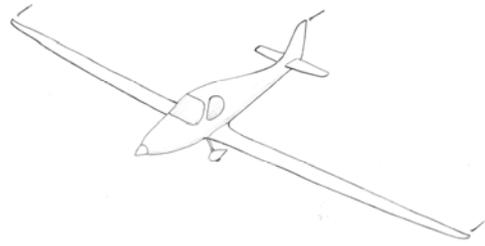
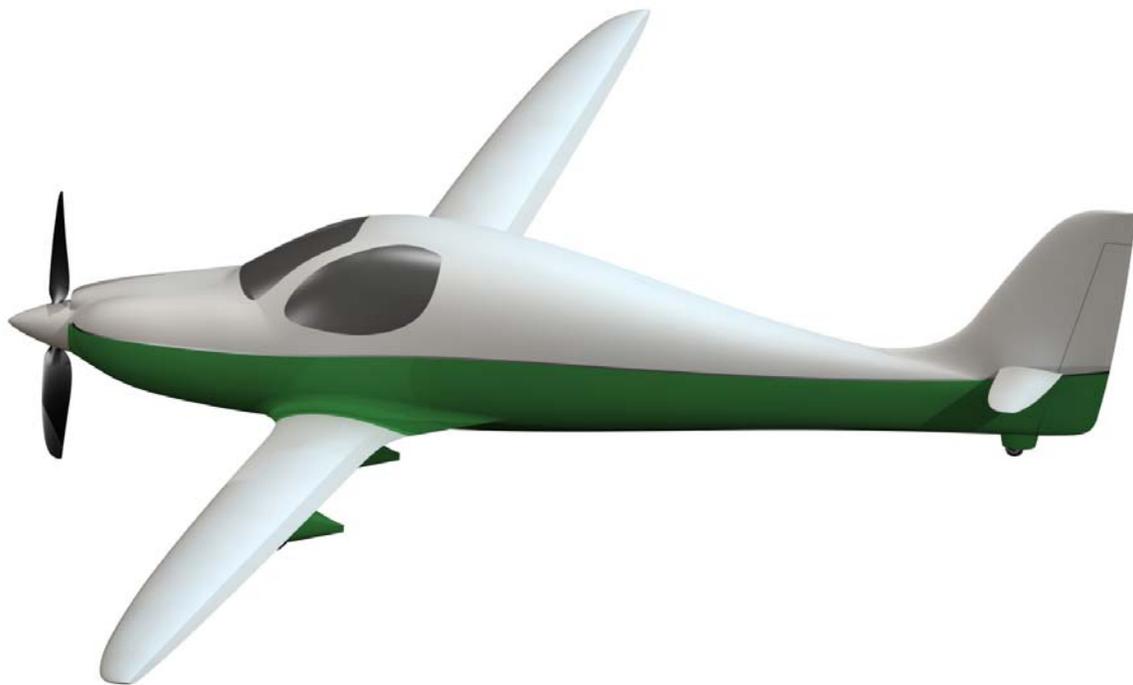


Windward Performance Ltd

GosHawk Electric



The GosHawk Electric is a two seat, side by side, conventional configuration aircraft. There the conventional ends. It incorporates a very sophisticated wing design incorporating the highest performance form from racing sailplanes. The long, nearly 51 FT, span gives the aircraft very low induced drag. Advancements in aircraft design have produced airfoils of exceptional performance, utilizing flaps for a broad speed range. Carbon fiber prepreg construction provides strength and stiffness with light weight with performance well beyond conventional room temperature cured carbon composite structures.



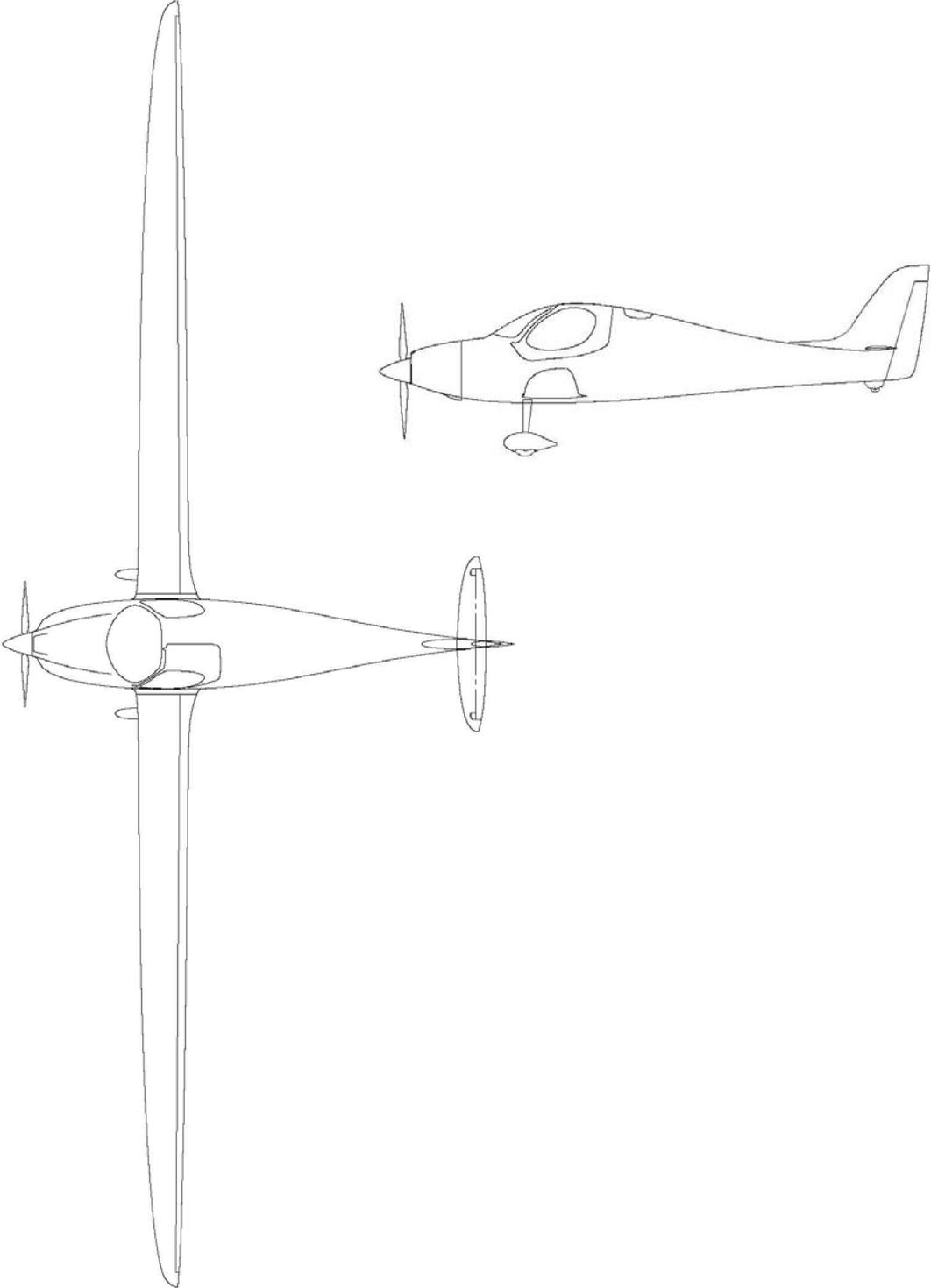
GosHawk Electric Specifications

The 40 kW motor provides more than adequate thrust for takeoff and climb, 1000 FPM at 900 LBS, while allowing efficient cruise at 54 KTS with only 3.3 kW of power (out motor shaft). Low noise is a design requirement and is achieved by low tip speeds and an advanced specially designed propeller. (**Note 50 kW motor is also available*)

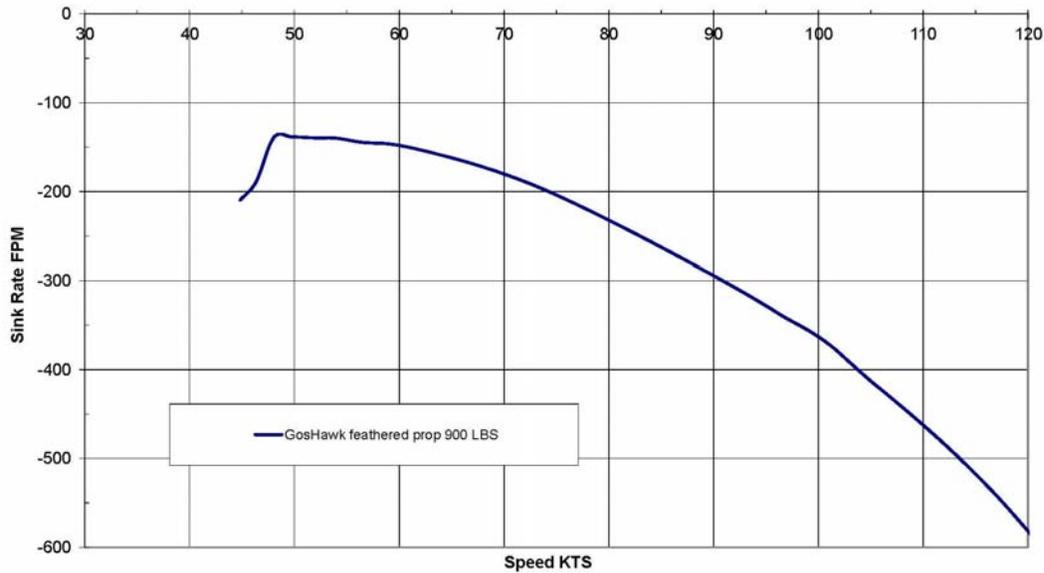
GosHawk Electric	
Wing Span	50.83 Ft
Wing Area	83.6 FT ²
Wing Aspect Ratio	31
Horizontal Span	6.5 FT
Horizontal Area	7.5 FT ²
Vertical Height above ground	4.55 FT
Vertical Area	17.9 FT ²
Length	21 FT
Gross Weight	1200 LBS
Empty Weight	720 LBS
Battery Capacity	12 kW hrs
Prop Diameter	60 INCH



The configuration of the GosHawk Electric is shown in the following two view drawing.



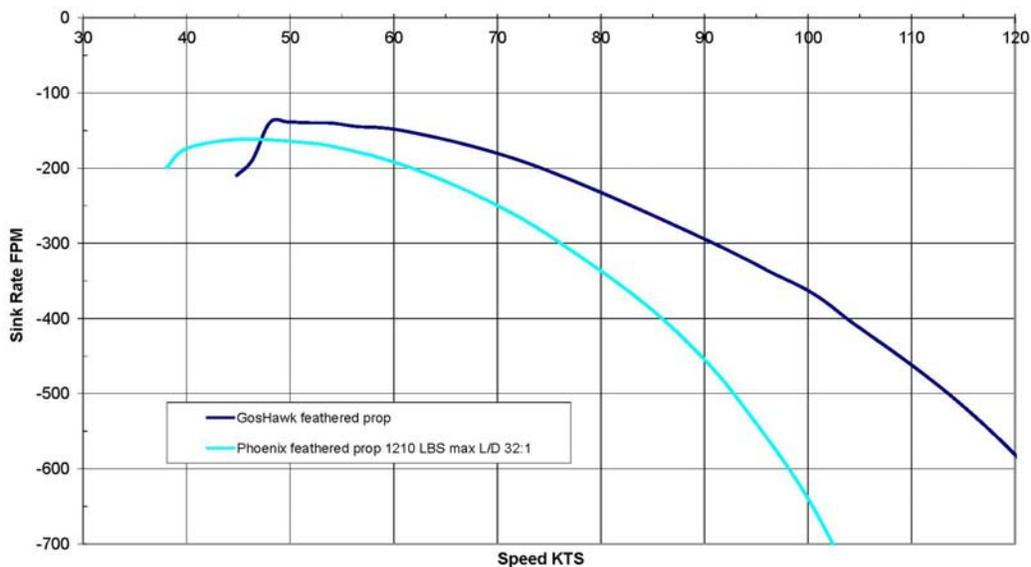
GosHawk Glide Polar



The GosHawk Electric glide polar is shown above in a feathered propeller configuration (approximately 90 DEG blade pitch and zero to near zero rotational velocity). This polar depicts a glider with quite good soaring performance. The degree of that performance will be explored by comparing GosHawk glide (and augmented glide) polars to other soaring aircraft. Soaring is an important element of the GosHawk Electric flight concept, allowing for greatly extended flight durations and distances and for gaining energy with regeneration.

How does this gliding (feathered propeller) polar compare with an existing modern motorglider? That polar comparison follows.

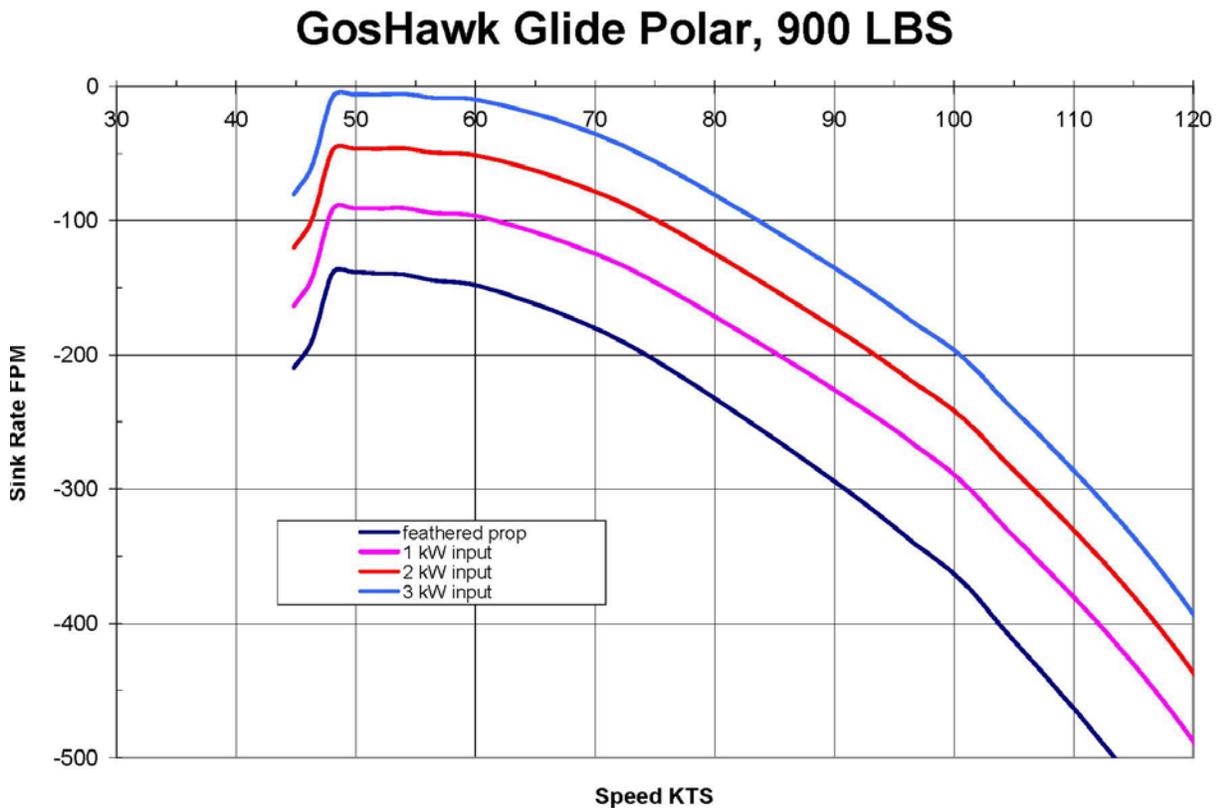
GosHawk Glide Polar, 900 LBS



This comparison of two side by side seating motorgliders strongly favors the GosHawk.

If the throttle is pulled all the way back the power is off. If the throttle is pulled to idle or near idle and the propeller is set for constant speed operation (propeller pitch adjusted to maintain a set RPM) regeneration will occur during flight. If the propeller is set for feather the rotation will stop, or very nearly so. This feathered propeller configuration may be the only one you have considered for soaring flight.

During soaring flight the motor does not need to be off with the propeller feathered. Application of small amounts of power to the propeller changes the glide polar of the GosHawk and this is shown in the following figure. Note that three of these curves represent the application of power to the propeller (power out of the battery will be greater due to losses in the motor, controller, and belt reduction). The bottom curve is for that feathered propeller configuration.



The best glide ratio for these curves is as follows.

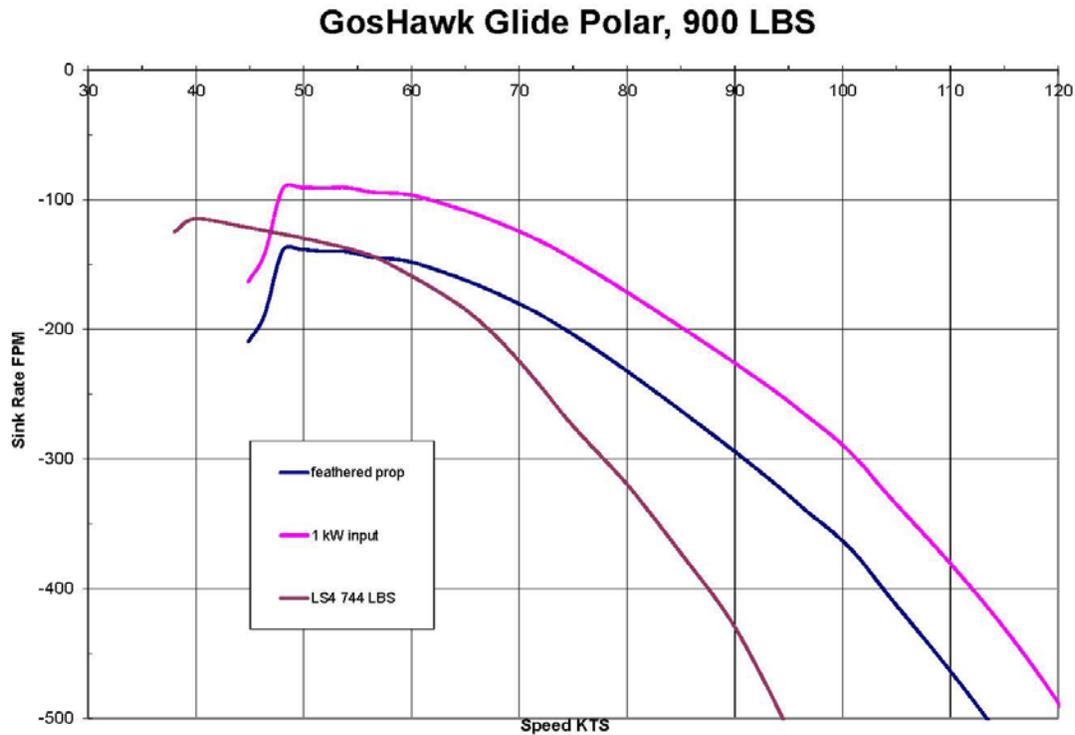
Feathered propeller gives 40 to 1 at 59 KTS

1 kW propeller power input gives best glide of 62 to 1 at 59 KTS

2 kW propeller power input gives best glide of 119 to 1 at 59 KTS

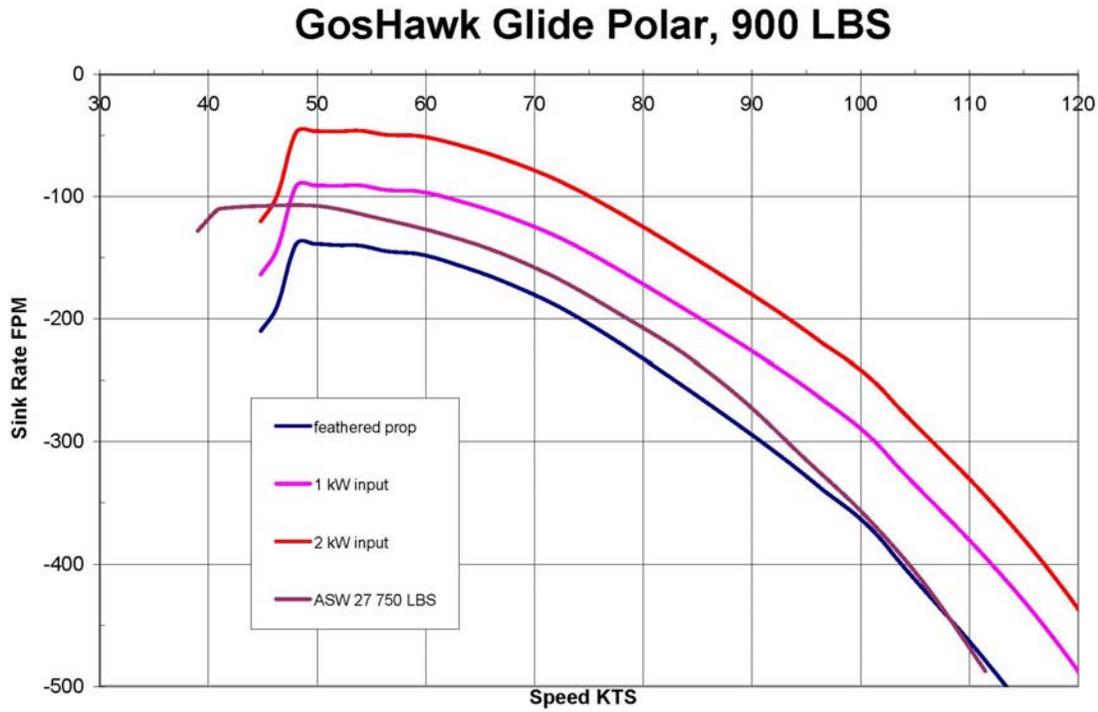
3 kW propeller power input gives best glide of 991 to 1 at 54 KTS

GosHawk feathered propeller and "powered" glide polars on the same graph with common sailplanes makes for some very interesting comparisons.



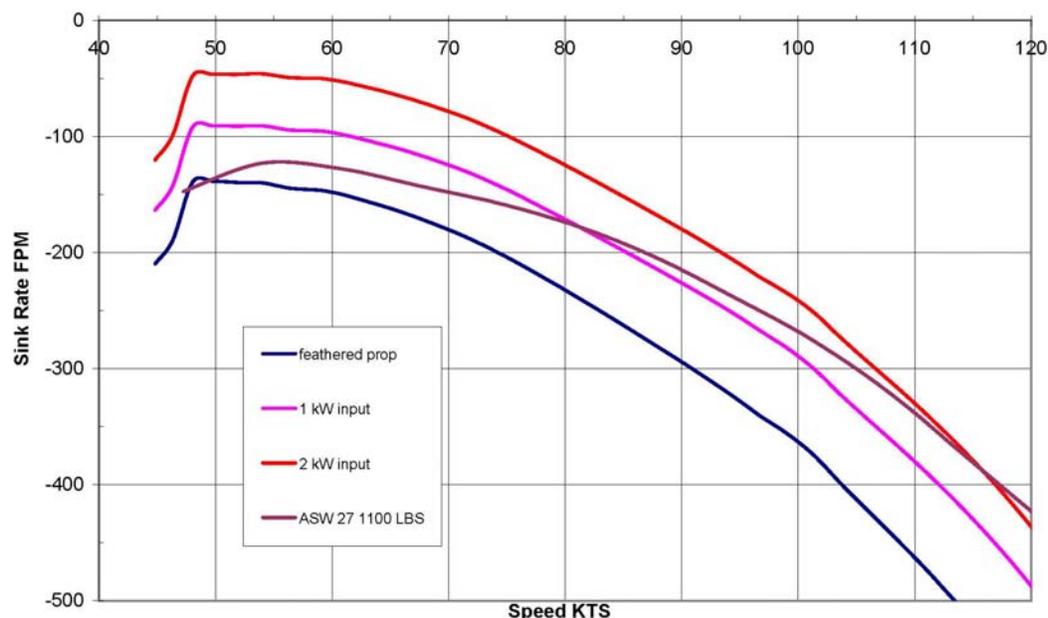
The LS4 is a very well known and respected standard class sailplane (pure sailplane i.e. unpowered). Use of a small amount of power allows the GosHawk to greatly outclass the soaring performance of this pure sailplane in both climbing and gliding. Granted the LS4 is an old design, and one without camber changing flaps.

How does the GosHawk compare to higher performance sailplanes? A comparison to a perennial championship level 15 m racing sailplane, the ASW 27 is shown below.



Now you might ask for a comparison to a 15 m racer that is ballasted up to a high weight to push the polar, biasing it for lower sink rates at higher airspeeds. Here is the comparison to an ASW 27 at 1100 LBS.

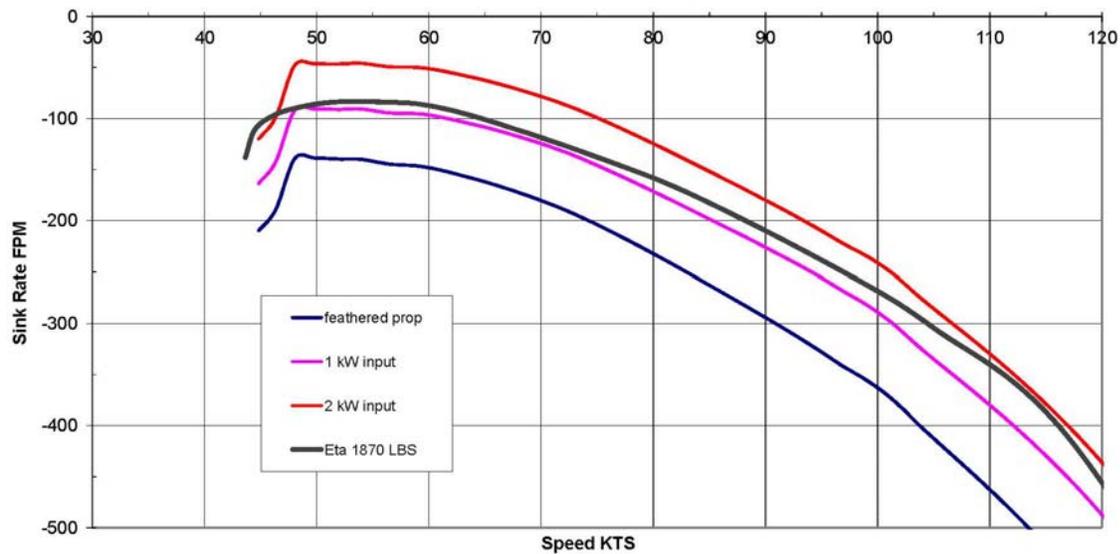
GosHawk Glide Polar, 900 LBS



Use of just 2 kW of shaft power into the propeller allows the GosHawk to match or exceed the performance of a fully ballasted 15 m racer all the way up to 115 KTS. It seems that an electric GosHawk running this small amount of power, something it can do for hours, would consistently allow for soaring flights of 500 km, 750 km, and even 1000 km, just like the high performance sailplanes do.

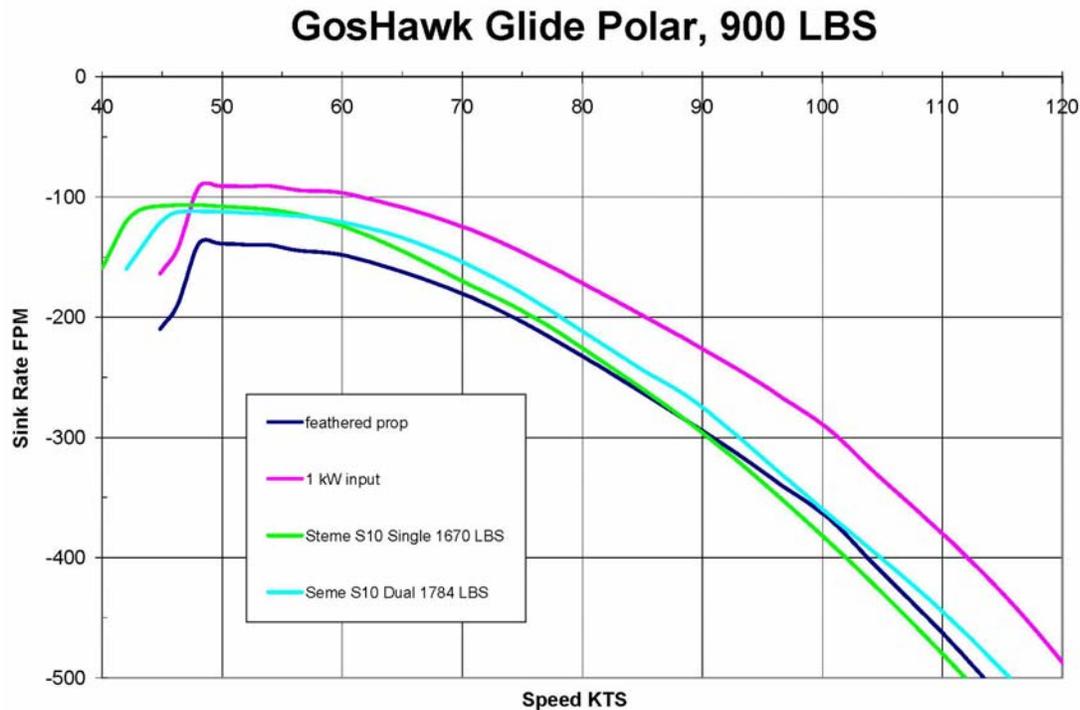
Crafty sailplane pilots know that the highest performance at very high speeds is accomplished by those heavy 15 m racers. At slightly lower speeds the open class sailplanes have phenomenal performance. How does the GosHawk compare to the open class aircraft? How does it compare to one of the most advanced (largest at least) open class sailplanes ever made called the Eta?

GosHawk Glide Polar, 900 LBS



The GosHawk seems very comparable at low speeds with 1 kW of shaft power and equal to or better than the Eta at high speeds 2 kW of shaft power. It might be useful information to point out that the Eta has a wing span over 100 FT and is reported to have cost around 1.6 million dollars each. Surly an interesting point but you can not buy one new. We might be so bold as to say that any non boundary layer control sailplane built in a large size (new design or modified with say a new wing) will not perform much better than the Eta (comparing the straight flight glide polar). The Eta did not prove itself to be faster than existing smaller open class sailplanes in soaring flight. Long wingspan is a hindrance in circling flight and in handling characteristics, let alone the takeoff, landing, and assembly / disassembly concerns.

Perhaps the GosHawk is being compared unfairly when cost is a consideration. It certainly costs more than an LS4 and even an ASW 27 (both only available as used). The GosHawk is much less expensive, and likely much more reliable, than the Stemme S10. How does assisted glide allow it to compare with this large two seat, also side by side, super sailplane?



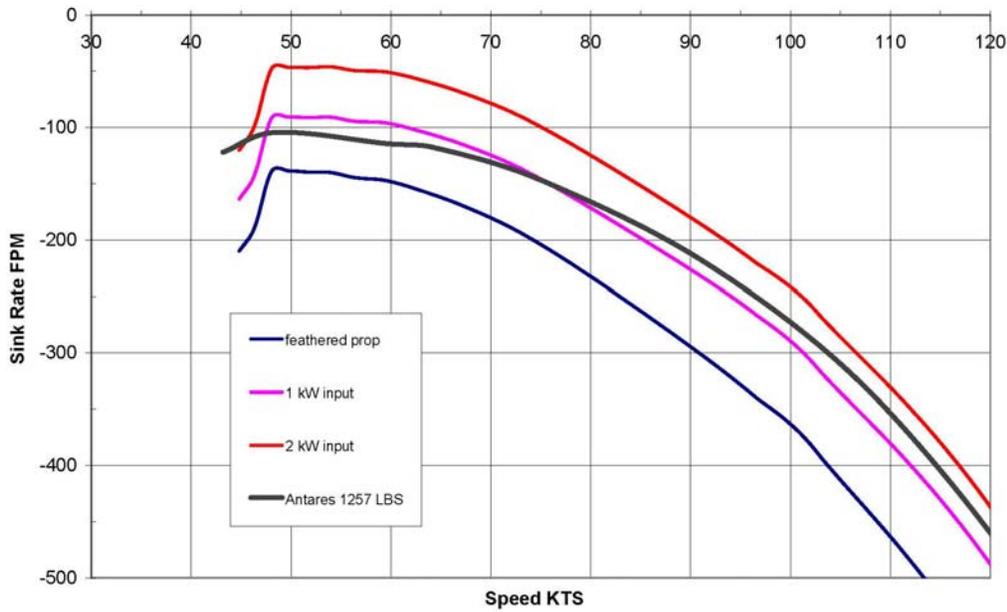
The GosHawk seems to compare very favorably with this aircraft as performance goes (when using an electric power assist). They are also very comparable in the overall sense as both are self launching.

A few electric self launching sailplanes have been made. To list a few, the group includes the Silent, Apis, Taurus, Antares, Arcus, Mini LAK, and GP 14. In this group perhaps only the Antares was produced in any numbers, followed by the Silent and Taurus. A few other have been made as one offs like the special E Phoenix and maybe a Viva. Most of these are pylon systems. The E Phoenix, Silent, and Mini LAK have tractor nose mounted propellers. Eric Raymond has built a couple of very interesting electric sailplanes. The SunSeeker I and II made many flights. They were electric with small batteries and solar cells. He followed this accomplishment with the SunSeeker Duo, a two seat self launching electric solar aircraft! The sailplanes with the pylon mounted propellers are draggy with those self launching systems deployed and this makes the option of running low powers into the propeller to enhance gliding performance unprofitable. They do make good clean sailplanes when those pylons are retracted.

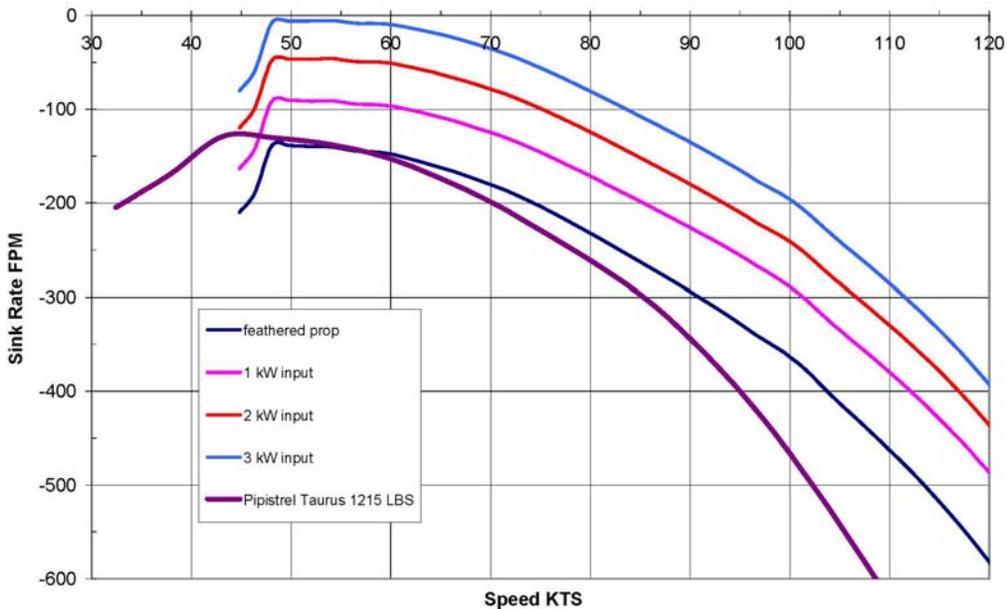
The Antares company has made the claim that this sailplane has the highest performance ever measured for a sailplane. The Taurus is a two seat side by side

configuration with 15m wingspan so it is very comparable to the GosHawk in seating and wingspan. These two polars follow overlaid with GosHawk polars.

GosHawk Glide Polar, 900 LBS



GosHawk Glide Polar, 900 LBS



The use of regeneration during periods of high soaring lift is possible. Using this wind turbine regeneration process for about 30 minutes of regeneration with a 400 fpm increase in sink rate will put 1kW HR back into the battery pack. Remember you get to

do this in the best lift of the flight, not the worst. When it comes to areas of lighter lift or areas of sink just use the motor and jump ahead to better conditions (lift).

Electric Propulsion and Energy Storage System

GosHawk Electric at 900 LBS flight weight and 11.4 kW HR battery

Flight Condition	Power Settings (kW)	Energy Used (kW HR)	time	Details
TO / Climb	37 out of battery 31.4 into prop	2.5	4 minutes	1000 FPM climb rate at 73 KEAS This is 40 SHP @ 2000 PRPM into the propeller Beta (.75R) = 23.7 DEG
Cruise (level flight)	5.0 out of battery 4.3 into prop	7.5	1.5 HRS	73 KEAS (84 mph) 110 nm or 126 statute mile range plus glide to landing 5.45 BHP @ 960 PRPM Beta (.75R) = 35.6 DEG
Reserve	4.2 out of battery 3.5 into prop	2.1	30 min	63 KEAS is max range speed 4.2 kW out of battery 3.5 kW into propeller 31 nm range 4.5 BHP @ 950 PRPM Beta (.75R) = 32.2 DEG

Alternate Performance Points that may be of interest are in the following table.

Flight Condition	Power Settings (kW)	Details
Fast Cruise	7.52 out of battery 6.36 into prop	90 KEAS 101 KTAS at 8,000 FT ALT ISA
Economy Cruise	4.18 out of battery 3.54 into prop	63.2 KEAS, max range speed 71.2 KTAS at 8,000 FT ISA
Max Speed	39.3 out of battery 33.3 into prop	174.6 KTAS (200 mph), SL ISA Beta (.75R) = 37.6 DEG
Max Speed at altitude	44.0 out of battery 37.2 into prop	174 KEAS 197 KTAS at 8,000 FT ISA
Fast power assisted glide 103 KTS	2.46 kW out of battery 2 kW into prop	39:1 glide Propeller efficiency = 84.8 % 2.68 BHP at 750 PRPM Beta (.75R) = 48.2 DEG
Fast power assisted glide 80 KTS	1.23 kW out of battery 1 kW into prop	47:1 glide Propeller efficiency = 84.3 % 1.34 BHP at 710 PRPM Beta (.75R) = 42.6 DEG