x Amps = Watts

3. You can determine the power requirements of a model based on the 'Input Watts per Pound' guidelines found below, using the flying weight of the model (with battery):

- 50-70 watts per pound; Minimum level of power for decent performance, good for lightly loaded slow flyer and park flyer models
- 70-90 watts per pound; Trainer and slow flying scale models
- 90-110 watts per pound; Sport aerobatic and fast flying scale models
- 110-130 watts per pound; Advanced aerobatic and high-speed models
- 130-150 watts per pound; Lightly loaded 3D models and ducted fans
- 150-200+ watts per pound; Unlimited performance 3D and aerobatic models

NOTE: These guidelines were developed based upon the typical parameters of our E-flite motors. These guidelines may vary depending on other motors and factors such as efficiency and prop size.

4. Determine the Input Watts per Pound required to achieve the desired level of performance:

Model: 100-size 3D ARF
Estimated Flying Weight w/Battery: 9 lbs
Desired Level of Performance: 150-200+ watts per pound; Unlimited performance 3D and aerobatics

9 lbs x 150 watts per pound = 1,350 Input Watts of total power (minimum) required to achieve the desired performance

5. Determine a suitable motor based on the model's power requirements. The tips below can help you determine the power capabilities of a particular motor and if it can provide the power your model requires for the desired level of performance:

- Most manufacturers will rate their motors for a range of cell counts, continuous current and maximum burst current.
- In most cases, the input power a motor is capable of handling can be determined by:

Average Voltage (depending on cell count) x Continuous Current = Continuous Input Watts

Average Voltage (depending on cell count) x Max Burst Current = Burst Input Watts

HINT: The typical average voltage under load of a Ni-Cd/Ni-MH cell is 1.0 volt. The typical average voltage under load of a Li-Po cell is 3.5 volts. This means the typical average voltage under load of a 10 cell Ni-MH pack is approximately 10 volts and a 3 cell Li-Po pack is approximately 10.5 volts. Due to variations in the performance of a given battery, the average voltage under load may be higher or lower. These however are good starting points for initial calculations.

Model: 100-size Frenzy 3D ARF (converted to electric)
Estimated Flying Weight w/Battery: 9 lbs
Total Input Watts Required for Desired Performance: 1,350 (minimum)

Motor: Power 90
Max Continuous Current: 50A*
Max Burst Current: 65A*
Cells (Li-Po): 8

8 Cells, Continuous Power Capability: 28 Volts (8 x 3.5) x 50 Amps = 1,400 Watts
8 Cells, Max Burst Power Capability: 28 Volts (8 x 3.5) x 65 Amps = 1,820 Watts

Per this example, the Power 90 motor (when using an 8S Li-Po pack) can handle up to 1,820 watts of input power, readily capable of powering the 100-Size Frenzy 3D model with the desired level of performance (requiring 1,350 watts minimum). You must however be sure that the battery chosen for power can adequately supply the current requirements of the system for the required performance.

Battery Choices:
We recommend Thunder Power Li-Po batteries for the best performance and lowest weight. Some examples of the packs we recommend for use with the Power 90 motor can be found below:

THP38504SX	3850mAh 4S 14.8V Li-Po (x2; for use in series as 8S)
THP42004S2PPL	4200mAh 4S2P 14.8V Li-Po, (x2; for use in series as 8S2P)
THP45004SX	4500mAh 4S 14.8V Li-Po (x2; for use in series as 8S)
THP50004SXV	5000mAh 4S 14.8V Li-Po (x2; for use in series as 8S)

Examples of Airplane Setups:
Please see our web site for the most up-to-date information and airplane setup examples.

NOTE: All data measured at full throttle. Actual performance may vary depending on battery and flight conditions.

Hangar 9 Frenzy 100 ARF (converted to electric)

Option 1:
Motor: Power 90
ESC: Castle Creations Phoenix HV-85 (CSEPHX85HV)
Prop: APC 16x8E (APC16080E)
Battery: Thunder Power PRO LITE 4200mAh 8S2P 29.6V (2 – THP42004S2PPL packs run in series)
Flying Weight w/Battery: 9 lbs

Amps	*Volts*	*Watts*	*Input Watts/Pound*	*RPM*
50	28.4	1,420	158	7,590

Expect very strong 3D performance and pulls from hover. Average duration is approximately 8 minutes depending on throttle management.

Accessories:
See our web site at www.E-fliteRC.com or www.horizonhobby.com for our complete line of brushless motors. We have posted a specification comparison sheet on our web site so you can compare the different motors we offer.

EFLA110	Power Meter (measures power in amps, volts, watts, and capacity)
EFLA249	BL Connector Set, Gold, 4mm (3)
EFLM40901	Shaft: Power 90
EFLM41102	X-Mount with Hardware: Power 90/110/160
EFLM40902	Prop Adapters: Power 90
HAN4245	EP Motor Mount with Hardware
EVO3307	Standoff Gas Engine Mount, 38MM
EVO3308	Standoff Gas Engine Mount, 45MM
EVO3309	Standoff Gas Engine Mount, 50MM
EVO3310	Standoff Gas Engine Mount, 20MM
EVO3311	Standoff Gas Engine Mount, 7MM
CSEPHX85HV	Phoenix HV-85 High Voltage ESC
CSEPHX110HV	Phoenix HV-110 High Voltage ESC

Electronic Speed Controls:
There are many brushless electronic speed controls available in the market. We have conducted our testing using Jeti Advance 90 Plus, Cyclon Pilot Pro 80A HV, and the Castle Phoenix HV-85 and HV-110 ESCs. The timing setting of the speed control is important for obtaining proper and maximum performance. In the past, some consumers have reported motor performance issues relating to timing at higher power levels when using the Castle Phoenix HV-85 and HV-110 speed controls. Castle Creations has updated their software to correct these issues. To ensure you have the most up-to-date software, we recommend that you update your ESC by downloading the software from their web site using the Castle Link USB Programmer Adapter (CSEPHXL).

Propellers:
Our testing was conducted using APC electric propellers. At these power levels, you may also experiment with using regular gas/glow props in the equivalent sizes listed in our specifications. Other options are available as well and will affect motor power output and RPMs.

Installation of Prop Adapters:
This motor includes two 10mm prop adapters tapped to accept 8-32 spinner mounting screws in order to allow quick and easy mounting of most spinners. There are two different prop shaft adapters. The adapter with four holes is intended for installation on the rotating portion of the case. Use this adapter when you are installing the fixed portion of the motor on the outside of a firewall or mount.

1. Use the included 4-40 x 3/8" screws to attach the prop adapter to the rotating portion of the case.
2. It is important that you then slide the included securing collar onto the motor shaft exiting the fixed portion of the motor. Slide the collar up to the retaining ring and tighten the setscrews, making sure that one of the setscrews lines up with the flat spot on the motor shaft. Do not remove the retaining ring. This is a preventative measure to ensure that the shaft is secured in case the retaining ring unclips during use.

The adapter with two setscrews is intended for installation on the motor shaft exiting the fixed portion of the case. Use this side when you are installing the fixed portion of your motor on the inside of a firewall or mount.

1. Slide the prop adapter onto the motor shaft exiting the fixed portion of the case.
2. Use two setscrews to secure the prop adapter to the motor shaft, making sure that one of the setscrews lines up with the flat spot of the motor shaft.

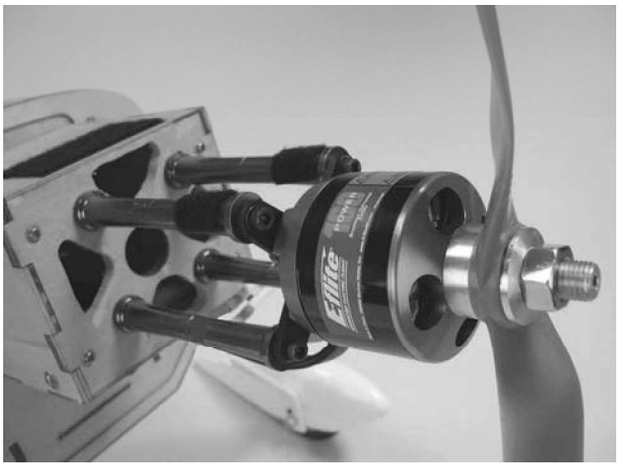
Note: Use blue thread lock to secure screws.

Operating Instructions:
1. This brushless motor requires the use of a sensorless brushless speed control. Failure to use the correct speed control may result in damage to the motor and/or speed control.
2. When mounting the motor, be sure the correct length of screws are used so damage to the inside of the motor will not occur. We suggest you use the mounting hardware included with your motor. **The use of long screws will damage the motor.**
3. You may connect the three motor wires directly to the controller with solder or use connectors such as 4mm gold plated brushless connectors (EFLA249), which will also need to be soldered properly to your wires. The three motor wires can be connected in any order to the three output wires or output port on a sensorless brushless speed control. Be sure to use heat shrink tubing to properly insulate the wires so the wires will not short. Shorting may damage the motor and speed control.
4. If you add connectors and you no longer wish to use them, never cut the motor wires. Remove them by properly desoldering them. Shortening the motor wires is considered an improper modification of the motor and may cause the motor to fail.
5. When you connect the motor to the esc, check the rotation direction of the motor. If you find the rotation is reversed, **switching any two motor wires will reverse the direction so the motor rotates properly**.
6. Proper cooling of the motor is very important during operation. New technology has brought much higher capacity batteries with higher discharge rates, which can cause extreme motor temperatures during operation. It is the responsibility of the user to monitor the temperature and prevent overheating. Overheating of the motor is not covered under any warranty.
7. You can install the propeller on the motor shaft after you have confirmed proper rotation direction, but first make sure it is properly balanced. Also consult the instruction included with your sensorless electronic speed control for proper adjustments and timing.
8. Once the battery is connected to the motor, please use extreme caution. Stay clear of the rotating propeller since spinning propellers are very dangerous as the motors produce high amounts of torque.
9. Never disassemble the motor. This will void any warranty.

Installation:

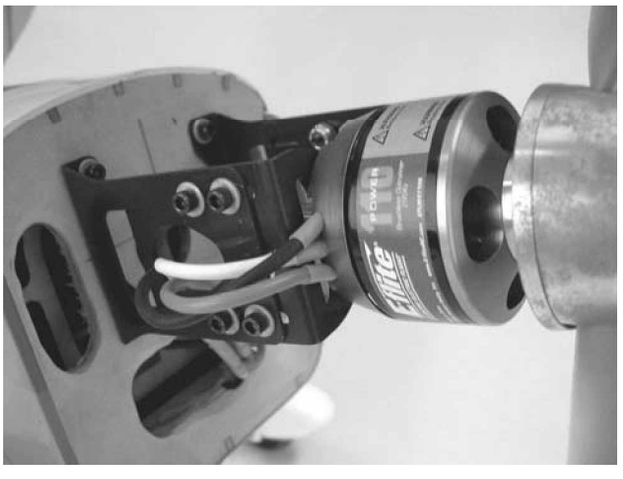
NOTE: Photo shows typical installation of motor and x-mount directly to the outside of the firewall. There are other options available including mounting the motor inside the fuselage or extending the motor further forward using aftermarket mount extensions when using cowls.

1. You can first trial fit the aluminum x-mount against the front of the firewall and use a Sharpie® to mark the locations of four holes and drill appropriate size hole to fit the blind nuts provided. Always be sure to maintain the proper thrust line and account for adequate prop/spinner clearance.
2. Attach aluminum x-mount to the outrunner motor using the four flat head (countersunk) screws provided with the motor.
3. Install four blind nuts on the inside of the firewall.
4. Attached the aluminum x-mount and motor to the outside of the firewall using the four socket head bolts and washers.



NOTE: Photo above shows installation using the Evolution™ Standoffs for Gas Engines (part numbers listed above). These standoffs work great for this application and are available in different sizes from 7mm up to 50mm in length. You can combine them to fit your exact needs. You will need to purchase socket head bolts to fit the customized standoffs lengths. Nylon motor standoffs (spacers) can also be used.

1. Attach aluminum x-mount to the outrunner motor using the four flat head (countersunk) screws provided with the motor.
2. Trial fit the cowl find the standoff length that will allow for proper clearance of your propeller once the cowl is installed.
3. Insert appropriately sized bolts and washers (purchased separately) into the four outside holes on the x-mount then directly into the Evolution standoffs, or through the standoffs and then into to blind nuts in the firewall if using hollow motor standoffs/spacers.



NOTE: Photo shows typical installation of motor directly to a separate electric motor mount such as the Hangar 9® EP Motor Mount with Hardware (HAN4245).

1. Assemble the mount per the instructions provided by the manufacturer.
2. Attach the motor as shown above to the mount using four 4mm screws (these are included with the Hangar 9 EP Motor Mount). The motor can also be mounted inside the electric mount if necessary.
3. Attach the electric mount with motor to the firewall using hardware provided with the electric mount.

Motor Safety Precautions:
The Outrunner motor case is a rotating part so use extreme caution. Please read the warning information included with your propellers for safety information related to the operation of motors with propellers. Failure to comply with these warnings and/or improper use of propellers may result in serious injury.

Limited Warranty Period
Horizon Hobby, Inc. guarantees this product to be free from defects in both material and workmanship for a period of 1 year from the date of purchase.

Limited Warranty
(a) This warranty is limited to the original Purchaser ("Purchaser") and is not transferable. REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PURCHASER. This warranty covers only those Products purchased from an authorized Horizon dealer. Third party transactions are not covered by this warranty. Proof of purchase is required for warranty claims. Further, Horizon reserves the right to change or modify this warranty without notice and disclaims all other warranties, express or implied.

(b) Limitations- HORIZON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCT. THE PURCHASER ACKNOWLEDGES THAT THEY ALONE HAVE DETERMINED THAT THE PRODUCT WILL SUITABLY MEET THE REQUIREMENTS OF THE PURCHASER'S INTENDED USE.

(c) Purchaser Remedy- Horizon's sole obligation hereunder shall be that Horizon will, at its option, (i) repair or (ii) replace, any Product determined by Horizon to be defective. In the event of a defect, these are the Purchaser's exclusive remedies. Horizon reserves the right to inspect any and all equipment involved in a warranty claim. Repair or replacement decisions are at the sole discretion of Horizon. This warranty does not cover cosmetic damage or damage due to acts of God, accident, misuse, abuse, negligence, commercial use, or modification of or to any part of the Product. This warranty does not cover damage due to improper installation, operation, maintenance, or attempted repair by anyone other than Horizon. Return of any goods by Purchaser must be approved in writing by Horizon before shipment.

Damage Limits:
HORIZON SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCT, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY. Further, in no event shall the liability of Horizon exceed the individual price of the Product on which liability is asserted. As Horizon has no control over use, setup, final assembly, modification or misuse, no liability shall be assumed nor accepted for any resulting damage or injury. By the act of use, setup or assembly, the user accepts all resulting liability.

If you as the Purchaser or user are not prepared to accept the liability associated with the use of this Product, you are advised to return this Product immediately in new and unused condition to the place of purchase.

Law: These Terms are governed by Illinois law (without regard to conflict of law principals).

Safety Precautions:
This is a sophisticated hobby Product and not a toy. It must be operated with caution and common sense and requires some basic mechanical ability. Failure to operate this Product in a safe and responsible manner could result in injury or damage to the Product or other property. This Product is not intended for use by children without direct adult supervision. The Product manual contains instructions for safety, operation and maintenance. It is essential to read and follow all the instructions and warnings in the manual, prior to assembly, setup or use, in order to operate correctly and avoid damage or injury.

Questions, Assistance, and Repairs:
Your local hobby store and/or place of purchase cannot provide warranty support or repair. Once assembly, setup or use of the Product has been started, you must contact Horizon directly. This will enable Horizon to better answer your questions and service you in the event that you may need any assistance. For questions or assistance, please direct your email to productsupport@horizonhobby.com, or call 877.504.0233 toll free to speak to a service technician.

Inspection or Repairs
If this Product needs to be inspected or repaired, please call for a Return Merchandise Authorization (RMA). Pack the Product securely using a shipping carton. Please note that original boxes may be included, but are not designed to withstand the rigors of shipping without additional protection. Ship via a carrier that provides tracking and insurance for lost or damaged parcels, as **Horizon is not responsible for merchandise until it arrives and is accepted at our facility**. A Service Repair Request is available at www.horizonhobby.com on the "Support" tab. If you do not have internet access, please include a letter with your complete name, street address, email address and phone number where you can be reached during business days, your RMA number, a list of the included items, method of payment for any non-warranty expenses and a brief summary of the problem. Your original sales receipt must also be included for warranty consideration. Be sure your name, address, and RMA number are clearly written on the outside of the shipping carton.

Warranty Inspection and Repairs
To receive warranty service, you must include your original sales receipt verifying the proof-of-purchase date. Provided warranty conditions have been met, your Product will be repaired or replaced free of charge. Repair or replacement decisions are at the sole discretion of Horizon Hobby.

Non-Warranty Repairs
Should your repair not be covered by warranty the repair will be completed and payment will be required without notification or estimate of the expense unless the expense exceeds 50% of the retail purchase cost. By submitting the item for repair you are agreeing to payment of the repair without notification. Repair estimates are available upon request. You must include this request with your repair. Non-warranty repair estimates will be billed a minimum of ½ hour of labor. In addition you will be billed for return freight. Please advise us of your preferred method of payment. Horizon accepts money orders and cashiers checks, as well as Visa, MasterCard, American Express, and Discover cards. If you choose to pay by credit card, please include your credit card number and expiration date. Any repair left unpaid or unclaimed after 90 days will be considered abandoned and will be disposed of accordingly. **Please note: non-warranty repair is only available on electronics and model engines.**

Motors requiring inspection or repair should be shipped to the following address (freight prepaid):

Horizon Service Center
4105 Fieldstone Road
Champaign, Illinois 61822

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