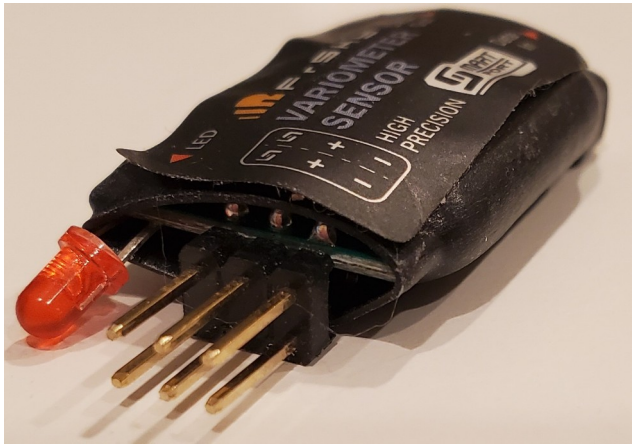
S-Port Traffic

Introduction:

The S-port bus is available on most FrSky receivers to connect external sensor devices to the receiver to gather sensor data for relay back to the transmitter. It carries only sensor data, never servo channel data. It is sometimes used to update firmware but that is beyond the scope of this paper. Sensors internal to the receiver like RSSI or rx-volts are never sent over the s-port line and hence do not appear here. Here is how s-port works:

The S-Port Bus:



The bus is a bi-directional single wire line (plus power and ground) identified by the logo above. S-port connections are available on s-port rated sensors and most recent FrSky receivers. Most sensor devices have two sets of s-port pins connected in parallel so they are interchangeable, like this High Precision Variometer. There is no defined “in” or “out”. This arrangement permits daisy-chaining several sensors on the same bus, putting them all in parallel so devices on the bus all see the same signal at the same time.

The bus is a master/slave polling arrangement running at 57.6k-baud 8N1 inverted. More details of the protocol are available here: https://github.com/yaapu/FrskyTelemetryScript/wiki/FrSky-SPort-protocol-specs

The Master, Polling:

The receiver, which is the master, sends out a short polling frame every 12ms. This frame consists of a flag byte signifying a poll and a physical device ID byte. The device ID is five bits in length so there may be up to 32 unique device IDs, although FrSky only polls 28 devices numbered 0-27. Polling begins with ID: 0 and advances to ID: 27 with one device being polled each 12ms. After ID: 27 the polling rotation repeats. This rotating polling sequence will be modified by responses from devices present. More on that later.

Slave Devices:

All slave devices present are required to respond when their ID is polled. They are not required to provide data however. If the device has no data to provide, it issues a null response frame. This happens quite a lot as devices typically don’t sample the real world very frequently.

If the device does have data to provide, it responds with a data frame. Data frames consist of a “type” byte indicating data, a two byte sensor #, and a four byte data value, plus a CRC byte. A physical device may contain multiple sensors. The altimeter illustrated above, for example, has the physical device ID: 0 and contains an Altitude sensor #100 and a Variometer sensor #110. Note that it is the physical device that is polled, not the sensor, and the slave provides the sensor #s, not the receiver.

Modified Polling Sequence:

When a device responds to a poll the receiver remembers that this device is present and responding. Devices that are responding are polled more frequently. The receiver polls all present devices sequentially and then polls the next one not-present device to find new devices if they start responding. This cycle repeats. Thus if only one device is present it will be polled every 24ms, alternating with polling the next sequential not-present device ID. With two devices, each would be polled every 36ms, as in the example below.

Example:

On the following page is a sample s-port log segment recorded with the S-Port_Snoop in “normal” mode which organizes and simplifies some of the data. When viewing this log, remember that a Null response is still a response and that zero is a valid data value. Two external sensors were connected during this log, a Vario and a Current Sensor. There was no source battery or load connected to the current sensor.

- First note the timing in the milliseconds column, 12ms per poll.
- On line 323, device ID: 26 was polled with no response, a not-present device
- On line 326, device ID: 27 was polled, also not present. This is the last device so the rotation would begin again.
- On line 324 the Vario was polled and a Null response was received, present but no data provided.
- On line 325 the FAS-40 Current Sensor was polled, also with a Null response.
- In sequence: The first present device was polled on line 324, the Vario. Then the next present device on line 325, the FAS-40. With all present devices polled, one not-present device is polled on line 326, ID: 27. Then it cycles again with the present devices polled on lines 327-328, and then the next not-present device ID: 1 on line 329. (Since the logger recognizes this ID it is identified as a FLVSS even though it is not present.)
- Further down the log there are some data responses. The device responds to the poll with a data flag instead of a Null and the sensor # is provided. It is the device that decides which sensor data to provide and when. The logger translates the sensor # to a name like “Volts” if it’s known. Data values provided in the log like the “Alt 65.43” on line 345 are just raw decimal numbers. Scaling that to an altitude in feet or meters is done downstream in the transmitter.

Telemetry with Multi-rx:

This paper describes the operation of S-port in a classic installation with one receiver and one or more external sensors. Newer ACCESS firmware permits s-port connection to multiple receivers in a redundant “Trio” installation. Mike Daily detailed such an installation here:
https://www.rcgroups.com/forums/showpost.php?p=47398449&postcount=8918

Looking at such an installation with S-Port_Snoop shows that traffic is the same as described here with a single rx. Telemetry at the tx continues even if one rx is disconnected. It’s not clear how the receivers work out which is master of the s-port. This type of s-port operation needs further investigation.

Log Sample from S-Port_Snoop:

A	B	C	D	E	F	G	H	I
Counter	Millis	ID	Device	Type	Sensor #	Sensor	Data	
323	4280	26						
324	4292	0	Vario	Null				
325	4304	2	FAS-40S	Null				
326	4316	27						
327	4328	0	Vario	Null				
328	4340	2	FAS-40S	Null				
329	4352	1	FLVSS					
330	4364	0	Vario	Null				
331	4376	2	FAS-40S	Data	210	Volts	0	
332	4388	3	GPS					
333	4400	0	Vario	Null				
334	4412	2	FAS-40S	Data	200	Amps	0	
335	4424	4	RPM					
336	4436	0	Vario	Null				
337	4448	2	FAS-40S	Null				
338	4460	5						
339	4472	0	Vario	Null				
340	4484	2	FAS-40S	Null				
341	4496	6						
342	4508	0	Vario	Data	110	Vario	0	
343	4520	2	FAS-40S	Null				
344	4532	7						
345	4544	0	Vario	Data	100	Alt	65.43	
346	4556	2	FAS-40S	Null				
347	4568	8						
348	4580	0	Vario	Null				
349	4592	2	FAS-40S	Null				
350	4604	9						
351	4616	0	Vario	Null				
352	4628	2	FAS-40S	Null				