

SFM₂ Binary Frame Description

1.0 Summary

This document describes the binary frame format as used in the USB binary data mode (see BINMODE command) as well as for BLE Data Stream(0x0101) characteristic.

2.0 Binary Frame Format

Start byte <i>0xFA</i>	Data description	Timestamp	Data	End byte <i>0xFB</i>
1 byte	2 bytes	4 bytes	Variable length	1 byte

2.1 Start byte

A single byte used as a frame delimiter. It's value is fixed: 0xFA.

2.2 Data description

Indicates what sample types are contained in the frame. The field consists of 16 bits, where each bit indicates if it's corresponding sample type is contained in the frame.

Bit	Sample Type
0	AD - Accelerometer
1	GD – Gyroscope
2	MD – Magnetometer
3	SFQ – Sensor Fusion Un-Tared Quaternion
4	SFQT – Sensor Fusion Tared Quaternion
5	SFLA – Sensor Fusion Linear Acceleration
6	SFEA – Sensor Fusion Euler Angles
7	SFCHT – Sensor Fusion Heading
8	SFM – Sensor Fusion Calibrated Magnetometer
9	PD – Pressure
10	ALT – Altitude
11	TD – Temperature
12	HD – Humidity
13	TS – Time Synch
14-15	Reserved for future use

2.3 Timestamp

Contains a single UInt32 value denoting time in 25us resolution. All samples contained in the frame share the same timestamp.

2.4 Data

Contains measurement sample data.

Sample type	Size	Content
AD - accelerometer	12 bytes	Vector of 3 floats
GD - gyroscope	12 bytes	Vector of 3 floats
MD - magnetometer	12 bytes	Vector of 3 floats
SFQ - Sensor Fusion untared quaternion	16 bytes	Quaternion of 4 floats
SFQT - Sensor Fusion quaternion	16 bytes	Quaternion of 4 floats
SFLA - Sensor Fusion Linear acceleration	12 bytes	Vector of 3 floats
SFEA - Sensor Fusion Euler Angles	12 bytes	3 floats: Roll, Pitch, Yaw
SFCHT - Sensor Fusion Heading	8 bytes	2 floats: Heading, Tilt
SFM - Sensor Fusion calibrated magnetometer	12 bytes	Vector of 3 floats
PD – Pressure	4 bytes	Single float value, in hPa
ALT - Altitude	4 bytes	Single float value, in meters
TD – Temperature	4 bytes	Single float value, in Celsius
HD – Humidity	4 bytes	Single float value, in %
TS – Time Synch	4 bytes	Two uint32 values 1) RTC time in RTC ticks(see TIME command) 2) Configuration index, incremented each time the RTC is set, either with the TIME or TOFFSET commands.

NOTE: If a frame contains more than one sample, the samples are packed one after another in the order as they appear in the table above.

2.5 End byte

A single byte used as a frame delimiter. It's value is fixed: 0xFB.

3.0 Examples

3.1 SFQT+SFLA @104Hz

Each data frame contains two samples, one for SFQT, one for SFLA. They always share a common timestamp.

Field	Start byte	Data description	Timestamp	Data		End byte
				SFQT	SFLA	
Value	0xFA	0x30*	4 bytes	16 bytes	12 bytes	0xFB

*0x30 = 0b0000 0000 0011 0000. With ones at 4th and 5th positions (zero-indexed), corresponding to SFQT and SFLA.

3.2 AD@208Hz + GD@104Hz

There are twice as many AD samples as there are GD. This means that AD samples are present in every frame, and GD samples in every other frame.

Frame 1 (AD+GD):

Field	Start byte	Data description	Timestamp	Data		End byte
				AD	GD	
Value	0xFA	0x03*	4 bytes	12 bytes	12 bytes	0xFB

*0x03 = 0b0000 0000 0000 0011. With ones at 0th and 1st positions (zero-indexed), corresponding to AD and GD.

Frame 2 (AD):

Field	Start byte	Data description	Timestamp	Data	End byte
				AD	
Value	0xFA	0x01*	4 bytes	12 bytes	0xFB

*0x01 = 0b0000 0000 0000 0001. With a single one at 0th position (zero-indexed), corresponding to AD.

Frame 1 and 2 come alternately, one after the other.