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Serial Binary Protocol (SBP) specification

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Table of Contents

Introduction

Protocol frame structure

Header		Range over which the checksum is calculated					Checksum	
SYNC1	SYNC2	ROUTE	MODE	ID	LENGTH	PAYLOAD	CHECK1	CHECK2
U1	U1	U1	U1	U1	U1	BYTE[LENGTH]	U1	U1
0xBB	0x55	BITFIELD	BITFIELD	1 ... 255	0 ... 128	BYTEARRAY	0 ... 255	0 ... 255

ROUTE		
Name	Bits	Description
DEV_ADDRESS	0:3 bit	Device address. Default and broadcast address is 0x0.
RESERVED	3:7 bit	Reserved

MODE		
Name	Bits	Description
TYPE	0:1 bit	Field defines the type and purpose of the data 0 — Reserved, 1 — CONTENT: DEVICE → HOST 2 — SETTING: HOST → DEVICE 3 —GETTING: HOST → DEVICE
RESERVED	2 bit	Reserved
VERSION	3:5 bit	Field defines the payload data version
MARK	6 bit	Once device is switched on, this flag is always in reset state (ZERO). It can be set to active state (ONE) by the host (see the ID_MARK) and the slave device keeps the flag in active state in every frame until hardware reset occurs or is reset by the host. Therefore the host monitors the device's actual settings.
RESPONSE	7 bit	HOST → DEVICE: Set the flag to active state (ONE) in order to get the result of processing the command. The flag doesn't affect the response if one is provided by the TYPE field. DEVICE → HOST: The flag is in reset state (ZERO) by default. Payload goes according to the command specification. If flag is set, the payload contains the result of command processing (see RESP).

Checksum

The checksum algorithm used is the Fletcher-16.

Example source code for calculating the checksum:

```
uint8_t CHECK1 = 0;
uint8_t CHECK2 = 0;

void CheckSumUpdate(uint8_t byte) {
       CHECK1 += byte;
       CHECK2 += CHECK1;
}
```

Number Formats

All multi-byte values are ordered in Little Endian format.

All floating point values are transmitted in IEEE754 single or double precision.

All bit-field in LSB format.

Name	Type	Size (Bytes)	Range
S1	int8_t	1	-128 ... 127
U1	uint8_t	1	0 ... 255
S2	int16_t	2	-32768 ... 32767
U2	uint16_t	2	0 ... 65535
S4	int32_t	4	-2'147'483'648 ... 2'147'483'647
U4	uint32_t	4	0 ... 4'294'967'295
F4	float	4	-1*2^+127 ... 2^+127
D8	double	8	-1*2^+1023 ... 2^+1023

Confirmation key

KEY_CONFIRM = 0xC96B5D4A

Command specification

Command overview

Name	ID	Description
Measurement data		
ID_TIMESTAMP	0x01	Timestamp
ID_DIST	0x02	Distance data
ID_CHART	0x03	Chart data in reflection patterns
ID_ATTITUDE	0x04	Attitude
ID_TEMP	0x05	Temperature data
Settings data		
ID_DATASET	0x10	Dataset management for automatic output
ID_DIST_SETUP	0x11	Detection Settings to Get Distance
ID_CHART_SETUP	0x12	Chart Settings
ID_DSP	0x13	
ID_TRANSC	0x14	Transceiver settings
ID_SOUND	0x15	Sound speed settings
ID_PIN	0x16	Pin functions settings
ID_BUS	0x17	Bus settings
ID_UART	0x18	UART settings
ID_I2C	0x19	I2C settings
ID_CAN	0x1A	CAN settings
ID_IMU_SETUP*	0x1B	IMU settings
System		
ID_VERSION*	0x20	Software and hardware version information
ID_MARK	0x21	Setting the mark of continuous work (non-reboot) device
ID_DIAG*	0x22	Diagnostic data
ID_FLASH	0x23	Work with built-in non-volatile memory
ID_BOOT	0x24	Boot device
ID_UPATE	0x25	Firmware update

Navigation		
ID_NAV	0x64	

* In developing

RESP

Contains the result of command processing. Can be used as a check if the command is processed correctly. The MODE and ID fields are the same as in the initiating command.

Message format					
TYPE	Version	Direction	Description		
CONTENT	ANY	DEVICE → HOST			
Format: [U1, U1, U1]; Length: 3					
	Type	Range	Default	Unit	Description
CODE	U1				The field contains the response code of processing the command. RESP_NONE = 0, RESP_OK = 1, RESP_ERR_CHECKSUMM = 2, RESP_ERR_PAYLOAD = 3, RESP_ERR_ID = 4, RESP_ERR_VERSION = 5, RESP_ERR_TYPE = 6, RESP_ERR_KEY = 7, RESP_ERR_RUNTIME = 8
CHECK1	U1				Command checksum
CHECK2	U1				

ID_TIMESTAMP(ID 0x01)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE	Request Timestamp		
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format

TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST	Timestamp from Device		
Format: [U4]; Length: 4					
	Type	Range	Default	Unit	Description
TIMESTAMP	U4	0 ...		ms	Timestamp

ID_DIST (0x02)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE	Get Distance		
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST	Data of chart		
	Type	Range	Default	Unit	Description
DISTANCE	U4	0 ...		mm	Distance

Message format					
TYPE	Version	Direction	Description		
CONTENT	1	DEVICE → HOST	Data of chart		
	Type	Range	Default	Unit	Description
NUMBER	U1				
STRONG	U1				

DISTANCE	U4	0 ...		mm	
WIDTH	U2	0 ...		mm	

ID_CHART (0x03)

Request CHART					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE	Get data of CHART		
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Chart data					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST	Data of chart in sample format		
Format [U2, U2, U2, U1[N]]; Length (6 + N)					
	Type	Range	Default	Unit	Description
SEQ_OFFSET	U2	0 ...			Sample Offset in Sequence
SAMPEL_RESOL	U2	10 ...		mm	Samples resolution
ABS_OFFSET	U2	0 ...			Absolute Offset in sample number for Sequence
CHART	U1[N]	ARRAY			Data of chart. The maximum data length in one packet is 250.

Chart data					
TYPE	Version	Direction	Description		
CONTENT	1	DEVICE → HOST	Data of chart in sample format		
Format [U2, U2, U2, U1[N]]; Length (6 + N)					
	Type	Range	Default	Unit	Description
SEQ_OFFSET	U2	0 ...			Sample Offset in Sequence
SAMPEL_RESOL	U2	10 ...		mm	Samples resolution

ABS_OFFSET	U2	0 ...			Absolute Offset in sample number for Sequence
CHART	U1[N]	ARRAY			Data of two charts. The two channels are represented by interleaved data. For example, the first byte is the first measurement of the first channel and the second is the first measurement of the second channel. The maximum data length in one packet is 250. Accordingly, the maximum channel length is 125.

ID_ATTITUDE (0x04)

Attitude					
TYPE	Version	Direction	Description		
GETTING	0, 1, 2	HOST → DEVICE	Request attitude		
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Attitude					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST	Attitude data in Euler 321 format		
Format: [S2, S2, S2]; Length: 6					
	Type	Range	Default	Unit	Description
YAW	S2	-18000 ...18000		0.01 deg	Yaw
PITCH	S2	-18000 ...18000		0.01 deg	Pitch
ROLL	S2	-18000 ...18000		0.01 deg	Roll

Attitude			
TYPE	Version	Direction	Description
CONTENT	1	DEVICE → HOST	Attitude data in quaternion format

Format [F4, F4, F4, F4]; Length 16					
	Type	Range	Default	Unit	Description
W0	F4			—	
W1	F4			—	
W2	F4			—	
W3	F4			—	

ID_TEMP (0x05)

Request temperature					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE	Request temperature from device		
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Temperature data					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
Format: [S2]; Length: 2					
	Type	Range	Default	Unit	Description
TEMP	S2			0.01 °C	

ID_DATASET (0x10)

Request Data set			
TYPE	Version	Direction	Description
GETTING	0	HOST → DEVICE	Request Data set
Format: [U1]; Length: 1			

	Type	Range	Default	Unit	Description
CHANNEL_ID	U1	0 … 2	0		Channel ID. Set 0 for request all active CHANNEL

Data set					
TYPE	Version	Direction	Description		
SETTING	0	HOST → DEVICE			
CONTENT	0	DEVICE → HOST			
Format: [U1, U4, U4]; Length: 9					
	Type	Range	Default	Unit	Description
CHANNEL_ID	U1	0 … 2	0		Channel ID. Set 0 for reset all channel.
CHANNEL_PERIOD	U4	0 …	0	ms	0 — for disable periodic response >0 — for periodic response with period by value [ms]
CHANNEL_MASK	U4	BITFIELD	0x00		bit0 — ID_DIST Ver. 0, bit1 — ID_CHART Ver. 0, bit2 — ID_ATTITUDE Ver. 0, bit3 — ID_ATTITUDE Ver. 1, bit4 — ID_TEMP Ver. 0, bit5 — ID_TIMESTAMP Ver. 0, bit6 — DIST_NMEA_SDDBT,

ID_DIST_SETUP (0x11)

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST	Data of chart		
Format: [U4, U4]; Length: 8					
	Type	Range	Default	Unit	Description
START_OFFSET	U4	0 …	0	mm	
MAX_DIST	U4	0 …	50000	mm	

ID_CHART_SETUP (0x12)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE	Get setting of Chart		
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format					
TYPE	Version	Direction	Description		
SETTING	0	HOST → DEVICE			
CONTENT	0	DEVICE → HOST			
Format: [U2, U2, U2]; Length: 6					
	Type	Range	Default	Unit	Description
SAMPLE_COUNT	U2	1 ... 5000		—	Sample count
SAMPLE_RESOL	U2	10 ... 1000		mm	Sample resolution
SAMPLE_OFFSET	U2	0 ...			Absolute Offset in number of sample

ID_TRANSC (0x14)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format			
TYPE	Version	Direction	Description

CONTENT	0	DEVICE → HOST			
SETTING	0	HOST → DEVICE			
Format: [U2, U1, U1]; Length: 4					
	Type	Range	Default	Unit	Description
FREQ	U2		675	kHz	Frequency
PULSE	U1		10	COUNT	
BOOST	U1		1	—	

ID_SND_SPD (0x15)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
SETTING	0	HOST → DEVICE			
Format: [U4]; Length: 4					
	Type	Range	Default	Unit	Description
SOUND_SPEED	U4		1500000	mm/s	Sound speed

ID_UART (0x18)

Message format

TYPE	Version	Direction	Description		
GETTING	0, 1	HOST → DEVICE			
Format: [U4, U1]; Length: 5					
	Type	Range	Default	Unit	Description
KEY_CONFIRM	U4		0xC96B 5D4A	—	
UART_ID	U1	1 ...	1	—	

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
SETTING	0	HOST → DEVICE			
Format: [U4, U1, U4]; Length: 9					
	Type	Range	Default	Unit	Description
KEY_CONFIRM	U4	—	0xC96B 5D4A	—	
UART_ID	U1	1 ...	1	—	
BAUDRATE	U4	9600 ... 921600	115200	bps	

Message format					
TYPE	Version	Direction	Description		
CONTENT	1	DEVICE → HOST			
SETTING	1	HOST → DEVICE			
Format: [U4, U1, U1]; Length: 6					
	Type	Range	Default	Unit	Description
KEY_CONFIRM	U4	—	0xC96B 5D4A	—	
UART_ID	U1	1 ...	1	—	
DEV_ADDRESS	U1	0...15	0		

ID_IMU_SETUP (0x1B) (In developing)

Message format					
TYPE	Version	Direction	Description		
SETTING	0	HOST → DEVICE	Calibrate Gyroscope		
SETTING	1	HOST → DEVICE	Calibrate Accelerometr		
Format: [U4]; Length: 4					
	Type	Range	Default	Unit	Description
KEY_CONFIRM	U4		0xC96B 5D4A	—	

ID_VERSION (0x20)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
Format: [U1, U1, U2, U2, U2, U4, U1, U1, U4 U1[16]]; Length: 34					
	Type	Range	Default	Unit	Description
HW_VER_MINOR	U1		—	—	
HW_VER_MAJOR	U1				
HW_VER_EXT	U2		—	—	
RESERVED1	U2		—	—	
RESERVED2	U2		—	—	
RESERVED3	U4		—	—	
BOOT_VER_MINOR	U1				

BOOT_VER_MAJOR	U1				
SERIAL_NUMBER	U4				
PART_NBR	U1[16]		—	—	

ID_MARK (0x21)

Message format					
TYPE	Version	Direction	Description		
SETTING	0	HOST → DEVICE			
Format: [U4]; Length: 4					
	Type	Range	Default	Unit	Description
KEY_CONFIRM	U4		0xC96B 5D4A	—	

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
Format: [U1]; Length: 1					
	Type	Range	Default	Unit	Description
MARK	U1			—	

ID_DIAG (0x22) (In developing)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
Format: []; Length:					
	Type	Range	Default	Unit	Description
UPTIME	U4			ms	
TEMP_IMU	S2			0.01 °C	
TEMP_CPU	S2			0.01 °C	
TEMP_MIN	S2			0.01 °C	
TEMP_MAX	S2			0.01 °C	
SYS_VOLT	U2			mV	
BOOST_VOLT	U2			mV	
DET_VOLT	U2			mV	
DET_NOISE	U2			mV	
AGC_GATE_VOLT	U2			mV	

ID_FLASH (0x23)

Save settings			
TYPE	Version	Direction	Description

SETTING	0	HOST → DEVICE	Save run settings to non-volatile memory		
SETTING	1	HOST → DEVICE	Restore run settings from non-volatile memory		
SETTING	2	HOST → DEVICE	Erase non-volatile memory		
Format: [U4]; Length: 4					
	Type	Range	Default	Unit	Description
KEY_CONFIRM	U4		0xC96B 5D4A	—	

ID_BOOT (0x24)

Message format					
TYPE	Version	Direction	Description		
SETTING	0	HOST → DEVICE	Reboot device		
SETTING	1	HOST → DEVICE	Run FW (for boot-loader mode)		
Format: [U4]; Length: 4					
	Type	Range	Default	Unit	Description
KEY_CONFIRM	U4		0xC96B 5D4A	—	

ID_UPDATE (0x25)

Message format					
TYPE	Version	Direction	Description		
SETTING	0	HOST → DEVICE	Upload firmware update (for boot-loader mode)		
Format: [U2, U1[N]]; Length: (2+N)					
	Type	Range	Default	Unit	Description
NBR_PACKET	U2	1 ...			
UPDATE_DATA	U1[N]	ARRAY			

ID_NAV (0x64)

Message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

Message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
Format: [D8, D8, F4]; Length: 20					
	Type	Range	Default	Unit	Description
LATITUDE	D8			deg	Latitude
LONGITUDE	D8			deg	Longitude
ACCURACY	F4			m	Accuracy

ID_DVL_VEL (0x79, 121)

Message format					
TYPE	Version	Direction	Description		
CONTENT	2	DEVICE → HOST			
Format: [U4, U4, F4, F4, F4, F4, F4, F4, F4, F4, F4, F4, F4, F4, F4, F4]; Length: 68					
	Type	Range	Default	Unit	Description
FLAGS	U4				
TIMESTAMP	U4			ms	
DELTA_TIME	F4			s	
LATENCY	F4			s	
VELOCITY_X	F4			m/s	
VELOCITY_Y	F4			m/s	
VELOCITY_Z	F4			m/s	
VELOCITY_Z1	F4			m/s	
VELOCITY_Z2	F4			m/s	
UNCERTAINTY_X	F4			m/s	
UNCERTAINTY_Y	F4			m/s	
UNCERTAINTY_Z	F4			m/s	
UNCERTAINTY_Z1	F4			m/s	
UNCERTAINTY_Z2	F4			m/s	
DISTANCE_Z	F4			m	
DISTANCE_Z1	F4			m	
DISTANCE_Z2	F4			m	

ID_SIGNAL_ENCODER (0x66, 102)

Data message format					
TYPE	Version	Direction	Description		
SETTING	0	HOST → DEVICE			
CONTENT	0	DEVICE → HOST			
Format: [U4, U2, U1]; Length: 7					
	Type	Range	Default	Unit	Description
RESERVED1	U4				
BIT_LENGTH	U2	>=0			zero if there is no data to send
DATA	U1				values: 0 (reserved for sync), 1, 2, 3, 4, 5, 6, 7, 8 (commands)

Data request message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					

ID_SIGNAL_DECODER (0x67, 103)

Data message format					
TYPE	Version	Direction	Description		
CONTENT	0	DEVICE → HOST			
Format: [U4, U2, U1]; Length: 7					
	Type	Range	Default	Unit	Description
TIMESTAMP	U4			ms	
CARRIER_US	S8	>=0		us	precision time solution in us
CARRIER_CNT	S8	>=0		-	precision time solution in carrier counter
SOURCE_LVL	F4	-INF, +INF, NAN		db	
SOURCE_SNR	F4	-INF, +INF, NAN		db	
AZIMUTH	F4	-180...180, NAN		deg	
ELEVATION	F4	-90...90, NAN		deg	
RESERVED1	U4				
RESERVED2	U4				
BIT_LENGTH	U2	>= 0			zero if no data decoded
DATA	U1				values: 0 (reserved for sync), 1, 2, 3, 4, 5, 6, 7, 8 (commands)

Data request message format					
TYPE	Version	Direction	Description		
GETTING	0	HOST → DEVICE			
Format: []; Length: 0					
	Type	Range	Default	Unit	Description
No data					