

Using the S.BUS interface with FrSky equipment

Peter Scott © 2018
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One of the benefits of using FrSky is that the X8R receiver comes with an S.BUS socket. This is an abbreviation of 'Serial Bus'. S.BUS enables you to have one wire feeding an area of your model that might have many servos and other devices. For example a wing might have servos for aileron and flap, an ESC (multi engines) and a retract. That means four signal wires. With S.BUS you only need one. It also means that you can use all sixteen channels without having to connect a second receiver.

Using standard servos with the S.BUS to PWM Decoder

You do not need to buy expensive S.BUS servos and other devices. FrSky sells a small 15g device called an "S.BUS to PWM Decoder", that plugs into the S.BUS receiver socket through a servo lead extension and then connects to four standard digital or analogue servos. PWM is Pulse Width Modulation, which means that the receiver sends a series of pulses to the servo. A short pulse moves the servo to one end of its travel and a long one to the other end.



Will all servos work?

People report that analogue servos sometimes don't work with the decoder. I tested three analogue servos. Of these the Hextronic HXT900 failed and the Tower Pro MG90S and Turnigy TGY-1440A worked. I have found that some retracts don't work. There seems to be no pattern about which will.

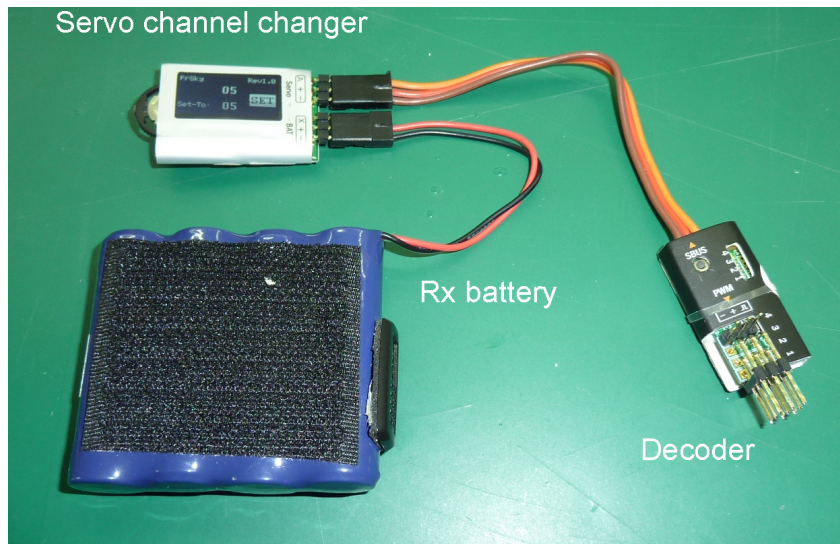
You need one decoder in each wing and perhaps a third in the fuselage to operate rudder, elevator and tailwheel devices. For three decoders you need two Y-leads at the receiver end or perhaps you might make a three-way. See my comments about wire sizes below.

On a normal receiver you assign a channel to a servo by plugging it into the correct channel on the receiver. On S.BUS all devices are on one wire, so each device has to be given and to store a channel number. For this reason you do not need to label the leads and connectors. S.BUS servos have to have the number stored inside them. FrSky's clever trick is to store these numbers in the decoder using a device called a "Servo Channel Changer". You can then plug non S.BUS servos into the decoder.



Setting channels on the decoder

Plug the **S.BUS** lead from the Decoder onto the **Servo** pins on the Servo Channel Changer (**SCC**) Connect a receiver battery to the **BAT** pins on the **SCC**. This is shown in the picture.



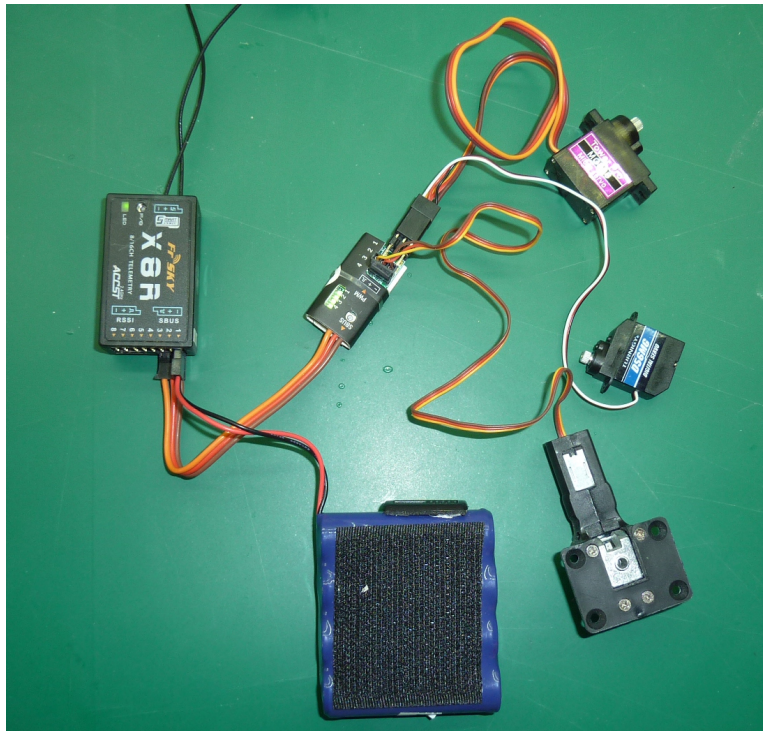
You will now see the SCC screen light up, together with one LED on the decoder. This LED shows the channel you are changing, probably 1. The upper of the two numbers on the SCC shows its current channel setting.

Now you have to use the SCC thumb wheel which is very fiddly. In general you push it in to select or save something and push it clockwise (CW) or anti-clockwise (ACW) to change something. The display will probably show **SET** lit up. Push ACW and the lower number will be lit up. Push in the wheel. You can then change the value by CW or ACW pushes. When you get the channel you want push in. Push CW to light up **SET**. Push in the wheel. You see the upper stored value change. The first time is the worst (and possibly the second and third isn't much better). After that you will know how to do it.

Now set channels for the other pins. Using a soft point push in the recessed button next to **SBUS** on the decoder. You see the LED for another servo light up. Go through the above for this and the other two sets of servo pins.

A typical setup for one wing

I decided to try out S.BUS, possibly to go in the Mosquito I am building. This is the set-up on my bench with an analogue and a digital servo and a small retract, but without the ESC connected. It all worked perfectly. Note the single wire from the Rx. You could of course use a Y-lead for another decoder if you needed more. That is the benefit of S.BUS. The ESC also worked when connected, but with the red core disconnected.



Assigning and mixing S.BUS and conventional channels

You can assign a receiver channel to more than one decoder. You can continue to use the conventional receiver channels, even one that is also used for S.BUS. For example you could use channel 7 in S.BUS for retracts in the wings and plug the tailwheel retract direct into the Rx channel 7.

Currents and wire sizes

There is one other consideration. If planning to use high-torque servos, or large retracts, the sizes of the wires will probably need to be increased, especially the ones from the decoders to the receiver. Remember that the currents for all devices travel down one wire. It would help to use high voltage servos (6 or 7.4V) as this will reduce the current for the same servo power. The wire that plugs into the S.BUS socket on the receiver will need to be the largest. The three sizes that are usually used for servo leads are 26 awg (flat), or 24 or 22 awg (usually twisted). These safely carry about 1, 3 and 5 A respectively. These numbers are very uncertain. Every table you look at gives very different values because it depends on cooling and the material of the sheath. Digital servos often draw a heavy current when starting to move or when stalled. By the way I am sorry to be using American Wire Gauge (awg) instead of modern metric, but this is how leads are specified.

Here are some typical maximum values (surprisingly difficult to discover):

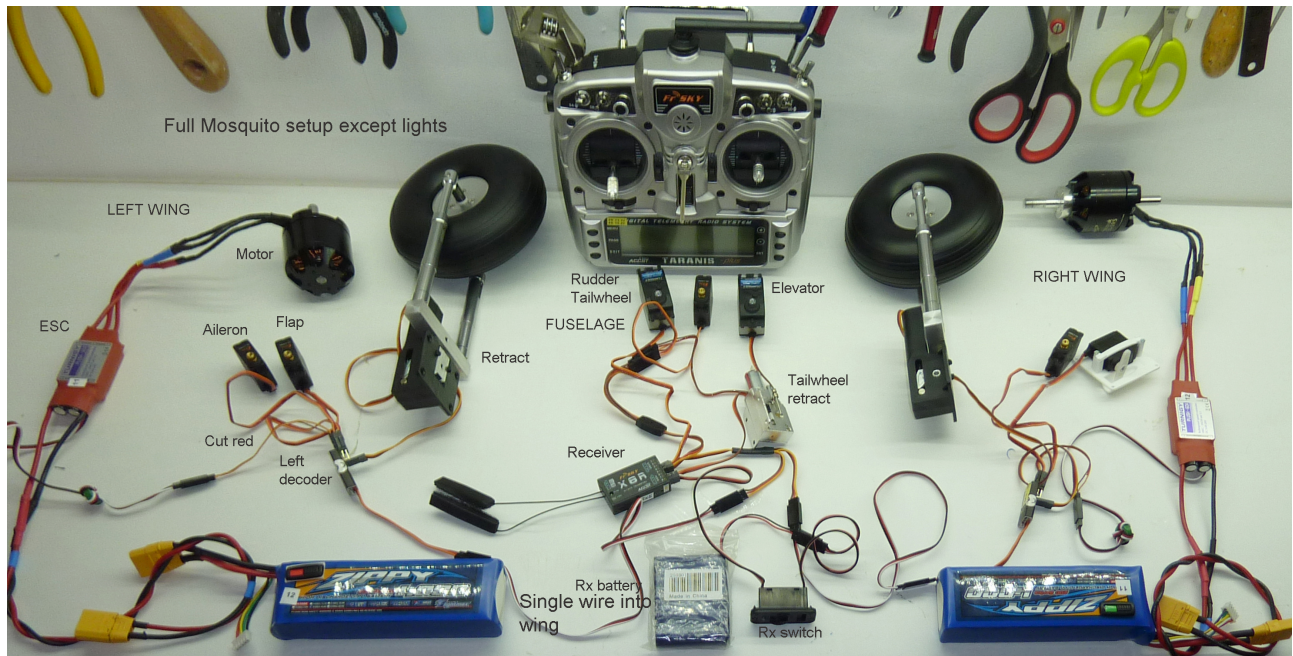
Retract unit	500 mA (or more)
Servos for aileron and flap	500 mA each (for a 15 kgcm servo)
Throttle lead for ESC	Unknown but probably low mA

Apparently some electric retracts for very heavy models can use 5 or 6 A, which is presumably why pneumatic retracts are used. Some high-torque servos can draw 3 A. However most appear to be around the figures shown. So it looks likely that for ordinary large size models 26 awg will be fine for each wing but perhaps when the wires all join up 22 or 24 awg would be advisable.

Complete system

Here is the bench layout for a system designed for my Mosquito. It is complete except for connections for lights. One key point to look out for is the fact that a single wire goes to the radio gear in each wing. There are of course also leads to connect the ESCs to the batteries in the fuselage.

In the picture you see that S.BUS is not used for the fuselage devices as my original chosen retract didn't work with the decoder. In any case fuselage connections are not unplugged so S.BUS is not essential. In the end I found a better rear retract that did work with the decoder so I reverted to using S.BUS in the fuselage as well.



Planning a FrSky S.BUS installation

In each Mosquito wing there are aileron and flap servos, together with a retract and an ESC. In the fuselage there are the usual elevator and rudder channels as well as a separate servo for tailwheel steering and a tailwheel retract. I will have two different Rx throttle channels so I can balance the motor powers exactly. I might add a sound system for the twin Merlins, with one input from each throttle channel on the Rx.

To make sure I didn't waste time putting the wrong numbers into the decoders I designed a planning sheet. This is on the last page.

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S.BUS planning table for FrSky decoders

Model MOSQUITO

Date 23 OCT 2018

Left wing			Fuselage			Right wing		
Label	Rx channel	Decoder 1 channel	Label	Rx channel	Decoder 3 channel	Label	Rx channel	Decoder 2 channel
M1			M3			M2		
Thr (twin)	1	1	Thr (single)			Thr (twin)	6	1
Aileron	2	2	Elevator	3	1	Aileron	5	2
Flap	8	3	Rud/wheel	4	2	Flap	8	3
Retract	7	4	Retract	7	3	Retract	7	4

Auxiliary functions		
	Rx channel	Decoder 4 channel
Kill switch		

Receiver		No:
Ch	Function	Input
1	THROTTLE L	STICK
2	AILERON L	STICK
3	ELEVATOR	STICK
4	RUDDER	STICK
5	AILERON R	STICK
6	THROTTLE R	STICK
7	RETRACTS	SE
8	FLAPS	SI
9		
10		
11		
12		
13		
14		
15		
16		

Installation notes

Separate throttle channels to allow balancing

Lights (if used) will be off ESCs or servo leads

S.BUS planning table for FrSky decoders

Model				Date			
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Left wing			Fuselage			Right wing		
Label	Rx channel	Decoder 1 channel	Label	Rx channel	Decoder 3 channel	Label	Rx channel	Decoder 2 channel
Thr (twin)			Thr (single)			Thr (twin)		
Aileron			Elevator			Aileron		
Flap			Rud/wheel			Flap		
Retract			Retract			Retract		

Auxiliary functions		
	Rx channel	Decoder 4 channel
Kill switch		

Receiver		No:
Ch	Function	Input
1		
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7		
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10		
11		
12		
13		
14		
15		
16		

Installation notes