No. 373 AUGUST 2017

T.W.I.T.T. NEWSLETTER

This is from the TWITT web site and is included as a reference to a couple of letters on page 2. I have enlarged it so you can make a better comparison of the two aircraft in question.

T.W.I.T.T.
The Wing Is The Thing
P.O. Box 20430
El Cajon, CA 92021

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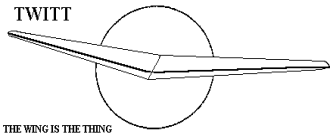

THE WING IS THE THING (T.W.I.T.T.)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with The Hunsaker Foundation, which is dedicated to furthering education and research in a variety of disciplines.

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Wt/#Issues	FRG	AUSTRALIA	AFRICA
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Meetings are held on the third Saturday of every other month (beginning with January), at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive (#1720), east side of Gillespie or Skid Row for those flying in).

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PRESIDENT'S CORNER

Just in as I was putting together this issue is a fantastic announcement outline on page 3. It looks similar to the PUL 10 and that design had some to do with this new USA effort. They are located in Tomball, TX, which is about a 3-hour drive for me from Austin so I will plan a future trip to get a first hand look at their progress in the coming months.

This month see the finishing page of Phil Barnes' High Efficiency Electric Flight article. I hope everyone enjoyed it even though it was spread out over several months. My thanks to Phil for providing it to our members along with other associated groups interested in the development of electric flight.

There is still time to make arrangements for attending the Experimental Soaring Association's Western Workshop over Labor Day weekend at Mountain High Glider Port in Tehachapi, CA. I haven't seen the speaker schedule yet but I am sure Al Bowers has assembled a great line-up of speakers and topics relating to soaring and aircraft in general.

I hope everyone is enjoying the soaring season or good flying weather for you power only pilots. Please keep me informed of any great flights or interesting destinations we can share with the members.

LETTERS TO THE EDITOR

Hello Andy,

One of the commenter's to *this* article (see: http://spaceflightnow.com/2017/07/12/first-images-of-jupiters-great-red-spot-reach-earth/) about the Juno spacecraft's *very* close pass—with its JunoCam taking pictures—above Jupiter's Great Red Spot (a storm wider than the Earth!) also posted a link to another interesting (and illustrated) website (see: http://what-if.xkcd.com/30/), which answered an unusual—but not silly—aeronautical question:

"What would happen if you tried to fly a normal Earth airplane above different Solar System bodies?" The answers are entertaining and detailed (and are backed up by simulation runs using the "X-Plane" software [see: http://www.x-plane.com/]); they shed light on the design challenges facing the designers of aerobot flying probes to explore Mars, Venus, Saturn's moon Titan, and even the gas giant planets (Jupiter, Saturn, Uranus, and Neptune). Their example Earth airplane was a Cessna 172, outfitted with an electric motor and lithium-ion batteries (due to the lack of oxygen—or sufficient oxygen—for a gasoline engine in the atmospheres of the other worlds) and with a life support system for the pilot. (The results certainly suggest that in most cases, sailplane-type airframes—including of the tailless and flying wing varieties—would fare much better than their example aircraft.)

Jason Wentworth

Hi Andy

Any way Thanks for the inclusions - a quick glance at the first one was an oooooo nice - twice, - and I havn't finished it...

You do manage to dig up a lot of interesting stuff.
I don't know if you know, but movements are afoot to build a dedicated Hangar for the be all and end all of flying wings - that entered service - The Vulcan, at its old cold war base of Finningley (Now called \Robin Hood Doncaster Airport). I lived 5 miles from there, and remember the big white tin triangles floating around the place - mainly on Finals.
After 8 years of post restoration flying, she is now restricted to (loud) ground runs and fast taxis :-(. Sic Transit Gloria Mundi - sigh.

The new hanger will be right alongside the sewage farm, but will be an innovative design (hope it works in the long term).

I'll drop you a link if you are interested.
Chins and all the best.

Mike Briggs

Andy,

The Backstrom Plank plans thread in the May issue of the newsletter was of particular interest to me because about 2 years ago I contacted the VSA regarding the availability of the EPB-1 plans. The response I got was the same as what the other writers reported (and which you reprinted). It made no sense to me....if there are liability concerns about the Plank plans, it would seem that there should be liability concerns about the other plan sets for sale as well. I found the response to be completely inadequate and more of an excuse than an explanation.

My interest in the plans is not to build a full-sized aircraft, but rather a scale RC model. Yeah, there's a kit available from an outfit in Ireland, but it is fairly expensive. Its also the EPB-1C version, not what I'm looking for.

The other reason for writing is to tell you about an article I found in a back issue of Model Builder magazine, April, 1981. Dave Thornburg wrote an article about his adventures in building and flying two RC models of the Backstrom Plank and some discoveries about CG location. I'm attaching the appropriate parts of the article for your review.

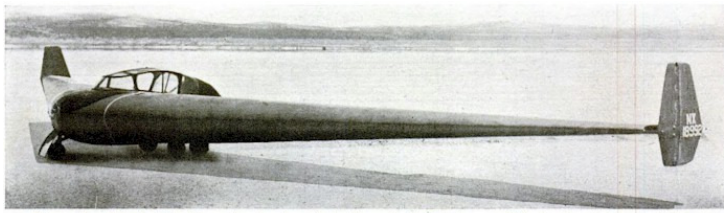
Now, if you'll excuse me I need to get back to work on my Peck Polymers Genesis.

Rod Lord

One of the guys on HBA found this in the March 1948 issue of Flying. Looks a lot like the Bowlus mystery wing shown at
http://www.twitt.org/bowluswing.htm#top

Norm Masters

This Discussion Thread: The design of a tailless flying wing is a link to an online conversation with Norman



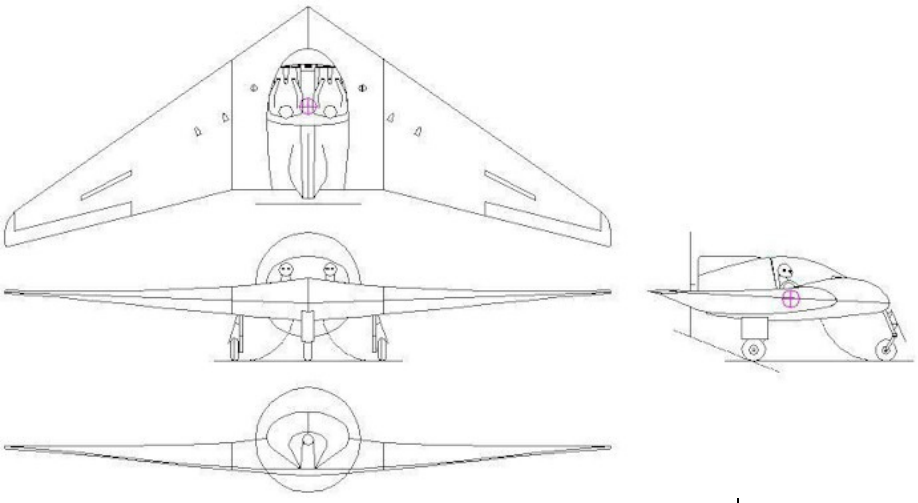
Flying wing glider is Mitchell Superwing, two-place side-by-side craft with 50-foot span. Glider has been tested extensively and now has engine attached to make it powered plane, cruising at 79 m.p.h., landing at 28 m.p.h. As glider it has glide ratio of 35:1.

Masters about a picture I stumbled across while reading through old issues of Flying Magazine. It is a picture of NX18992 which according to your Mitchell history page was completed in 1946, but it appears to be identical in every way to the fuzzy picture of a large flying wing on your Bowlus wing page. Norman thought you might be interested in this information; below is the pic and a link to the source:

Bret S

(ed. – I am not sure if the picture above and the flying wing in the background of the TWITT image are the same aircraft. This one doesn't have the dropped ailerons and the airfoil is much thicker. If anyone has more definitive information please speak up.)

Good day. My name is Brian Link. I am the Technical Director for L:V Aeronautics. We are a new company whose goal is to advance the state of the art in light aircraft design. Your organization might be interested in an aircraft we just completed engineering work on,



and as of this Saturday at about 7:30am, will be commencing construction on the first prototype.

The LV-13X "Phoenix", once proven, will be marketed as a kit, and will be the first all wing light sport aircraft to hit the market!

Attached is a basic 3-view and a general data sheet for the Phoenix. It is a modernized and improved version of the Horton Aircraft GmbH PUL-10 (whose group was involved in the design of the Phoenix in a limited capacity).

It has been a project in the works for quite sometime, and we are even more glad to have received the full support from folks like Bernhard Mattlener and others out in Germany. The funny fact behind this aircraft is that it started out as a sketch on graph paper when I was a full-time flight test engineer on the V-22 Osprey way back in 2008, inspired by my graduate studies that effectively centered on all wing aircraft! Basically, our design builds from the lessons learned from the PUL-10 and some other designs. We are hoping this aircraft will satisfy the demand and interest that the PUL-10 generated.

It's composite design and build is very similar in principle to Cozy's and Long EZ's. During my research, I tried reaching out to Rod Schapel about his SA-882 project, but never received a response...

Our build timeline, once we get going to full speed on it, is projected to be about 12 months...hopefully sooner! That being said, we are on the lookout for a Rotax 912, so if you know of anyone out there trying to unload one, I am all for taking a look!

If you wish to speak by phone sometime, my number is 803.630.7870

You are more than welcome to post our email to the membership if anyone is interested.

Also, I discovered during my time living in Germany that I am a distant blood relative of the Horten family!

I am very interested in joining your organization, and wanted to make sure you're still up and running. Thank you for your time, and have a great weekend.

Respectfully,

Brian Link (XP/FTE/ATP/AMT)
L:V Aeronautics, LLC
www.lvaero.wordpress.com

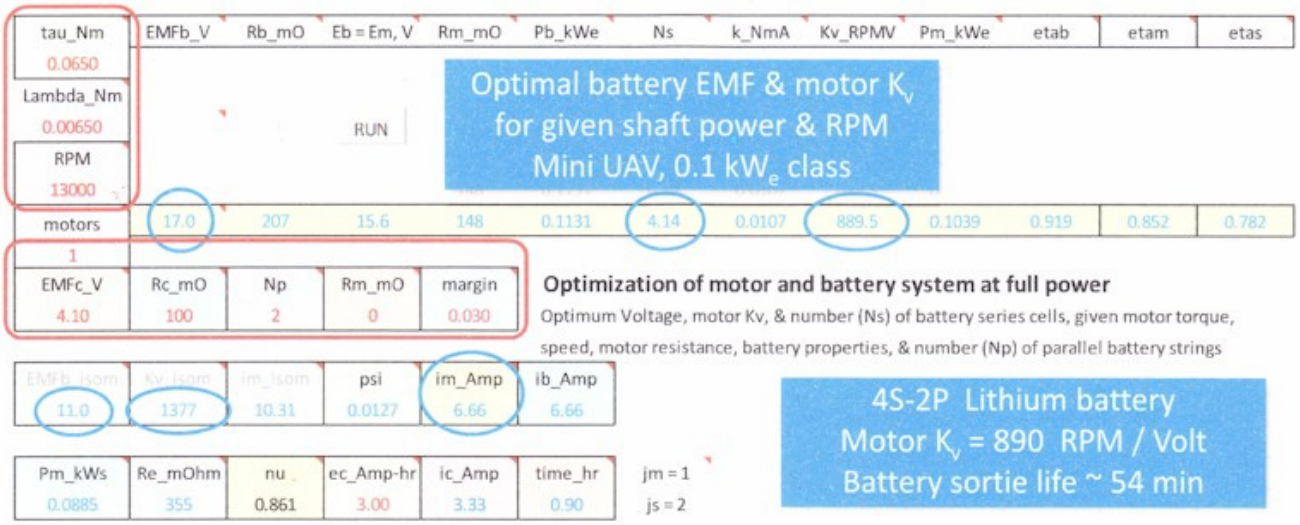


Figure 9. Full-power optimization of 0.1-kW$_e$ UAV electrical power parameters.

V. Power Conditioning: Substantial Losses of Main-current PWM

For a ground or flight electric vehicle, cruise torque is a fraction of full-power torque. In a popular method of reducing power, pulse-width modulation (PWM) is superimposed on the commutation wave (Figure 10) to "chop" the main current. For an electric aircraft, both speed and torque may be reduced for cruise as in the example of Figure 11, where the motor has 58% efficiency *when energized*. But when de-energized between power pulses, the motor continues to sustain windage, bearing, and magnetic losses. Here, neither motor alone nor ESC alone can be "blamed" for what becomes quite poor *system* efficiency as they operate together.

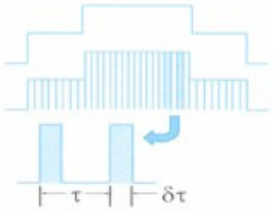


Figure 10. PWM cycle

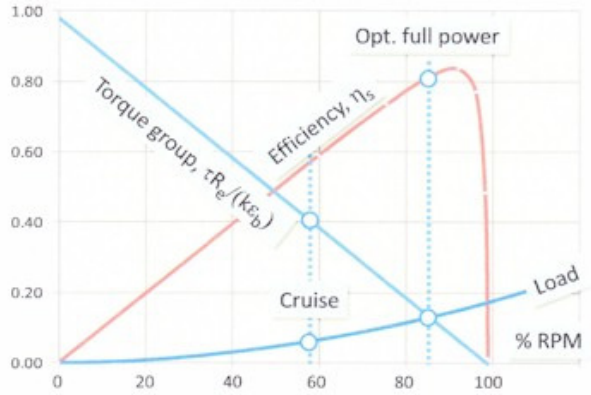


Figure 11. Torque and speed at cruise.

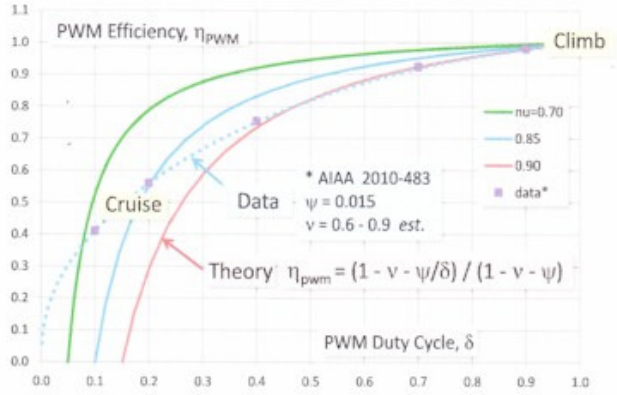


Figure 12. PWM efficiency, data and theory.

ESC power loss is the product of switching cycle energy loss (~100 μJ model scale, ~100 mJ sport scale) and switching frequency, typically of order 10 kHz. Chopping loss, perhaps 3% of power transferred, is unaffected by PWM "duty cycle," the fraction (δ) of "on" time. The ESC does not "control speed." It reduces time-averaged current, to which torque is proportional. In the example of Figure 11, the duty cycle will be about 1/7 to match motor and load torques at cruise. In effect, main-current PWM magnifies motor torque losses by the factor (1/δ).

Figure 12 shows data[3] and applies our Eq. (1c) to predict PWM losses as duty cycle is reduced. The theory ignores chopping loss. The data, which includes chopping loss, was taken by first driving a model-scale propeller at various voltages with unity duty cycle, then driving the same propeller at fixed voltage, reducing the duty cycle. The ratio of system efficiencies with/without PWM at each RPM was then correlated to duty cycle (dashed curve) in Figure 12. Such "PWM efficiency" represents a factor on the 58% energized-motor efficiency at cruise, returning to Figure 11.

VI. High-efficiency Power Conditioning with DC-DC Conversion

We showed in the previous section that main-current PWM imposes significant losses at cruise. But in an entirely different role, PWM proves essential to control voltage "buck" (step-down) or "boost" (step-up) in a DC-DC converter. In the *DC boost converter* of Figure 13, the duty cycle of the low-voltage PWM applied to the gate of the single transistor controls the converter voltage gain. A "similar" schematic would describe a DC buck converter. At least at sport-flyer scale, DC-DC converter efficiency (η_{DC}) is excellent (~97%) at all conditions[1]. Today's weight for a 30-kW integrated inverter-converter package is about 15-kg, and the associated volume about 3-liters.

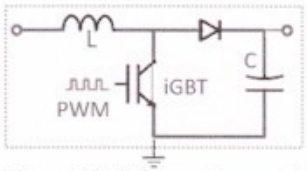


Figure 13. DC boost converter.

Earlier herein we optimized the system at full power. Now, we apply DC-DC conversion to "buck" motor terminal voltage at cruise, or to "boost" battery terminal voltage above its EMF for regen. In Figure 14, the DC-DC converter has a boost or buck voltage ratio $\beta \equiv E_m / E_b$. Our aim, given *full-power* optimal (k, ε_b), together with *cruise* or *regen* torque (τ) and speed (ω), is to determine the required (β) for cruise or regen. We first define (α_{DC}) as equal to converter efficiency (η_{DC}) for regen, or ($1/\eta_{DC}$) to motor. Eqs (4) then solve the quadratic equation representing the system which, in the example of Figure 15, consistently exhibits "good" system efficiency, per the objective of this paper.

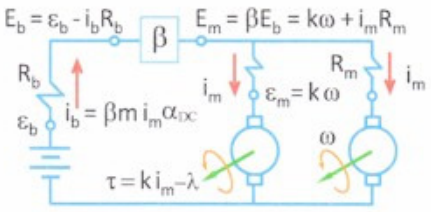


Figure 14. DC-DC converter Circuit.

$$\textit{Currents}: \quad i_m = (\tau + \lambda)/k\,; \quad i_b = \beta\, m\, i_m \alpha_{DC} \qquad (4a\,;\,4b)$$

$$\textit{Voltages}: \quad E_m = k\omega + i_m R_m = \beta\,(\varepsilon_b - \beta\, m\, i_m R_b \alpha_{DC}) \qquad (4c)$$

Quadratic Eqn; Motor: negative root ; Generator: positive root

$$z \equiv m\, i_m R_b \alpha_{DC} \quad ; \quad \beta = \frac{(\varepsilon_b / z) \pm \sqrt{(\varepsilon_b/z)^2 - 4\,(k\omega + i_m R_m)/z}}{2} \qquad (4d : 4e)$$

FULL POWER, OPTIMIZED

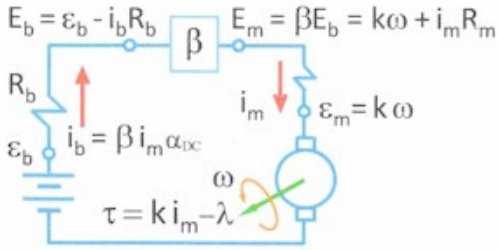
tau_Nm	EMFb_V	Rb_mO	Eb = Em, V	Rm_mO	Pb_kWe	Ns	k_NmA	Kv_RPMV	Pm_kWe	etab	etam	etas
360.0000												
Lambda_Nm												
18.00000												
RPM												
1000												
motors	234.2	111	213.5	9	43.7538	57.11	2.0226	4.7	39.8879	0.912	0.945	0.861
1												

Sport-elec., 40 kW_e full power, 10 kW_e cruise , 9 kW_e regen

EMFc_V	Rc_mO	Np	Rm_mO	margin
4.10	95	49	9	0.030

EMFb_isom	Kv_isom	im_isom	psi	im_Amp
64.2	17	681.26	0.0046	186.85

Pm_kWs	Re_mOhm	nu	ec_Amp-hr	ic_Amp	time_hr
37.6991	120	0.904	3.00	3.81	0.79



CRUISE, BATTERY VOLTAGE BUCK

tau_Nm	beta	eta_DC	Eb_V	Em_V	Pb_kWe	ib_Amp	im_Amp	Pm_kWs	Pm_kWe	etab	etam	etas
140.0000	0.558	0.970	229	128	10.514	44.9	78.118	8.796	9.982	0.979	0.881	0.837
RPM												
600												

High efficiency ~ 85% in all operating modes

REGEN, GENERATOR VOLTAGE BOOST

tau_Nm	beta	eta_DC	Eb_V	Em_V	Pb_kWe	ib_Amp	im_Amp	Pm_kWs	Pm_kWe	etab	etag	etas
-162.0000	0.531	0.970	238	126	-8.583	-36.7	-71.196	-10.179	-9.002	0.983	0.884	0.843
RPM												
600												

Figure 15. Sport-electric full-power optimization & DC-DC conversion for cruise & regen.

VII. Conclusion

With our main focus on electric-aircraft propulsion, but also with wide-ranging applicability, we have introduced a new way of characterizing and optimizing the *permanent-magnet motor-generator as a system* with its battery or fixed-voltage supply. We introduced new formulas for system efficiency, relating it to *non-dimensional terms* representing rotational speed, current, torque, and torque loss. Next, we solved for the conditions yielding optimum motor and battery *system efficiency at full power*. We then revealed the substantial losses of the popular "PWM" method for power conditioning at cruise, and introduced *DC-DC conversion* as a high-efficiency alternative which, for the sport-electric flyer example studied, yielded 85% system efficiency for all operating modes, including regeneration. We hope that these methods for obtaining high efficiency will find application in the coming era of green ground and aerial electric propulsion.

Acknowledgments

This paper is dedicated to Michael Faraday, electrochemistry pioneer and inventor in 1821 of the world's first electric motor. With little formal education, Faraday became "one of the greatest scientific discoverers of all time," according to Earnest Rutherford. Albert Einstein posted on the wall of his study three images, those of Isaac Newton, James Clerk Maxwell, and Michael Faraday.[6]

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6 www.WikiPedia.com "Michael Faraday".

7 www.HowFliesTheAlbatross.com presentation-embedded

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Coming Soon: Tailless Aircraft Bibliography Edition 1-g

Edition 1-f, which is sold out, contained over 5600 annotated tailless aircraft and related listings: reports, papers, books, articles, patents, etc. of 1867 - present, listed chronologically and supported by introductory material, 3 Appendices, and other helpful information. Historical overview. Information on sources, location and acquisition of material. Alphabetical listing of 370 creators of tailless and related aircraft, including dates and configurations. More. Only a limited number printed. Not cross referenced: 342 pages. It was spiral bound in plain black vinyl. By far the largest ever of its kind - a unique source of hardcore information.

But don't despair, Edition 1-g is in the works and will be bigger and better than ever. It will also include a very extensive listing of the relevant U.S. patents, which may be the most comprehensive one ever put together. A publication date has not been set yet, so check back here once in a while.

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VIDEOS AND AUDIO TAPES

(ed. – These videos are also now available on DVD, at the buyer's choice.)

VHS tape of Al Bowers' September 19, 1998 presentation on "The Horten H X Series: Ultra Light Flying Wing Sailplanes." The package includes Al's 20 pages of slides so you won't have to squint at the TV screen trying to read what he is explaining. This was an excellent presentation covering Horten history and an analysis of bell and elliptical lift distributions.

Cost: $10.00 postage paid
Add: $ 2.00 for foreign postage

VHS tape of July 15, 2000 presentation by Stefanie Brochocki on the design history of the BKB-1 (Brochocki,Kasper,Bodek) as related by her father Stefan. The second part of this program was conducted by Henry Jex on the design and flights of the radio controlled Quetzalcoatlus northropi (pterodactyl) used in the Smithsonian IMAX film. This was an Aerovironment project led by Dr. Paul MacCready.

Cost: $8.00 postage paid
Add: $2.00 for foreign postage

An Overview of Composite Design Properties, by Alex Kozloff, as presented at the TWITT Meeting 3/19/94. Includes pamphlet of charts and graphs on composite characteristics, and audio cassette tape of Alex's presentation explaining the material.

Cost: $5.00 postage paid
Add: $1.50 for foreign postage

VHS of Robert Hoey's presentation on November 20, 1999, covering his group's experimentation with radio controlled bird models being used to explore the control and performance parameters of birds. Tape comes with a complete set of the overhead slides used in the presentation.

Cost : $10.00 postage paid in US
$15.00 foreign orders

FLYING WING SALES

BLUEPRINTS – Available for the Mitchell Wing Model U-2 Superwing Experimental motor glider and the B-10 Ultralight motor glider. These two aircraft were designed by Don Mitchell and are considered by many to be the finest flying wing airplanes available. The complete drawings, which include instructions, constructions photos and a flight manual cost $140, postage paid. Add $15 for foreign shipping.

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