Precision Aerobatics

iPAs Review

by Clarence Boudville

My Initiation into Electrics:- Baptism by Fire & Bloated Lipos

Over the years of dabbling in electrics, I have gone through all the methods of motor selection, made plenty of boo boos and amassed quite a collection of useless gear cooked, stuffed and fried in many imaginative ways. I had learnt electrics the hard way!

I'm sure most have at some stage or another experienced the frustrating (and expensive) results of trial and error when it comes to selecting, combining and using the many segments in a typical high power electric drive train. This is mainly due to the loosely defined airframe class and the existence of an unusually wide variant of motors, ESC and power packs. On the extreme end, motors from one single manufacturer, for example, Feigao with their 380 class BL inrunners have gone as far as to produce a huge range of motors in one turn increments, coupled with three different casing lengths (S,L,XL) within a single class totalling close to 100 or more models to choose from. This is entirely mind boggling even to the most experienced of electric enthusiast.

The last few years I have started using computer aided drive prediction tools and soon depended very heavily on it to select my gear for a specific airframe. No more guess work this time. 'Motorcalc' was initially quite difficult to digest and over time the field experience allowed a more informed gear selection. It was my tool of choice to a point where it became the last word in gear selection for me. In the interim I also tried a few combo's recommended by distributors and was really disappointed with the conservative performance in comparison to the videos they post. I bought quite a few lemons and it was literally a sour experience indeed. That in turn vindicated my belief in computer aided drive prediction tools. The only drawback I noticed over the years was that the gear selected appeared to be oversized and the initial thought was more power was good and completely ignored the overall aerodynamic performance and handling characteristics.

This was usually written off as "Well it's just me behind the sticks and if the airplane behaves like that then I am just not good enough". I unknowingly accepted this notion and continued to fly the model as is, overweight and relatively poor flight times of 5 minutes and below because there was nothing better and long flight times meant under powered performance. Throughout those times, many of my knowledgeable friends kept emphasizing on unpredictable flight characteristics associated with wing loading. However I could not really appreciate their attempts at enlightenment and usually dismissed the short falls to the inherent characteristics of a particular airplane or the clown behind the sticks. Those were the times when I started changing airframes on a regular basis in the pursuit of the "perfect" airplane. I also resented the manufacturer's videos because "what I saw was not what I got" and I just told myself that I can only depend on myself to get it right and never bothered to look at combos or manufacturer's recommendations again.

Precision Aerobatics Integrated Performance Airframe-Drive System (iPAs)

When PA launched their Katana MD, I told myself that I will not repeat my mistake and go with the flow so I bought the KMD with a PA Thrust 30. I initially did not go for the full iPAs gear since I already had compatible JAS 2300mAh, 20C, 158gr 3S1P Lipo packs and a Castle Creations Phoenix 35 ESC that should work with the KMD as verified by Motocalc, to

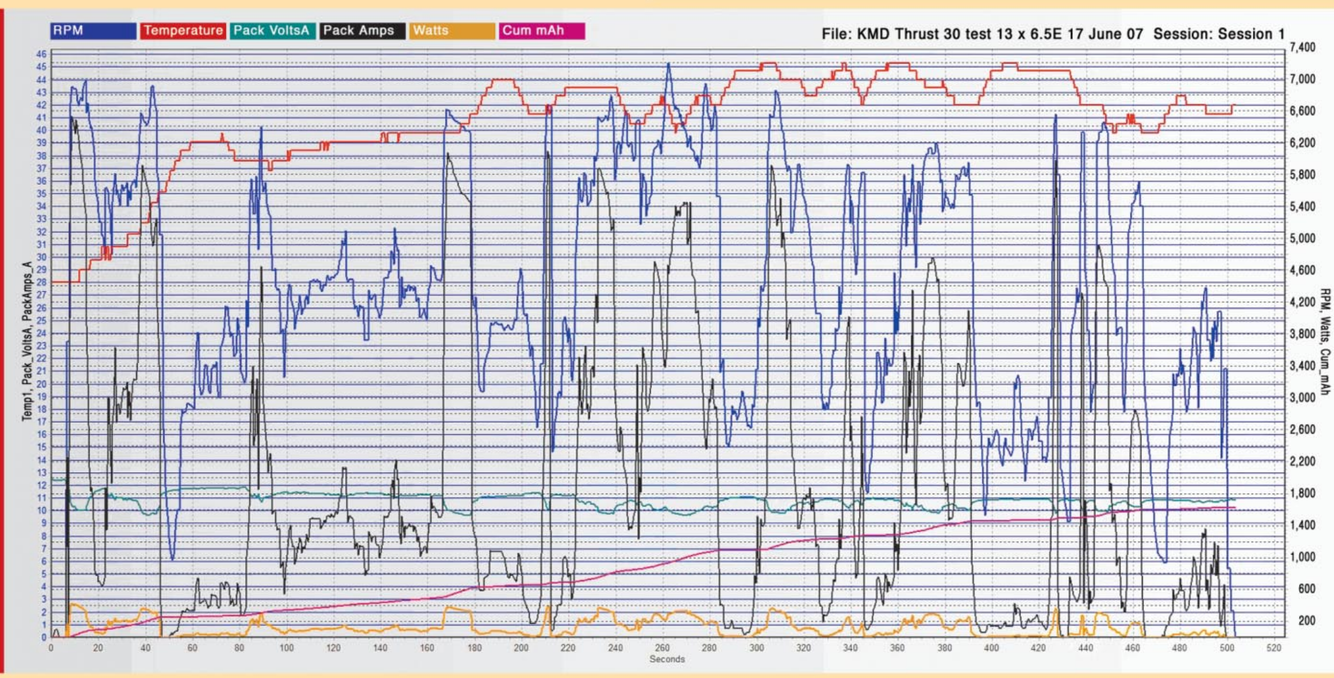
be a very good setup. The AWT came out close to spec and the KMD flew like "as seen on TV" and I was delighted at the outcome but was still very curious about their iPAs stating that the gear was exhaustively tested on the specific airframe to attain an optimum combination. I was quite curious to know as to how far off be my setup in relation to the optimum specified by PA. When PA recently launched their combo deal plus free global shipping, it was very hard to resist and I got one along with the PA2200mAh, 18-30C Lipo pack to test things out, just to find out if there are any significant difference in performance with the ancillary drive gear beyond the motor.

Prior to receiving my new PA gear, I used EagleTree Micro E-logger to take flight data logs of my previous setup to establish a baseline of my current performance. Motor Temperature, RPM, Current, Pack Voltage and cumulative milli-Amps were logged for each flight with a flight time set for 8 minutes. The same would be done for the new gear from PA as I plan to push both gears really hard without the risking unwanted LVC.

The KMD is also flown with the average 3D/Freestyle manoeuvres consisting of harrier rolls, hovers, torque rolls, knife edge, snaps, water falls, inverted harriers, up-right harriers, inverted and upright spins and walls since this was the intended flight performance of the KMD and how it should be flown.

Should Work Versus Optimum

Gear	Old Gear	iPAs Gear
Motor	PA Thrust 30	PA Thrust 30
ESC	Castel Creations Phoenix 35	PA Quantum 40
Lipo	JAS 3S1P, 2300mAh, 20C (158gr) 4 weeks old	PA 3S1P, 2200mAh, 18-30C (150gr) 4 weeks old
Props	APC 13X6.5E	APC 13X6.5E
Connectors	Deans Ultra	Deans Ultra
Prop Adapter	PA German Prop Adapter	PA German Prop Adapter
Receiver	JR 610M	JR 610M
Antenna	Deans 2 piece Base loaded	Deans 2 piece Base loaded



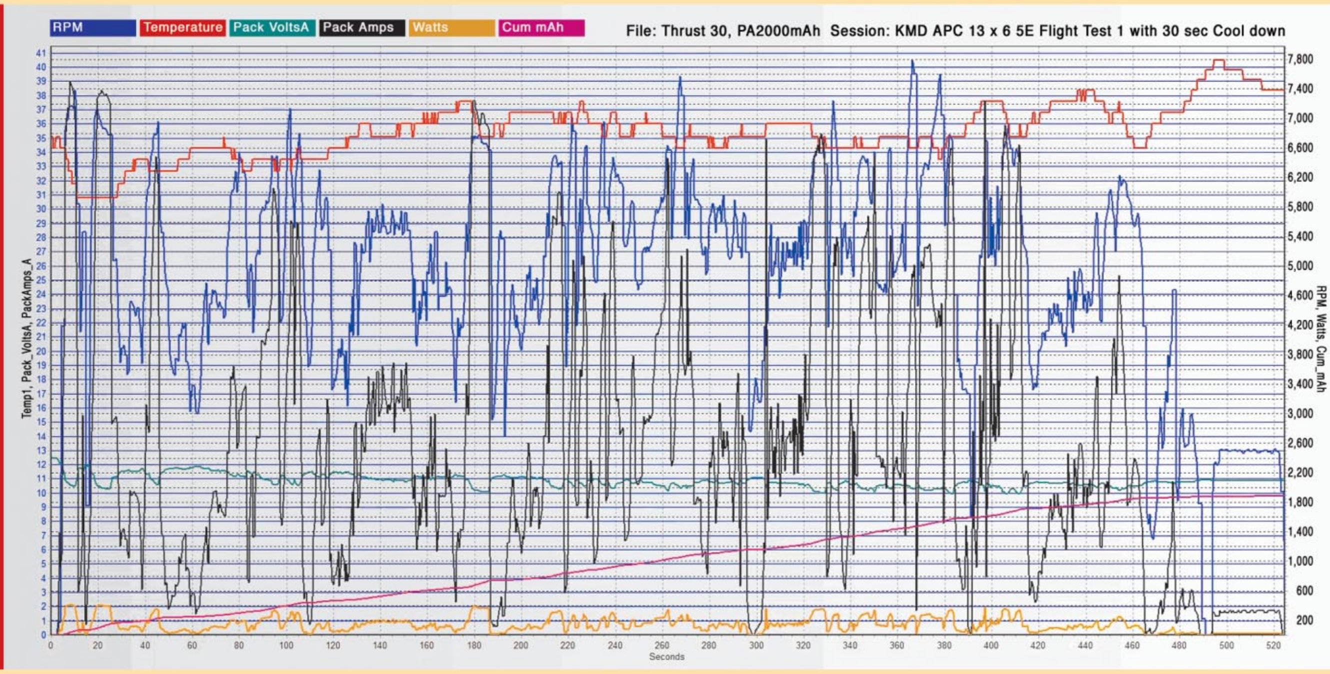
Graph 1: Should Work Setup:
(Thrust 30, CC35A, JAS 3S1P, 2300mah, 20C, APC 13X6.5E, Katana Midi @ 33oz)

Graph Comparison

Data	Graph 1 (Old Gear)	Graph 2 (iPAs Gear)	Remarks
Motor Coil Temperature (During flight)	37-45O C	32.5-37.7O C	Quantum 40 provides cooler running temp, i.e. lower losses in-spite of starting with a higher ambient air temperature of 31O C.
Motor RPM (Max)	7190	7792	More thrust & power delivered to the motor with iPAs setup. iPAs setup feels considerably more punchy.
Motor Current (Max)	41.58A	39A	Less efficient running on old setup drawing more amps with less rpm.
Input Watts	429.52W	413.4W	Old setup appears less efficient and consumes more power but lower output evident by prop RPM.
Battery Voltage (min)	9.61V	9.94V	PA2200 offers better sustained voltage.
Cumulative mAh	1702mAh	1885mAh	PA 2200 appears to be able to deliver more stored energy and voltage appears to stay stable for longer before LVC kicks in.

Notes: iPAs gear shows a performance increase in actual flight. Actual feel when flown with an APC 12X6E felt very close to the old gear flown with a 13X6.5E.
Lipo packs felt cooler after the flight and less noticeable reduction in power at the 8 minute mark.

Graph 2: Optimum Setup:
(Thrust 30, PA Quantum 40A, PA 3S1P 2200mAh, 18C-30C, APC 13X6.5E, Katana Midi @ 33oz)

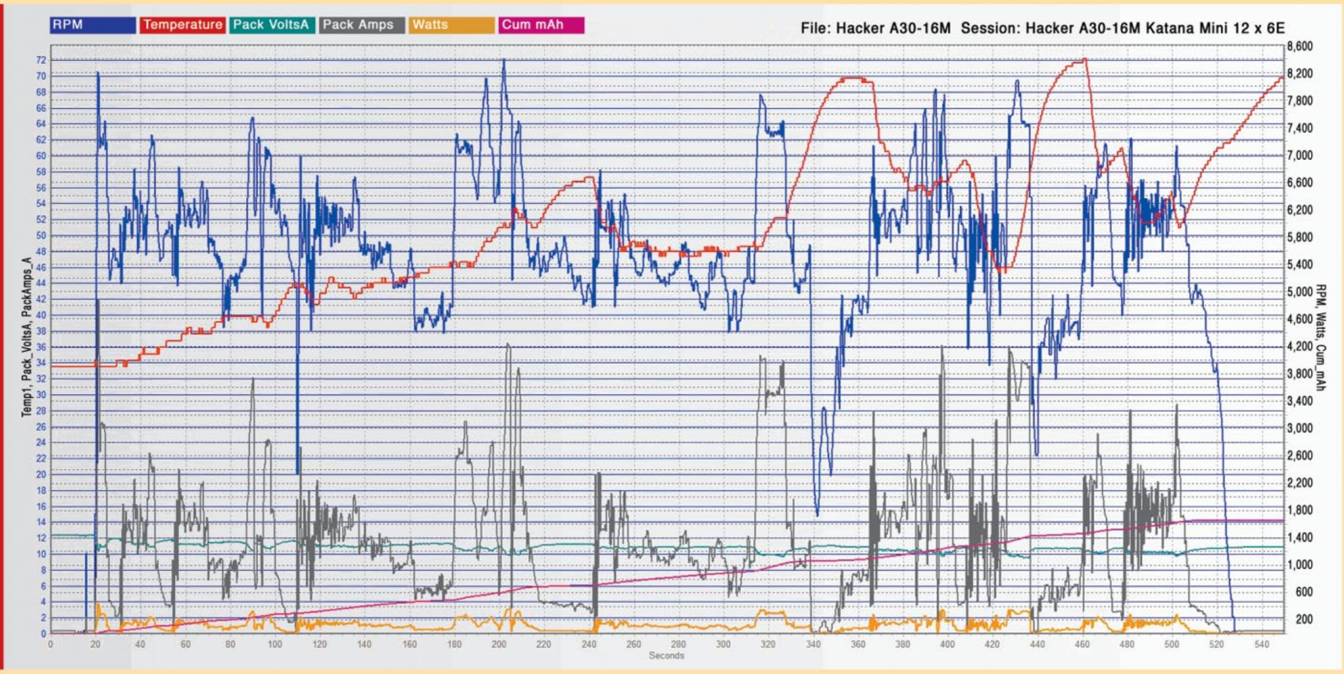


Static Bench Test Results

Data	Graph 1 (Old Gear)	Graph 2 (iPAs Gear)	
Motor RPM (Max)	7095	7142	Static Bench Test
Motor Current (Max)	37.94A	40.15A	Data indicates very
Battery Voltage	10.47V	10.47V	little performance
Input Watts	397.23W	420.37W	difference between
Thrust	68.96oz	69.92oz	iPAs and Non-iPAs
Horsepower @ the Prop	0.474hp	0.483hp	on the bench.

It is very interesting to note that although the static bench test results appears to be relatively close, the dynamic test results shown on the graphs clearly indicates the difference in actual flight. This indicates that the traditional method of using static bench test results alone is not necessarily a definitive indication of the drive's performance because evidence shows that it does not reflect what is actually happening in flight, and what actually happens in flight matters the most and therefore can not be accurately simulated on a bench. As such static bench test either conducted on the bench or derived from computer aided applications appears to have some limitations.

Graph 3: Non-RotorKool™ Controlled Experiment:
(Hacker A30-16M, CC35A, JAS 3S1P, 2300mAh, 20C, APC 12X6E, Katana Mini @ 29oz AWT)



Graph Comparison: RotorKool™ Versus Conventional

Data	Graph 1 PA Thrust 30	Graph 3 Hacker A30-16M	Observations
Prop	APC13X6.5E	APC 12X6E	12X6 is the A30-16M's max limit to provide equivalent load to the Thrust 30.
ESC	CC35A	CC35A	Same ESC Settings
Battery	JAS 2300mAh 20C	JAS 2300mAh 20C	Same Lipo Packs used
Motor coil Temperature (During flight)	37-45O C	48-72O C	The Thrust 30 RotorKool™ clearly shows the cooling effectiveness. The operating temperature difference is about 27 Deg C and the range within the oscillations is considerably smaller indicating some form of temperature control mechanism being applied to manage overheating.
Motor RPM (Max)	7190	8403	Difference in RPM due to different prop sizes being applied.
Motor Current (Max)	41.58A	41.98A	The Thrust 30 pulls slightly less current in-spite of a larger prop.
Input Watts	429.52W	442.05W	The Hacker A30-16M appears less efficient. 12.53W wasted as heat.
Bench Test Static Thrust	68.96oz	58.72oz	Both provide approximately 2:1 Thrust to weight ratio on respective airplanes and prop used to level the playing field.

This also helps answers as to why there was a performance difference noted between my "should work" set up versus the optimum recommended by PA and finally tells me how far I can only go with computer aided drive prediction applications.

Testing the Effectiveness of RotorKool™:- How cool is cool?

In order to find out the effectiveness of the PA Thrust 30,s RotorKool™ features, I used an equivalent 100gr class Hacker A30-16M on its max prop of 12X6E with the same ESC and motor used in Graph 1, (i.e. Castle Creations Phoenix 35A and JAS 3S1P 2300mAh, 20C pack) in order to keep the playing field level as best I can. This was flown on a smaller and lighter Katana Mini to balance out the prop size limitations imposed by the motor. Please refer to the graph for the temperature trace and compare to the table using the same controller and Lipo packs. No changes were made to the ESC programming.

As observed from the temperature trace, the non-RotorKool™ equipped Hacker A30-16M operates at a much higher temperature while the range within the temperature oscillation are also much higher. The motor also appears to become progressively hotter. When compared to Graphs 1 & 2 the RotorKool™ equipped Thrust 30's temperature measurements appears to be relatively flatter with smaller oscillations and does not appear to be getting progressively hotter. This indicates that motor temperature is being controlled by the innovative High Velocity Force Cool Ventilation (HFCV) feature and kept within a small & stable temperature range. RotorKool™ also appears to help the motor operate at a much lower temperature which indirectly implies that the health of the neodymium magnets will be much better. Therefore, I would believe that the cooler running Thrust 30 could possibly provide a much longer and consistent service life in relation to a much hotter running motor.

Conclusion

From the graphs, it becomes obvious that the performance offered by the iPAs setup is superior to the "should work" mix and match setup as well as the importance of dynamic flight testing. The iPAs gear certainly appears to be optimally selected and provides the best performance as advertised. This also shows what could be achieved out of a non-iPAs, semi-iPAS and full iPAS setup.

I am convinced that the iPAs setup provides the best option for any modeller to attain optimum performance. The plus side with the iPAs option is that it allows any modeller to attain the best performance without the need to undertake an extensive and complicated drive selection process. This appears to be truly performance out of the box and I would highly recommend the iPAs option.

The iPAs components are available directly from Precision Aerobatics and from good hobby shops around Australia. For more details visit PrecisionAerobatics.com or call 02-9558 0443.