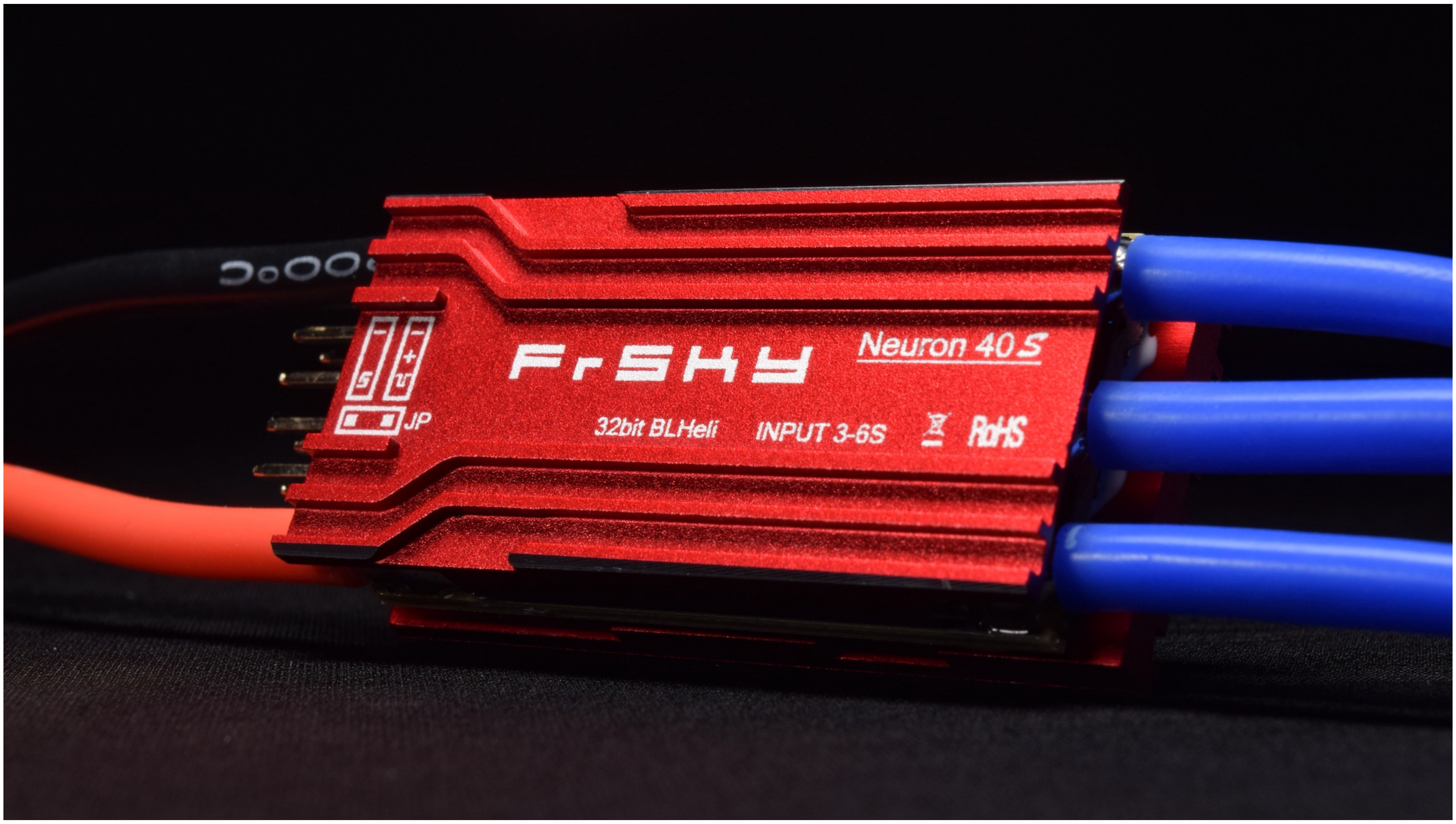

The FrSky Neuron 40S (image: Aloft Hobbies)

FrSky Neuron Electronic Speed Controller

It packs plenty of performance and features into a surprisingly small package at a reasonable price.

Peter Scott Follow
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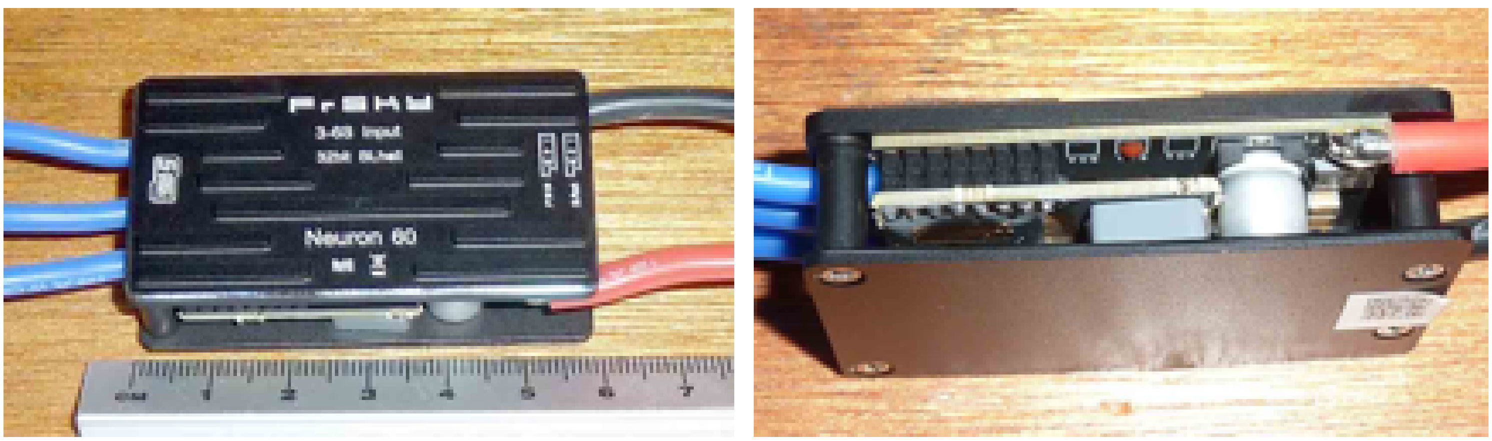
First impressions were very good. The FrSky *Neuron* electronic speed controller (ESC) comes packed in foam in a solid plastic box, and is very strongly made with a thick aluminium plate top and bottom. All sides are open. There are two servo-style connectors for leads to go to the receiver — one for the throttle/battery eliminator circuit (BEC) lead pulse width modulation (PWM) and the other for the Smartport (S.Port) telemetry feed. You need leads with both ends female (socket rather than pin). You will need to cut the red core on the PWM lead if using a separate receiver battery, but this is a separate lead so you are not cutting one that is permanently connected to the ESC. The ESCs are compact with good heat sinks and are available in 40, 60 and 80 amp versions with 50% extra capacity for short times (burst). All versions are the same size and weight, though different prices, and can be connected to 3S through 6S lipo batteries.

I tested the *Neuron* 60 in detail. After soldering on XT90 and 4 mm bullet connectors and sleeving, the device weighed 76 g. This is exactly the same as a Turnigy *Plush* 60A, though of course the latter has no telemetry. The sizes are: *Neuron*: 60 x 33 x 16 mm *Plush*: 72 x 30 x 17 mm so the *Neuron* is just a bit shorter. Later in this article I will describe even smaller versions.



Photos 2 and 3: The Neuron 60 top and side views.

The *Neuron* includes a range of FrSky telemetry. I tested the telemetry using a Taranis *X9D* plus transmitter running OpenTx V2.2.2 and a freestanding *X8R* receiver. Initially no motor was connected, so the current, RPM and mAh consumption data were zero. I allowed the ESC to power up the receiver through the BEC and the voltage shown in RxBt telemetry was 4.9V. Using a voltmeter I checked whether this was the voltage sent by the BEC and it was, so the BEC appears to default to 5V, though the voltage can be changed. It can provide 7A.

After using `Discover New Sensors` on the Taranis all of the data appeared as follows:

Data Names	Values During Test	Description
EscV	16.71 V	Lipo voltage
EscA	0.00 A	Motor current
EscR	0 RPM	Motor speed
EscC	0 mAh	Power consumption
EscT	44° C	ESC temperature
0E50	2560804	'Encrypted BEC values' — presumably the ESC setup data

Figure 4: Observed values on Taranis transmitter.

As you see the data (sensors) have different names from the ones created by separate telemetry devices. You can change them if you want but they seem meaningful. All have the same device ID (17). If using two of these ESCs in a twin motor model you would have to change the device ID for one of the ESCs.

I then added the new data to a numeric telemetry transmitter screen. I decided also to add `EscA+` and `EscR+` so that I could have a reading of the maximum current and motor speed during the flight. These will be essential to make sure that I have the correct propellor fitted. To get maximum safe power I want about 95% of the maximum current for the motor when the prop is unloaded in the air.

Then I connected a sizable 4Max motor and ran it up, hand held, without a propellor. Sensors `EscA` , `EscR` , `EscC` now generated data. `EscR` , the RPM one, showed over 30000 RPM which puzzled me until I remembered that RPM has to be calibrated for the number of coils in the motor, and defaults to one. I edited the sensor to the six coil pairs for the Eflite Power 46 that it will be connected to when I install the ESC in a model. The defaults appear to work fine for fixed wing, though I think braking is set on as the motor stopped quite sharply. You will want this for folding props anyway.

Neuron S Versions

More recently FrSky issued updated versions of the *Neuron*, designated 'S'. I bought a *60S* and a *40S*. They are very much smaller as you can see from the photograph comparing the *60* and the *60S*. FrSky has done an amazing job squeezing the speed control circuitry and the telemetry into such a small device. The S has a jumper to select whether the BEC is used.

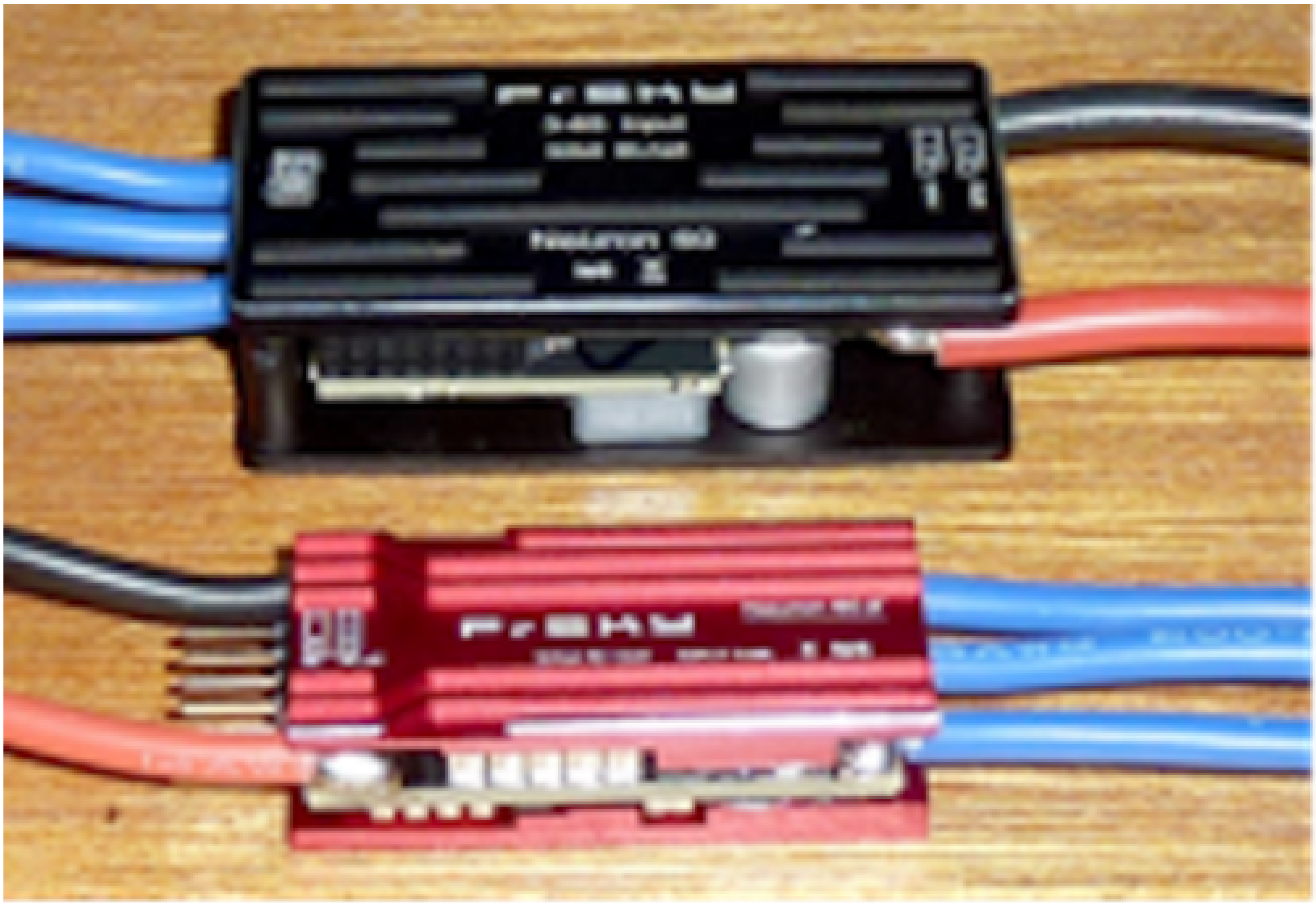


Photo 5: 60 — 76g 60 × 33 × 16 mm; 60S — 47g 45 × 22 × 12 mm. In both cases weights are with one XT90 and three 4 mm bullet connectors.

I have installed a *40S* in my Acrowot foam-e. It fitted perfectly in the original position. I don't need to connect the battery balance lead for voltage telemetry so the wiring is much neater. And now I'll know when I've used 1500 of the 2200 mAh in the battery 'cos the nice lady (Amber) will tell me. I used the default 5V BEC on the *40S*. I put the *60S* into a larger model. It was so much smaller and lighter than the current Turnigy *Plush* ESC that I was able to put it in a more convenient place and add a NiMH receiver battery and switch. As always, in both cases the telemetry data was found by the Taranis without a problem.

Advantages

Size

The dimensions of the *Neuron* are good compared with other makes especially the *S* variants. No further sensors are needed so the whole setup takes up much less space. Glider pilots might want separate variometer and/or GPS sensors, though the former is now built in to some FrSky receivers.

Weight

The *Neuron* is no heavier than most ESCs and you will not need to install other sensors with their associated wires. To match the *Neuron* you would need lipo voltage, current and speed/temperature sensors which add up to about 27g plus wires. We are not told what the current sensor will read up to, but I assume that it will be at least the current capacity of the ESC.

Cost

Neuron 40 £45.60 ($60), *40S* £55.20 ($70), *Neuron 60* £55.20 ($70), *60S* £60.00 ($78) *Neuron 80* £63.60 ($83). Unless you need an air speed, vario or GPS sensor, that's it. The cheapest FrSky sensors are: lipo £10.44 (2.8g), current £17.00 (17g), RPM/Temp £14.50 (6.7g). That's another £42 ($55) you would pay over the cost of a simple ESC. Dynamic soaring pilots unfamiliar with FrSky should not get excited by talk of an ASI sensor. It only goes up to 360kph (224mph). That's only mach 0.3.

Throttle Calibration Using the Transmitter

I fitted the *60* ESC into my motor test bed, running a Turnigy 3542 motor on a 4S lipo battery. To start I used a self-powered servo tester to provide the throttle signal. I connected the battery. The ESC made quite a few beeps but when I pushed the tester to full throttle the motor turned quite slowly. Clearly throttle calibration is needed for the non-*S* ESCs. The throttle on the *S* variant did not need calibrating. It presumably defaults to 1000 to 2000 ms.

While you will want to consult the documentation (which you should consider as definitive) here is my simplified summary of the procedure:

1. Push the throttle stick to maximum.

2. Connect the ESC battery.

3. You then get — wait for it — three fast rising beeps.

4. One long low beep — signal detected.
5. Four slow high beeps — measuring setting.
6. Three sets of four fast rising beeps — max throttle stored.
7. Silence.
8. Pull the throttle to minimum.
9. Four slow lots of two low beeps — measuring setting.
10. Three sets of four fast falling beeps — min throttle stored.
11. Then the startup, arming tones.
12. Three rising tones — power on.
13. One long low tone — signal detected.
14. One long high tone — zero throttle detected.

That's almost enough to orchestrate as the theme of a symphony. I wonder what would happen if I fed it to the phone app that recognises tunes?

And then, on throttle up, the motor ran full chat. There was no need to disconnect the battery to reset it. Next I connected the *Neuron* to an *X8R* receiver on the test bed, powered with a separate battery. I had to go through the calibration again for the *X9D* transmitter throttle stick. All the telemetry sensors produced good data after discovery.

I am getting to like the tune. Maybe I'll write a rap to it celebrating the joys of FrSky. Then a Spektrum, Futaba or Hitec lover can write another and we'll do a battle rap on the flying field.

Flight Testing

Setup

For flight testing I fitted a 60 in a Wot trainer with a separate receiver battery. This has an Eflite Power 46 turning a 13 x 8 prop. Motor current ratings are 40A continuous and 55A burst. I set up my telemetry screen to display current, maximum current, RPM, maximum RPM, consumption (mAh used) and battery voltage. The battery was a fully charged 5 Ah 4S Nanotech with internal resistances of about 3mΩ.

Current and Power

Full throttle current was 55A static and 40 to 50A in the air. This rose to 52A in manoeuvres. This makes the maximum power about 52 x 14.4 = 748W. The motor spec shows 800W. Cruise current was 20 to 30A in level flight and taxiing was around 15A.

Consumption

I also checked the consumption figures. I landed after nine minutes having used 3000mAh. The iSDT charger pushed in 2870mAh to full charge, so the error was 4%. This is excellent for a low cost device and good enough to rely on for maximum safe flying time.

RPM

According to the motor specification it should be 14.4 x 670 = 9648 (volts x kV). I checked that I had the number of motor coils correct for the RPM sensor. The spec gives 12 pole so I edited the sensor to 6 pairs and got a reading of just over 9000, so once again accurate.

Power

After carrying out the flight tests I realised that I could have recorded power as well. I created a calculated sensor called `Watt` by multiplying current and voltage and set the unit to watt W. I selected integer value so avoiding decimal places. I displayed `Watt` and `Watt+` on the screen, and carried out a static test. Clearly the current is measured in amps not milliamps as the simple multiplication gave watts. With a fully charged battery I got a reading of just over 900W. The full charge voltage is 16.8 so multiplying this by 55A gives 924W. Therefore the calculation seems to give a correct result. It also shows that under full charge the motor is being asked to produce slightly more than the specified power.

Word of Warning

Make sure you disable the power feed to the receiver if using a separate receiver battery. If not the ESC bursts into flames. Yes, I did exactly that.

Conclusions

This is a great advance by FrSky and I will only be buying the *Neuron* in future. The telemetry gives very good results. The *S* versions are astonishingly small.

Thanks for reading and please let me know your thoughts. Or if you want to have that battle rap next time we're at the field together.

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