Precision Aerobatics Thrust 20 Brushless motor with RotorKool™ technology

The development of our new PA Thrust™ motors has followed our traditional design philosophy employed in our aircrafts; which is doing things better. Thrust™ motor is one of the coolest running high performance, high-torque and high efficiency brushless motor ever produced to date. The design incorporates our latest innovation, ***RotorKool™*** which keeps the stator core material, the low resistance windings, highly permeable stator plates, high quality NMB Japan triple bearings and powerful neodymium magnets at optimum operating temperatures regardless of duration or the number of consecutive flights made*.

*provided sufficient airflow is permitted.

Motor specs

Outside Diameter	37.2mm
Length	31mm
Weight (gr/oz)	71gr / 2.5oz
Motor Shaft Dia.	4.0mm
Mounting Bolts Dia.	M3
Max efficiency Current A *	4-22A
Peak current A (15 sec)*	27A
Battery pack range **	2~3 LiPo / 6-10 NiCd
Poles	14
KV rpm/V	1030
Recommended ESC	PA Quantum 30
Peak Watts	286 watts

** Unrestricted airflow and air scoops are mandatory to ensure long service life and long term performance consistency. Extended Continuous Operation without the required cooling provisions may be detrimental to the coils and magnets and will void warranty.*

*** PA 3cells (11.1V) 1800mAh pack is recommended.*

Propeller selection

APC 11x5.5E - excellent over-all propeller with very high efficiency and long flight duration. It allows high speed maneuvers with a lot of punch. Adequate airflow to cool down the motor and ESC is required, as well as a good battery and throttle management. This is our recommended propeller for the Addiction and the Katana Mini.

APC 11x4.7SF - This is the higher range propeller for the Thrust 20 and an excellent overall propeller for 3D, freestyle aerobatics with more thrust and nice flight speed. It draws more amps comparing to the 11x5.5E but spools up fast! This is a good propeller for hovering and torque rolls practice with a nice prop sound too ;) throttle management is required as well as adequate airflow to cool down the motor and ESC

APC 11x3.8SF - If you are a thrust freak and want a 3D beast give this propeller a shot. Producing over **58.9oz** of thrust!! This propeller is not a good choice for freestyle flying due to the lower flight speed (low pitch propeller). The amp drawn is a tad lower than the 11x4.7SF with higher efficiency and additional 15%+ of thrust!
It slows down the plane nicely for hardcore 3D flying (excellent for low rolling harriers) and still provides lots of instant thrust. Not a beginner propeller.

APC 10x5E Good sport aerobatic propeller with outstanding efficiency. If you are after long flight duration give this propeller a try.

We recommend getting a few different size propellers with your thrust 10 motor. Swapping a propeller is an easy task so you may want to experiment and feel the difference to fit different style of flying. Also in a hot summer day you may want to use a smaller propeller while in a cooler day you can run the motor with a larger propeller.

The iPAs Drive Test Methodology:- An Engineered Approach to Testing

Through hundreds of hours of flight testing our airframe designs, we have established that there is a direct correlation between the airframe and drive system and one affects the other with consequences to the desired aerodynamic performance. We designed our power plants with the airframe that promotes efficient cooling. The idea behind the design was to allow the power plant and airframe to work in harmony in order to achieve optimum performance, that could never be easily achieved with a mix and match approach. Every step of the design from the airframe, motor, speed controller through to the matching power packs have been done in a very careful and measured fashion with the sole propose to achieve the maximum aerodynamic performance without compromising flight time. We call the result **iPAs**, PA **I**ntegrated **P**erformance **A**irframe-Drive **S**ystem, allowing any modeler to get it right the first time in the simplest and shortest way; the completely hassle free buy, fix, fly and forget method.

Below we will tell you a bit about the task of testing the gear to confirm the performance results.

While this may sound easy, it is actually a very complex test that should be done carefully. Any variations with the type of ESC set up, ESC brand, type of battery, charging of the battery pack (can even vary between same brand and type of pack), type of chargers, climate (environment temperature) and testing gear will derive different results. Even the duration of the bench run will change the reads due to the battery voltage drop caused by the internal resistance of the battery as well as the age of the battery. All those factors can create A LOT of read variations.

We conducted **multiple** tests (both static and dynamic tests) on each of our motors in different climates/temperature, using different testing equipment, changed ESC and batteries to determine the real performance of the motor. We also had the model flown by multiple test pilots to obtain different individual flying styles.

We believe that drive system testing should not be purely based on bench testing, because those are clinical test done in controlled environments that are completely different from actual flight conditions. Interactions of external environmental factors such as cooling, prop loading, G-Force etc. can not be accurately simulated on the bench. The real performance data comes from actual flights because this is where it counts the most. Therefore, we have taken the approach to conduct actual live test to acquire our data, i.e. flying the actual aircraft and performing actual 3D maneuvers, like any other experienced modeler would for real. We do not simply fly straight and level circuits and performing simple aerobatic maneuvers during our flight test but we actually fly our aircraft to the maximum limits of their aerodynamic performance envelope.

We strongly recommend going over the graphs below since they are the real dynamic test we've conducted with the motor.

Static Bench Testing Results **iPAs Gear: PA Thrust 20, Quantum 30, PA1800mah**

Prop Type	Battery Voltage (V)	Current (A)	RPM	Watts (W)	Static Thrust (oz)	Static Thrust (gr)
APC 11X5.5E	10.47	22.4	7995	236	45	1275
APC 11X4.7SF	10.21	25.7	7185	263	51.4	1456
APC 11X3.8SF	10.12	24.6	7695	250	58.88	1670
APC 10X5E	10.87	18.2	8775	200	36.96	1048
APC 10X4.7SF	10.50	23.1	7845	243	41.8	1184

In 3D flights, thrust and power usually require the immediate power for few seconds to get out of a maneuver. We have based our static tests on this datum. We used 4 different brands of testing gear to verify the results and accuracy of reads. Test results may vary depend on your set up of your ESC, climate, altitude, duration of run etc.

Dynamic Flight Test

The dynamic test is real time data acquisition by onboard data loggers installed on the actual aircraft which the gear is designed for. These airplanes are deliberately flown by advanced pilots executing actual advanced maneuvers to simulate the real world performance conditions where these airplanes are expected to be flown.

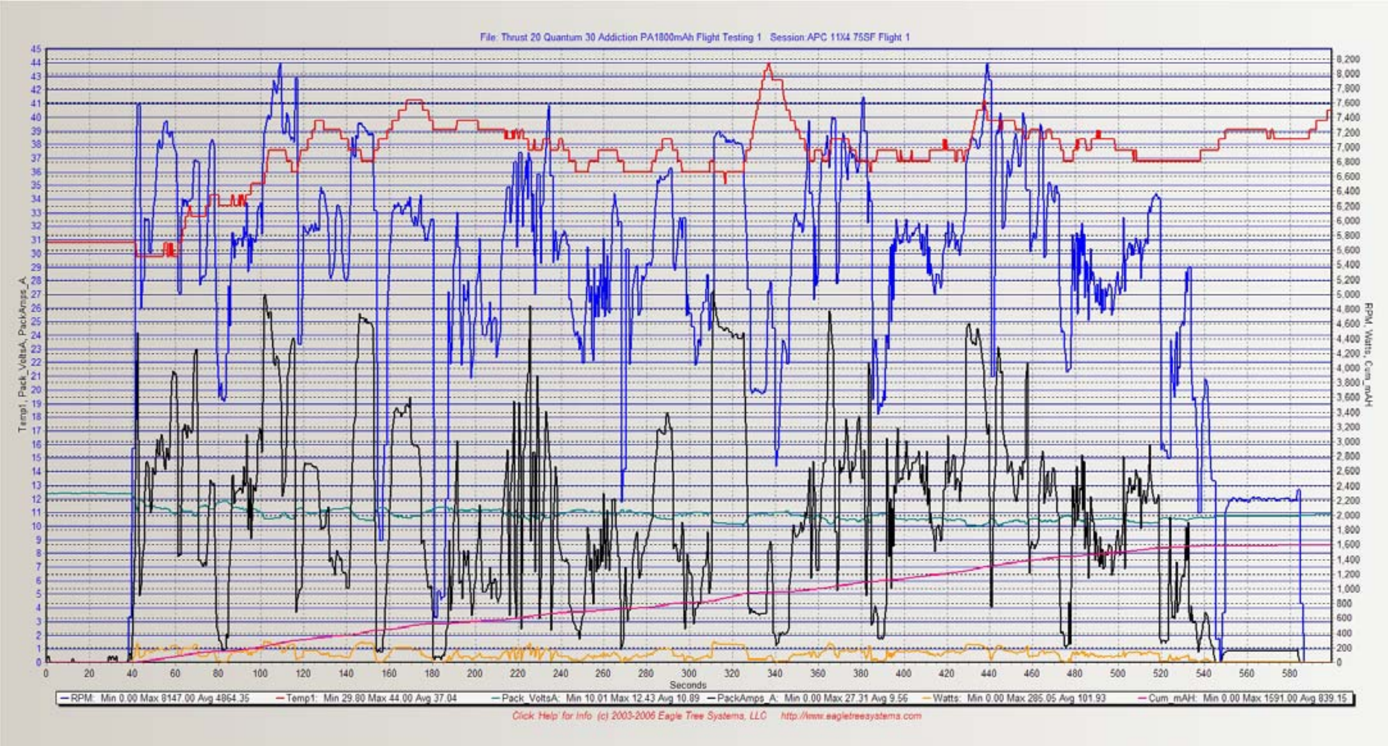
We have included several graphs to cover as many advanced freestyle and 3D routines as possible especially maneuvers that places the most demand on the drive system. The graphs also show the actual motor cooling performance as it goes through each different maneuver and air speeds.

You may also want to look at all the temperature traces on the graph that indicates a fairly constant operating temperature throughout the flight in relation to the dynamic loads imposed by the propeller. This is where our exclusive Rotorkool™ feature comes into action to keep motor core temperature considerably below the critical temperature limits of the neodymium magnets allowing our Thrust Motors to provide consistent performance far longer than any other motor.

iPAs Dynamic Flight Test Results

Gear: PA Thrust 20, PA Quantum 30, PA1800mah (General Freestyle/Hardcore 3D Maneuvers)
Engineering Units
Current = Amps, Voltage = Volts, Power = Watts, Temperature = Deg C., RPM = RPM, Battery Capacity = mAh.

Test Flight 1 APC 11X4.7SF



Graph interpretation & Flight Report:
Dynamic test deliberately conducted in a hot summer day with ambient Air temperature of 29.8 Deg C (85.6F).

The **red line** shows the motor operating temperature throughout the fight is between 36-41 Deg C (96.8-105.8F) rising and dropping corresponding to the loads imposed in flight. The temperature rose only after the motor has stopped (after the flight) indicating the RotorKool HVFCV feature was managing the temperature while the motor was in operation. This is indicative of both the **blue** (RPM) and **Black** (Motor current) lines.

Please note that the momentary max current drawn 27.31A (see time mark 310-330sec) caused by a full powered vertical climb for 20 seconds where the motor temperature increased to 44 Deg C (111.2F) and subsequently cooled down to 36.7Deg C (98F).

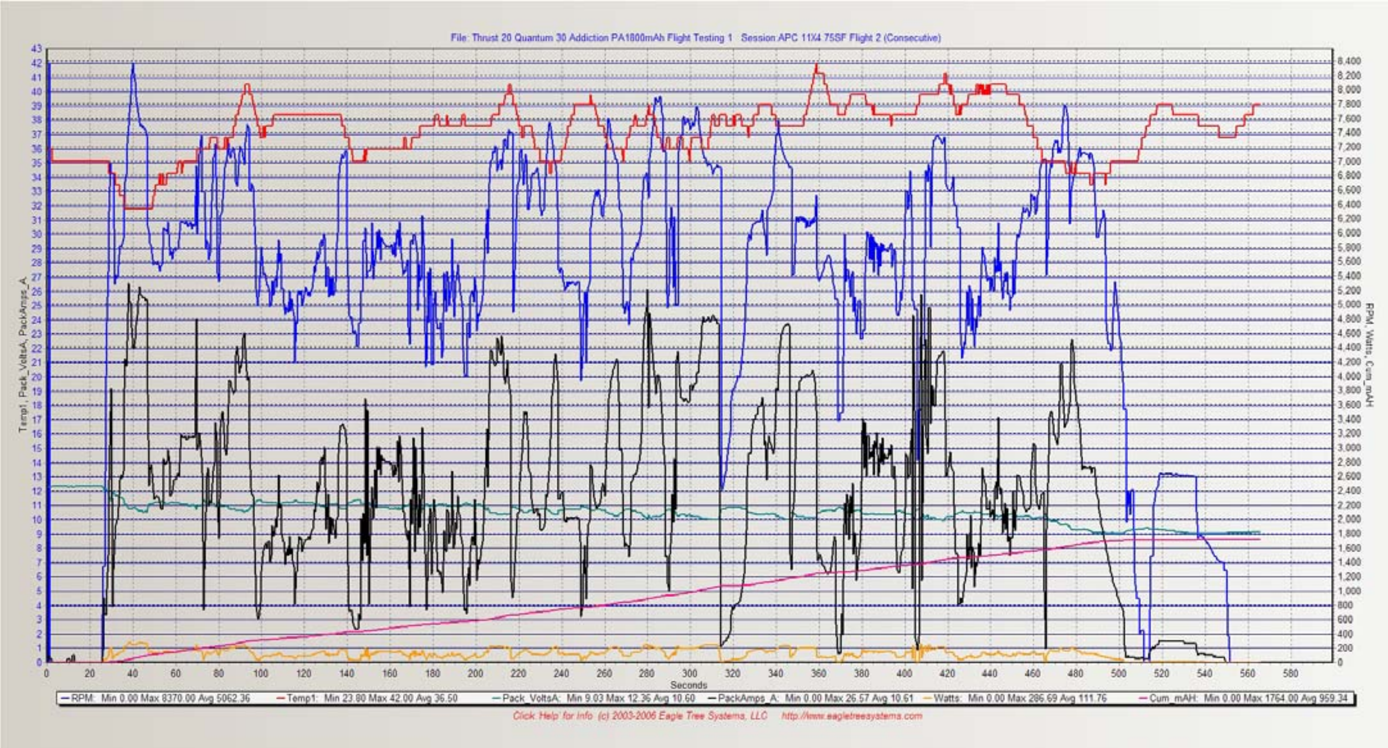
The **green line** shows the performance of the PA 1800mAh, 18-30c pack. Throughout the flight the battery voltage never dropped below 10.01V with a high average of 10.89V. The maximum current drawn (15C rate) was way below the critical 30C burst rate and even below the 18C continuous rate meaning that the pack was not being over stressed and maintained performance with no risk of LVC (Low Voltage Cutoff). It also remained cool after the flight.

The **pink line** (cumulative mAh) indicates the accumulated battery capacity throughout the flight. Approximately 88% of the pack's capacity consumed after a hard 9 minutes flight.

The **orange line** (watts) shows the motor power output throughout the flight peaking at 285W on this propeller.

The Quantum 30 ESC (Electronic Speed Controller) performed very well providing a smooth linear instantaneous throttle response with no hesitation and remained within the ESC's design temperatures in-spite of the abuse.

Test Flight 2 APC 11X4.7SF



Graph interpretation & Flight Report:

Dynamic test deliberately conducted in a hot summer day with ambient Air temperature of 29.8 Deg C (85.6F). This graph shows a consecutive flight immediately after Test Flight # 1 with no break in between.

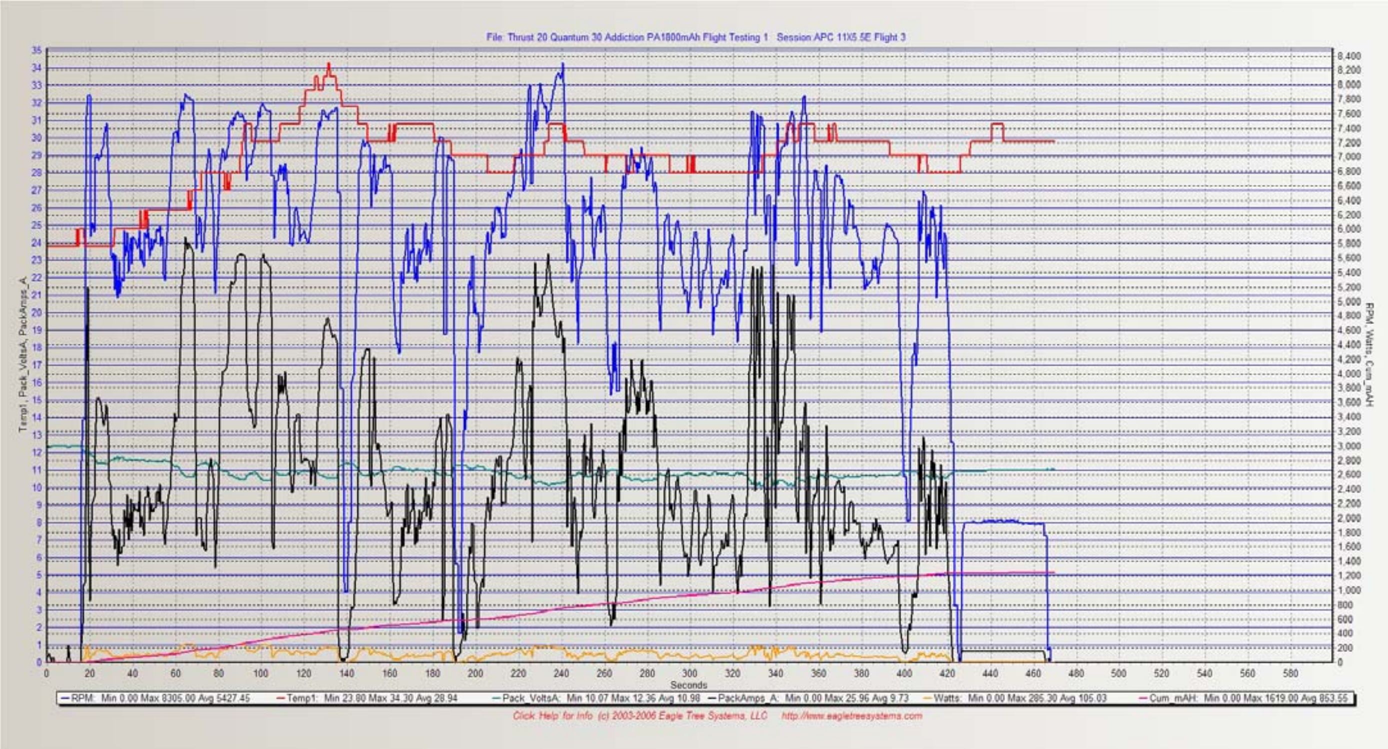
The **red line** shows the initial motor temperature at 36 Deg C (96.8F) ,after the completion of Test Flight 1, then started to cool down to 32 Deg C (89.6F) in spite of the take off (into a vertical climb on full throttle). The motor operating temperature throughout the fight remained between 35-42 Deg C (95.0F-107.6F) rising and dropping corresponding to the loads being imposed.
This particular flight was deliberately flown with several full throttle vertical up-lines followed by Knife Edge spins and climbing flat spins to stress the drive system and the temperature oscillations in a small band between 35-42 Deg C (95.0F - 107.6F) demonstrates the effectiveness of the RotorKool temperature control.

The maximum current drawn in this flight was 26.57A with output of **286.98W.** The PA 1800mAh pack handled the high discharge rate (14.76C) well and remained cool in spite of the abuse on this flight.

The cumulative battery capacity (**pink line**) after the extremely hard 8 minutes flight depleted to a whopping 98% while the battery voltage in-spite of the abusive test held constant throughout the flight and only manage to drop to 9.03V at the end of the flight (approximately 500sec into the flight). The LVC only kicked in mid-way during the taxi back to the pits.

Here again the Quantum 30 ESC performed very well and the throttle response was smooth, direct with no hesitation and remained within the ESC's design temperatures in-spite of the abuse. Throttle response was instantaneous with surplus reserves for punch-out during torque rolls and hover-recovery right up to the end of the flight.

Test Flight 3 APC11X5.5E



Graph interpretation & Flight Report:

Dynamic test conducted in a warm summer day with ambient Air temperature of 24.8 Deg C (76.6F).

The flight began with a full throttle take off into several sets of vertical climbs, Knife Edge spins and climbing flat spins. The drive system was deliberately stressed with the resultant temperature peak of 34 Deg C (93.2F) after initial stressing. It then cooled down and remained fairly constant through the remaining of the flight.

The **red line** shows the motor operating temperature throughout most of the fight was between 28-30.9 Deg C (82.4–87.62F) rising and dropping corresponding to the loads being imposed.
The temperature remained in this range in-spite of the additional loads imposed by the 11X5.5E prop with a peak current drawn of 25.96A.

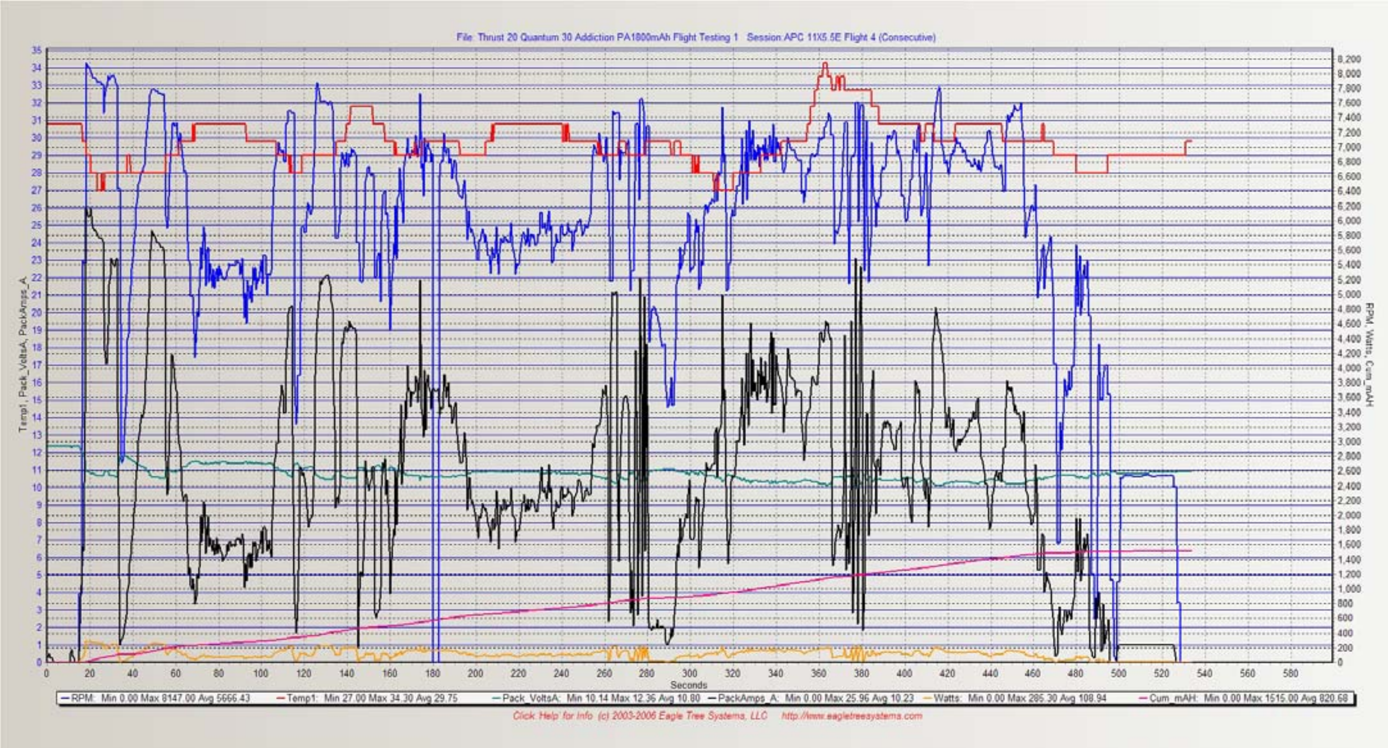
The **green line** (battery voltage) shows how well the battery is coping with the additional loads imposed on the motor. Throughout the flight it never dropped below 10.07V and so provided a safe LVC-free flight with excellent motor output. Note that the pack was driven very hard **(285.3W)** yet the voltage remained in the safe range.

The **blue line** demonstrates the motor's rpm throughout the flight. Note sec 240 in this flight shows a thrust peak of **47oz**!)

The cumulative battery capacity (**pink line**) was 68% of its capacity after this hard 7 minutes flight.

The Quantum 30 ESC performed very well and the throttle response was smooth, direct with no hesitation and remained within the ESC's design temperatures in-spite of the abuse. Throttle response was instantaneous with surplus reserves for punch-out during torque rolls and hover-recovery right up to the end of the flight.

Test Flight 4 APC 11X5.5E



Graph interpretation & Flight Report:

Dynamic test deliberately conducted in a warm summer day with ambient Air temperature of 27 Deg C (80.6F). This graph shows a consecutive flight immediately after Test Flight # 3 with no break in between.

The motor was allowed to rest for a period long enough for a quick battery change after the previous flight and this test deliberately started with a motor resting temperature of 30.8 Deg C (87.4F).

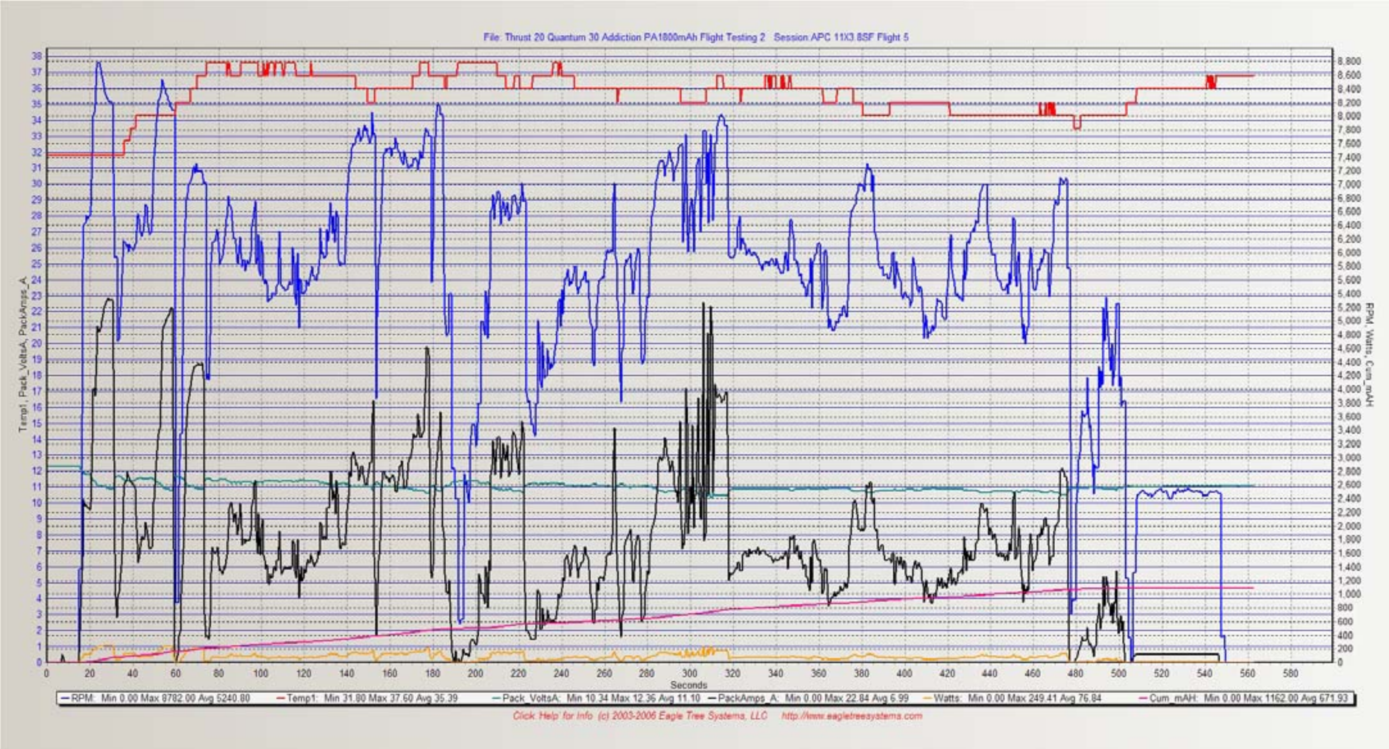
The **red line** shows the motor operating temperature throughout the fight is between 28-31.8 Deg C (82.4F-89.2F) rising and dropping corresponding to the loads being imposed and peaked at 34.3 Deg C (93.7F) when the drive was stressed hard (360sec-390 sec).

The **green line** (battery voltage) shows how well the battery is coping with the additional loads imposed on the motor. Throughout the flight it never dropped below 10.8V and so provided a safe LVC-free flight with ample thrust. Note that the pack was driven very hard **(285.3W)** yet the voltage remained in the safe range. The peak current drawn on this flight was 25.96A. The drive drew at a rate of 14.4c from the PA1800mAh pack which remained cool after the flight.

The cumulative battery capacity (**pink line**) after the hard 8 minutes flight shows how well the battery retains the required voltage to maintain performance and safety. This pack was flown to 84% of its capacity.

Here again the Quantum 30 ESC performed very well providing a smooth linear instantaneous throttle response with no hesitation and remained within the ESC's design temperatures in-spite of the abuse.

Test Flight 5 APC 11X3.8SF



Graph interpretation & Flight Report:

Dynamic test was deliberately conducted in a hot summer day with ambient Air temperature of 32 Deg C (89.6F).

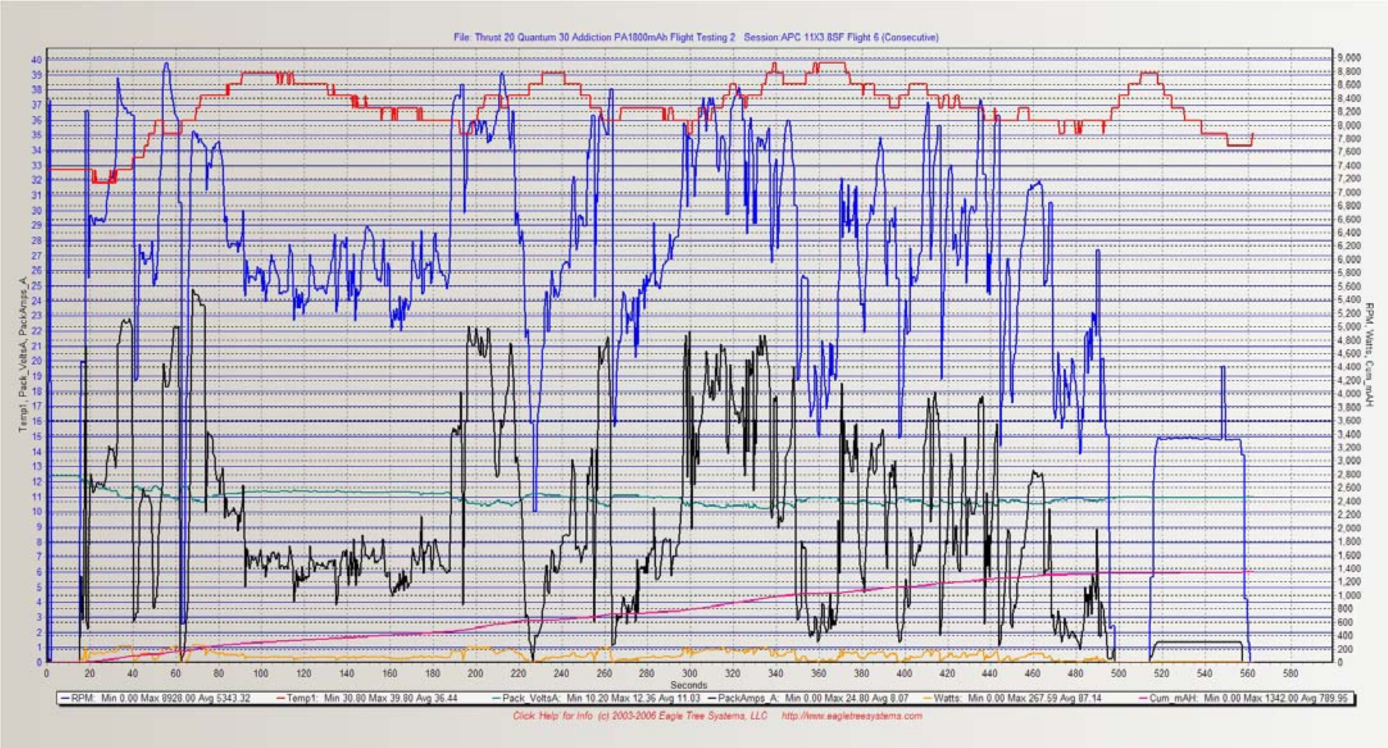
In spite of the extremely hot weather, the **red line** shows the motor operating temperature throughout the fight is in a very narrow, constant band of 35-37.7 Deg C (95F–99.8F). This is a phenomenal range of temperature control! The temperature rose and dropped by only 1.4 Deg C (2.5F)!
This flight consisted a lot of rolling harriers and mild 3D. The maximum current drawn was 22.84A!

This exceptionally narrow band of operating temperature is a classic example of how well RotorKool maintains a constant temperature when the drive is subjected to a relatively constant load.

The cumulative battery capacity (**pink line**) after 8 minute flight was 1162mAH (64.5% of the PA1800mAh pack's capacity) in this relatively mild (average) 3D flight providing potential of additional 3 minutes flight time on this pack.

The Quantum 30 ESC (Electronic Speed Controller) performed very well providing a smooth linear instantaneous throttle response with no hesitation.

Test Flight 6 APC 11X3.8SF



Graph interpretation & Flight Report:
Dynamic test was conducted in a hot summer day with ambient Air temperature of 31.8 Deg C (89.2F).
This graph shows a consecutive flight **immediately** after Test Flight # 5 with no break in between.

The **red line** shows the motor operating temperature throughout the fight is between 35-39 Deg C (95.0F–102.2F) rising and dropping corresponding to the loads imposed, with a peak of 39.8 Deg C (103.6F).

You may note the temperature dropped from 32.8 Deg C (91.0F) to 31.8 Deg C (89.2F) after the motor started demonstrating the effectiveness of the RotorKool HVFCV feature in this warm ambient air environment.

The cumulative battery capacity (**pink line**) after the 8 minutes flight is about 74% capacity and does not drop below 10.2V and so provides a safe LVC-free flight with LOTS of thrust!

The **blue line** demonstrates the motor's rpm throughout the flight. Note that in a few occasions in this flight the propeller rpm reads are over 8150rpm shows a thrust peaks of **66oz**!)

As accepted, the Quantum 30 ESC (Electronic Speed Controller) performed very well providing a smooth linear instantaneous throttle response with no hesitation throughout the entire flight.