The Electronic News letter of the Chichester and District Model Aero Club

Clear Dope

July 2020

Chichester and District Model Aero Club: Committee 2020

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Hello everybody hope you are all well and active Any Comments on Articles or additions please do contact me All the Best Ken Knox

KAVAN PARTENAVIA UPDATE

Thanks to David Hayward for this flying shot

I'm astonished to find that my original Partenavia write-up appeared in Clear Dope as long ago as the March, 2017 edition. Since that time, and seeking better performance, I've dome more work on the model, replacing the 8-cell NiMH flight batteries with 3S Lipos, and fitting re- worked props.

It's not been without its problems, and these notes may be of interest to those with models still using brushed motors because of the difficulty of replacing them with brushless.

To explain why I couldn't adopt other solutions, I repeat the note I made in the previous article -

" Brushless outrunner motors would have been a good option, but they can't be mounted to the moulded foam cowlings. Inrunners would fit, but their kV ratings are too high in this case size, and they export their heat mainly from their outer casings, far from ideal when mounting directly into foam. That said, I have taken the opportunity to bury a third motor wire alongside the pair used, to cater for any future eventuality of this kind."

The change I made was to Turnigy 3S 2200mAh Lipos, and it presented some interesting challenges in installation and in dealing with the higher motor voltage. I was forced to a 3S Lipo, when I'd hoped of getting-by with 2S for weight-saving, but I found that I'd need to increase prop-load into excessive motor current to achieve the power I needed, but with 3S I was now faced with excessive voltage and the need to reduce the prop load.

At this point, for those who have not had the opportunity to get into the workings of electric motors, and at risk of “teaching grandmothers to suck eggs”, I'd like to enlarge on this a little.

My motors could also function as dynamos if driven mechanically, since if the armature windings are rotated inside a magnetic field, voltage will be induced across the windings, and current could be supplied if the “motor” is provided with an electrical load. This voltage is therefore present when voltage is applied to power the motor, but it is reversed in polarity and opposes the voltage applied to the motor, and is why we label it - “Back-EMF” (Electro-Motive Force).

This is a very important property to grasp in motor physics, since it reduces the effective voltage applied to the windings of the motor, proportionate with rotational speed. Thus with a perfect motor having no frictional or air drag or other loads or losses, the RPM would rise until the back-EMF matches the applied voltage, and the consumed current would be zero. Conversely, if the motor were held stalled, with no back-EMF, then the current would be the full applied voltage divided by the sum of winding and brush/commutator resistances, and because of the very low winding resistance, that current would be damagingly high.

With a Lipo replacing the earlier NiMH battery, we have substantially more voltage applied to the motor, not only through the nominal battery voltage, but also because the Lipo has a much lower internal resistance and thus lower on-load volts-drop. This can be as much as about 2.5V higher than that delivered by my previous NiMH batteries. So we need the RPM to rise to increase the back-EMF by 2.5V in order to reduce the current to that drawn with the NiMH batteries, Keeping the Yellow-Bendy prop would increase the power demand on the motor and thus increase the current very substantially, so we are forced to reduce the load presented by the prop.

I did some sums on the RPM needed to restore the voltage differential (motor volts - back-EMF) and came-up with some concerning numbers, but trusting that the plain bearings, brushes and commutator would be good-natured and that the armature windings wouldn't fly, I moved-on to run into the next problem. - at extreme RPM the high rate at which the commutator switches motor current increases electrical losses in the motor, whilst air drag and frictional losses are also mounting, so current now increases due to those causes, reducing the gains made in current saving by reduced prop load. Thus it's a case of diminishing returns, and I had to settle for a loading that draws about 37A static at full throttle on two motors with a fresh battery. It's therefore desirable to bring the motors up to speed slowly to bleed-off some of the fresh charge, and to be sympathetic with the throttle at take-off. It would have been useful if I'd been able to use throttle-trim as a safeguard against over-stressing the motors, but it only works at low-throttle on my Field Force 6 Tx. However, I would expect the current to reduce in flight when the props tend to unload.

To achieve that optimum loading, the generously-bladed Kavan Yellow-Bendy props were replaced initially by Master Airscrew 6” x 4” props of the original pre-GF-3 design. Loaded current was still far too high and so I finished-up with 6” x 3”, with narrowed blades and their aerofoil sections restored. Getting four blades absolutely matching and balanced takes several hours of meticulous work, but it's worth taking the trouble, because the motors can be running at over 16,000RPM.

Here's how I tested the reworking of the props, digital scales just peeping out, ESC operated by a 35MHz Rx and Tx, rev counter and DVM not shown, monitoring thrust, applied volts, motor current and RPM. As you can see, I had to extend the motor supports high above the equipment because I found that airflow reacting with the obstacles underneath was generating a force opposing the true thrust force.

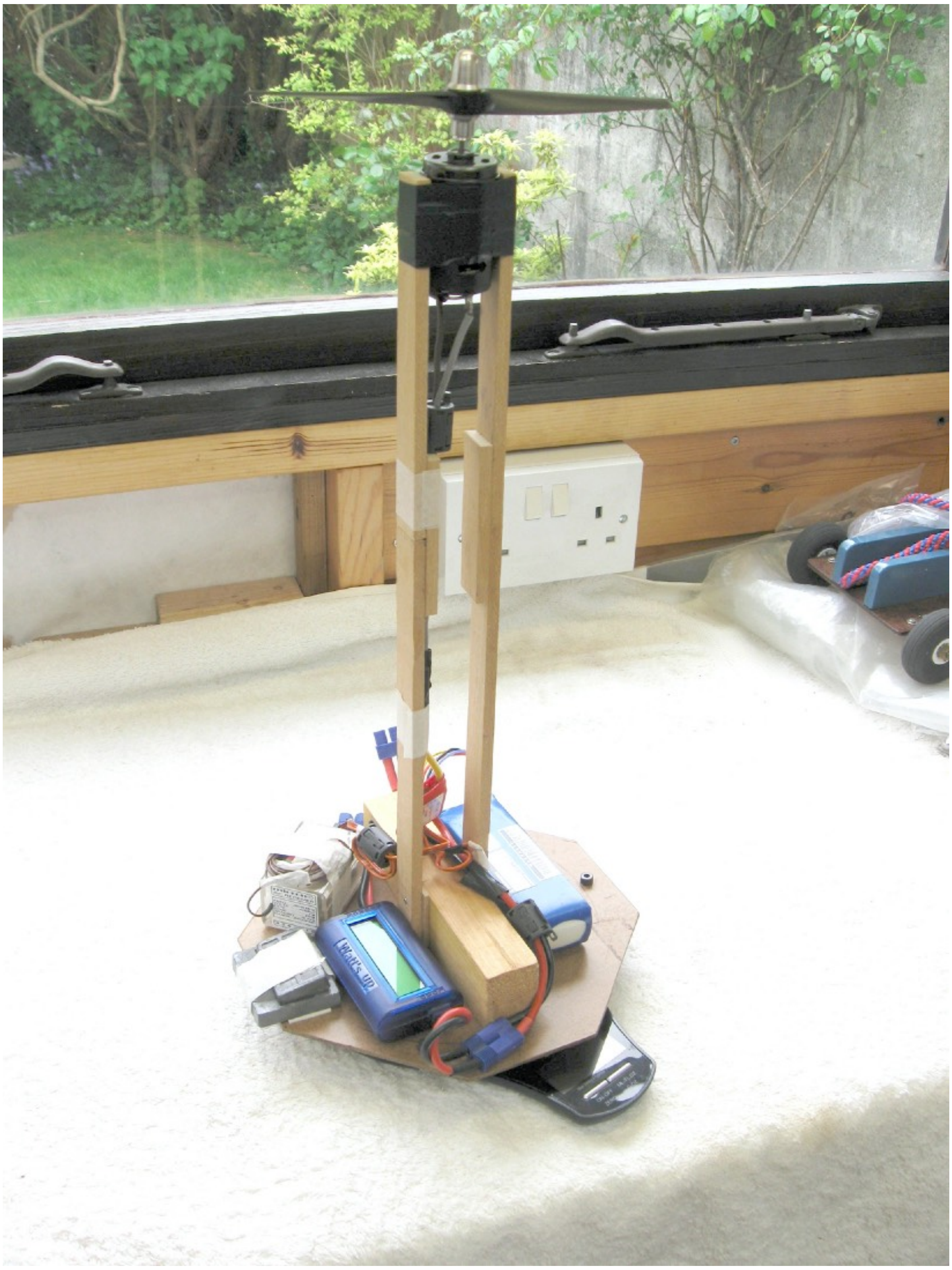
I couldn't find a Lipo-powered brushed speed controller of adequate current rating, so I was forced to retain the existing Jeti NiMH brushed controller, and to correct the low-voltage safety cut-off needed for Lipos, I had to add a Dimension Engineering "Smart BEC" to control the Jeti. I finished-up with triple redundancy of the Rx supply via Shottky diode combining - Rx battery, Jeti BEC and Smart-BEC.

Starlings hitching a ride ?

Here is the somewhat scruffy installation, a lot to get in/out, but it works well on the field -

Note the snap-on interference suppressor needed at 35MHz. The Smart BEC is buried in there behind the Jeti ESC, and the two tiny green LEDs indicate the BEC outputs being available, proving redundancy pre-flight. Being fearful of a fire inside a foam cocoon, I included an automotive 30A blade fuse in the Lipo supply, and a tiny wire-ended fuse for the Smart-BEC. To my surprise, in spite of being surrounded by foam with no venting, temperatures rise only to warm rather than hot, with no smells, thanks maybe to having air volume right up to the tail.

I couldn't gain the full 6 oz. benefit of the lighter battery because of CG issues, even with the LIpo



in its furthest forward position and the need for extra hardware. Additional nose-weight was required for final balance, so the overall saving was 4.5oz., usefully reducing the wing loading to 18oz.sq.ft.

This has been a very worthwhile upgrade, but it has to be admitted that a 7.2V 480PRO motor and 3S Lipo make for a difficult marriage, requiring very careful set-up. However, with more thrust and reduced battery weight I get a more sprightly performance and a very positive take-off and climb
out. The airframe, being very efficient, allows flight-times of around 25 minutes when making use of any lift around. It's quite aerobatic with Lipo power, but it's not usually flown that way, being a scale subject. All in all, now ideally balanced in power and flight characteristics, and so nice to fly.

Colin Stevens

Peter Rieden of the Border clubs writes

I've been building an acrowot (EP/GP version) with a 6s battery and an Axi 4120/18 for something that can handle a bit more breeze. As I now have all the telemetry capabilities I decided to get an 80Amp FrSky Neuron ESC because this has a whole bunch of telemetry sensors built in. These ESCs aren't cheap, but they are very programmable and if you include the cost of all the sensors you'd need to do the same thing with anything else they actually work out much the same. Here's my mini-review of the FrSky Neuron ESC:

I looked at these speed controllers because they have extremely useful embedded telemetry. For example if you plug the S-Port connector into a FrSky Rx you will get Voltages (flight battery, Rx Battery, BEC), Currents (motor and BEC), Power(mAh) consumed, ESC Temperature, motor RPM. They also have a huge range of selectable/ adjustable settings (including BEC voltage which can be set anywhere from 5 - 8.4v). The particularly useful one of these is the Power Consumption. Pack voltage is a poor indication of remaining charge in a large lipo, and so this allows me to set a fairly accurate electric fuel gauge with an alarm at (say) 4,000mAh consumed from a 5,000mAh pack.

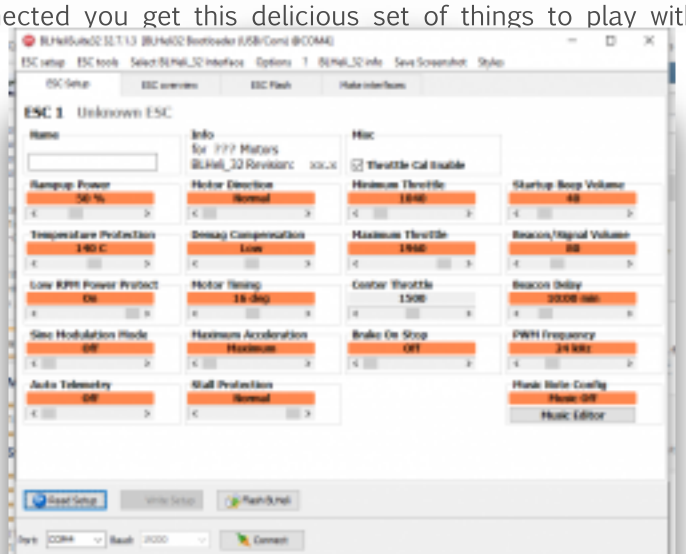
These ESCs come in two types and a range of sizes. The standard (black) ones are about double the size and weight of the newer "S"(red) versions, but the S-types only come in 40 and 60 amp versions while the originals had an 80A (120 peak), and have robust machined aluminium cases for both strength and heat-sinking. They are all the same size - that is to say the standard ones are the same size and weight for the 40, 60 and 80A versions and the two S-types are the same size and weight as each other (about half that of the standard ones). There also isn't that much of a price difference between them (the cheapest 40 amp one is £45 while the most expensive 80amp one is £63, and the difference between the 40S and 60S is about a fiver).

So I got one of the 80Amp ones for my AcroWot - I actually needed the extra weight, and couldn't see any point in getting the lower rating for the price. It arrived in a nice plastic box but with no connectors fitted. One of the first things to grab my attention was that it doesn't have a lead to go to the Rx - it has a pair of servo-lead *sockets* (Rx and Smart Port) instead. So you may need a couple of plug-to-plug servo leads - I feel these could have been supplied in the box! But that aside the impression is of a very sold, well-made unit with a decent build quality.

I mentioned the plethora of adjustable settings. Unlike other ESCs these are not set with throttle movements or a programming card, but are set from a piece of software called "BLHeli_32" that you have to download. To use it you also need a USB-linker" device (available from T9 for £6.60 - cheaper alternatives are available but you need to know what you're doing to choose one). This adjusts everything other than the BEC voltage, which is adjusted via a LAU script in an OpenTx transmitter. You can just plug it in and use it, and it will work (including the telemetry), but it will probably have the prop-brake set to on (fine of you're a gliderist with a folding prop or a multicopter flyer, less-so for normal people).

Also in the box is the manual (two sides of A4) which, like most FrSky documentation, pretty hopeless - especially on how to use the USB-linker. This took me some research and head-scratching (because some aspects of it are unexpected and counter-intuitive) so at the bottom of this post I've included step-by-step instructions so that they're written down where people can find them!

Once you have it connected you get this delicious set of things to play with:



The full details of what they all do can be found in the manual (in a PDF under the "BLHeli_32 Info" menu. Things to note include that the range of options presented will depend on what ESC is connected, and that most of these ESCs seem to be shipped with the prop brake or "damping" (this setting only appears when certain ESCs are connected) set to "on". So if you're a normal fixed-wing user with a non-folding prop you'll want to change this. I believe they default it to on because a lot of FrSky customers are multicopterists, and they like to have "throttle damping" because it slows motors down quicker and thus gives them better control response. In some cases this menu item appears as "Regenerative braking/damping" which seems to imply that the ESC can actually put energy back into the batteries - an interesting idea that I have no way of testing. Lots of these settings can be ignored by the typical sport user - they're included so competition flyers can fully optimise their setups and for the inveterate, compulsive tinkerers who tend to be attracted to FrSky kit!

Anyway - my overall conclusion after one evening of head-scratching followed by success is that this is an excellent piece of kit whose telemetry functions offset the slightly higher price and will allow be to operate my larger electric models with a much better understanding of how much duration remains in the battery!

So the next morning I took the Acrowot out onto the drive for some ground running tests. I was expecting the 14-8.5 prop to be over the top for the motor, but it was only drawing around 30 amps, and something seemed to be strangling it from half throttle onwards. I bit of googling suggested that the defaults settings for rampup power may restrict things for low kW motors (like the Axi) and also the Low RPM Protection could be overly cautious. So I plugged in the laptop and set the ramp-up power to 100%, disabled the low RPM protection and with a freshly-charged battery I tried it again. This time it didn't mess about - serious grunt all the way to full chat, smooth running and barely breaking a sweat (temperature less than 45degC throughout). The Axi4120/18 on a 6s pack (two turnigy 40-50C 3s3000 packs in series) turned the 14-8.5APCe at over 9,000rpm and around 58A. The Axi's nominal limit is 55A for 60 seconds, so I would say this is probably the perfect prop, although a 13-10 might give me more airspeed. The telemetry log is attached, showing a peak power of 1300watts or 1.75bhp in old money – that's about the same as a typical 80-90-size 4stroke. I think that should match the acrowot pretty well…

How to use the USB Linker with BLHeli_32

I appreciate that to some who speak arduino the following is a "well DUH!", but the information isn't in the manuals so I thought I'd add it as a summary in case anyone else comes at it for the first time and searches for help.

The Process goes like this:

Before you start plug the USB Linker into your PC and confirm that there's a driver for it. When you plug it in Windows should recognise it and announce it exists. If Windows doesn't seem to recognise it, or it it doesn't seem to work when you follow the steps below, you may need to manually install the driver. Go into Windows Device Manager and look down the list for Ports - expand this branch and you should see something like "Silicon Labs CP210 UART bridge" with a Com Port number. If you don't then ask Mr Google for a "Silicon Labs CP210 UART bridge driver" - choose the option from the Silicon Labs website and download/install the driver in accordance with the instructions.

1. The S-Port and Rx leads must BOTH be disconnected from the ESC

2. The programming lead from the USB linker goes into the PWM port (ie the normal one from the Rx, not the telemetry port)

3. The programming lead MUST have the +ve pin (the middle one) disconnected

4. Plug the USB linker into your PC and fire up BLHeli32 (suggest you maximise it so that bits of the window aren't hidden beyond the bottom of the screen)

5. After firing up BLHeli32 you must find the top Windows menu bar (above the tabs) and open the "Select BLHeli_32 Interface" menu and select "BLHeli32 Bootloader (USB/Com)"

6. At the very bottom of the screen there's a box labelled "Port" - click the down-arrow and select the one from the list which includes the words "Silicon Labs CP210 UART bridge" or similar (ignore the "baud" box - this is automatic).

7. WITH THE ESC DISCONNECTED FROM THE FLIGHT BATTERY connect the programming lead from the USB Linker to the PWM port of the ESC.

8. In BLHeli32 click on the "connect" button (at the bottom of the screen next to the "Port" and "Baud" boxes. The screen will ask you to power-up the ESC - do this by connecting a flight battery. If you're too slow it will stop trying - just press connect again and this time connect the flight battery more quickly! It will announce success and the "connect" button will change to a "disconnect" button.

9. Click on the "Read Setup" button (above the Ports box at the bottom of the screen). It should load all the data from the ESC including its type and settings.

You can now make whatever settings changes you wish. You can also give the ESC a specific name (a good idea if you have more than one). You can save settings in files on the PC using the top menu "ESC Setup" and load them again later. There are other options for working with multiple ESCs - these are for multicopter use, Instructions on what all the settings do can be found in the "BLHeli_32 Info" menu which links to a PDF copy of the manual.

10. When you have made your settings changes click on the "Write Setup" button (next to the Read Setup button at the bottom of the screen). Do not use the "Flash BLHeli" button - I assume this is for updating the ESC firmware itself, which is a very different thing.

11. Now click on "Disconnect", and when it has done so (indicated by the button changing back to "connect" you can unplug the flight battery, then unplug the programming lead and then reconnect the PWM lead from the Rx (and the S-Port lead if you're using it).

I've managed to make that sound very involved - it isn't. The second time you do it it's obvious - it's just a series of very simple steps. I wasted a lot of time doing an Eric Morecombe - I *was* doing the right steps, but not *necessarily* in the right order...

Peter Rieden

Key for test results on next page

EscT – temperature of the speed controller (internal sensor)
RSSI – receiver Received Signal Strength (failsafe triggers at around 38)
RxBt – receiver power voltage
BecV – the BEC voltage put out by the speed controller (difference between RxBt and BecV shows a calibration error!)
BecA – current drawn by the receiver and servos (very low here because it was a ground test with no servo movements!)
EscV – the flight pack voltage (note how this drops when the current goes up – that shows “resting” vs “loaded” voltages for this 6s pack)
EscA – the current drawn by the motor
Watts – calculated as current x voltage
BHP – calculated at 745.7 watts per bhp (technically this is “horsepower” not “brake horsepower”, but people are used to seeing “BHP”)
IR – calculated internal resistance of the battery based in resting voltage, loaded current and loaded voltage
Erpm – motor RPM as reported by the speed controller
EscC – energy consumption (mAh consumed since start of test or last reset)
TxBat – transmitter battery voltage

Test results

Date	Time	EscT (@C)	RSSI (dB)	RxBt (V)	BecV (V)	BecA (A)	A2 (V)	EscV (V)	EscA (A)	Watts	BHP	IR (mOhm)	Erpm (rpm)
27/06/2020	06:01.8	0	0	0	0	0	0	0	0	0	0.00		0
27/06/2020	06:02.2	0	0	0	0	0	0	0	0	0	0.00		0
27/06/2020	06:02.7	0	0	0	0	0	0	0	0	0	0.00		0
27/06/2020	06:03.2	0	0	0	0	0	0	0	0	0	0.00		0
27/06/2020	06:03.7	0	0	0	0	0	0	0	0	0	0.00		0
27/06/2020	06:04.2	0	0	0	0	0	0	0	0	0	0.00		0
27/06/2020	29:14.7	38	101	4.9	4.92	0.01	11.4	25.58	0	0	0.00	#DIV/0!	0
27/06/2020	29:15.2	37	107	4.9	4.91	0.01	11.5	25.58	0	0	0.00	#DIV/0!	0
27/06/2020	29:15.7	38	102	4.9	4.93	0.17	11.7	25.57	0	0	0.00	#DIV/0!	0
27/06/2020	29:16.2	37	105	4.9	4.91	0.01	11.7	25.57	0	0	0.00	#DIV/0!	0
27/06/2020	29:16.7	37	102	4.9	4.92	0.01	11.6	25.57	0	0	0.00	#DIV/0!	0
27/06/2020	29:17.2	38	104	4.9	4.9	0.01	11.5	25.57	0	0	0.00	#DIV/0!	0
27/06/2020	29:17.7	38	107	4.9	4.91	0.01	11.5	25.57	0	0	0.00	#DIV/0!	2800
27/06/2020	29:18.2	38	102	4.9	4.93	0.17	11.5	25.56	0	0	0.00	#DIV/0!	1900
27/06/2020	29:18.7	38	106	4.9	4.9	0.01	11.6	25.53	0	0	0.00	#DIV/0!	4900
27/06/2020	29:19.2	38	103	4.9	4.92	0.01	11.4	25.57	0	0	0.00	#DIV/0!	5500
27/06/2020	29:19.7	38	107	4.9	4.91	0.01	11.5	25.41	0.6	15	0.02	283.33	6000
27/06/2020	29:20.2	38	102	4.9	4.9	0.01	11.6	25.5	0.3	8	0.01	266.67	11500
27/06/2020	29:20.8	38	104	4.9	4.9	0.01	11.5	25.51	0.27	7	0.01	259.26	12300
27/06/2020	29:21.3	37	107	4.9	4.91	0.01	11.4	25.51	0.28	7	0.01	250.00	12300
27/06/2020	29:21.8	37	101	4.9	4.9	0.01	11.3	25.52	0.3	8	0.01	200.00	12300
27/06/2020	29:22.3	37	105	4.9	4.9	0.01	11.5	25.55	0.29	7	0.01	103.45	12200
27/06/2020	29:22.8	37	99	4.9	4.9	0.01	11.5	25.53	1.01	26	0.03	49.50	16900
27/06/2020	29:23.3	37	106	4.9	4.9	0.01	11.6	25.47	0.99	25	0.03	111.11	17000
27/06/2020	29:23.8	37	105	4.9	4.9	0.01	11.7	25.45	0.98	25	0.03	132.65	17100
27/06/2020	29:24.3	37	102	4.9	4.93	0.13	11.7	25.52	0.98	25	0.03	61.22	17100
27/06/2020	29:24.8	37	104	4.9	4.91	0.01	11.6	25.41	1.82	46	0.06	93.41	20600
27/06/2020	29:25.3	37	105	4.9	4.9	0.01	11.3	25.37	1.97	50	0.07	106.60	21900
27/06/2020	29:25.8	37	105	4.9	4.93	0.05	11.3	25.34	2.35	60	0.08	102.13	22500
27/06/2020	29:26.3	37	104	4.9	4.9	0.01	11.5	25.33	3.42	87	0.12	73.10	25100
27/06/2020	29:26.8	37	105	4.9	4.93	0.13	11.6	25.36	4.39	111	0.15	50.11	28300
27/06/2020	29:27.3	37	101	4.9	4.92	0.01	11.7	25.23	4.57	115	0.15	76.59	29600
27/06/2020	29:27.9	37	107	4.9	4.92	0.01	11.6	25.16	7.16	180	0.24	58.66	33500
27/06/2020	29:28.4	37	95	4.9	4.91	0.01	11.7	24.98	9.78	244	0.33	61.35	37000
27/06/2020	29:28.9	36	104	4.9	4.89	0.01	11.6	24.75	10.67	264	0.35	77.79	38400
27/06/2020	29:29.4	36	100	4.9	4.92	0.01	11.6	24.75	12.39	307	0.41	66.99	40200
27/06/2020	29:29.9	36	105	4.9	4.9	0.01	11.8	24.61	14.72	362	0.49	65.90	44000
27/06/2020	29:30.4	36	99	4.9	4.92	0.23	11.1	24.54	16.48	404	0.54	63.11	43600
27/06/2020	29:30.9	36	104	4.9	4.9	0.03	11	24.57	17.51	430	0.58	57.68	44900
27/06/2020	29:31.5	36	104	4.9	4.92	0.03	11.2	24.36	19.97	486	0.65	61.09	47400
27/06/2020	29:32.0	36	104	4.9	4.89	0.01	11.5	23.98	22.01	528	0.71	72.69	49600
27/06/2020	29:32.5	36	103	4.9	4.91	0.03	11.5	23.98	24.94	598	0.80	64.15	50200
27/06/2020	29:33.0	36	100	4.9	4.92	0.25	11.7	23.84	28.71	684	0.92	60.61	52000
27/06/2020	29:33.5	36	104	4.9	4.93	0.07	11.8	23.72	31.31	743	1.00	59.41	53400
27/06/2020	29:34.0	36	100	4.9	4.93	0.03	11.6	23.64	32.11	759	1.02	60.42	53900

Dear CADMAC members,

It has been great to resume flying at Portshole and the Covid arrangements seem to be working well. Some of the mornings have been busy but the afternoons are relatively quiet.

When you next go flying there you may find sheep grazing in the field. We were asked by the landlord and the grazier whether we could accommodate sheep grazing the long grass around the flying patch. Sheep have been grazing the rough grassland in the fields beyond the flying field since the winter but over the last few weeks the weather has been so dry that they a fast running out of green grass to eat. The long grass around the patch has not been grazed and still has plenty for the sheep to eat.

Having discussed it with the grazier, Graham Pick, we decided to try putting an electric fence round the outside boundary of the whole field giving the sheep access to the patch as well as the long grass around it. They still have access to their old fields beyond the patch and their water and supplementary feed will stay there. When you go to fly you will find a temporary gate leading from the pits to the patch.

Grazier, Graham was sure that the sheep would not be a problem when we were flying. He thought they would simply walk back to their old field when any fliers arrived. We tested this today when my wife and I met with George to check out the electric fencing and the other arrangements. The whole flock of sheep were feeding in the long grass around the patch when we arrived but as soon as we walked slowly down the path to the patch they walked off to their old field. The electric fence only went up on Sunday, so it is amazing that the sheep had already found the new grass!

This is only a temporary measure – Graham thought two weeks maximum should be enough for his sheep to graze this small area. It is also a bit of an experiment. If we find it is not working we can ask Graham to move the sheep away. Please let us know if you run into any problems.

Key points:

- If the sheep are in the flying field when you arrive, walk slowly down the path giving them time to move to the lower field.
- Please ensure the gate is tied closed when you leave.

Some of you who have visited Portshole over the last week or so will have noticed that the gate to the barnyard where we normally park our cars has been tied closed. There is nothing sinister about this. We are still allowed to park in the barnyard but have been asked to close the gate when we leave. Given that we are limited to six fliers and there is plenty of dry parking outside the yard, we decided to leave the gates closed for now.

Ken & George

Flying alone on Thorney is not recommended however pilots are requested to concentrate on flying within the grass area to the west of the runway.

Please Try to leave Porthole as tidy as possible, making sure no fuel is left on site

When Driving Around Thorney be aware of young children on bikes

The Commander at Baker Barracks Thorney and the MOD have decreed that there shall be NO drone flying whatsoever

When flying at Thorney please keep an eye out for traffic(all kinds walkers, horses, bikes, runners, and low flying aircraft) coming from behind the flyers and inform them accordingly

The club Facebook page is now in its fourth year. It has over one hundred members. It contains many contemporary site reports, and has a wealth of photos in its archives.

Administered by Nick Gates. and David Hayward

Here is the link:-

https://www.facebook.com/groups/Chichesteraeromodellers/