

AHRS-21 Protocol

Abstract

This document defines the data input and output protocols for the AHRS-21 product.

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1 Configuration Commands

All input configuration commands are in hexadecimal format

- Restore factory settings

50 42 E0 01 00 01 01 00

- Query firmware version

50 42 E3 01 00 00 00 00

- Data Rate – 400Hz by default

Data Rate	command
1Hz	50 42 E4 01 00 80 80 00
10Hz	50 42 E4 01 00 81 81 00
20Hz	50 42 E4 01 00 82 82 00
50Hz	50 42 E4 01 00 83 83 00
100Hz	50 42 E4 01 00 84 84 00
200Hz	50 42 E4 01 00 85 85 00
400Hz	50 42 E4 01 00 86 86 00
500Hz	50 42 E4 01 00 87 87 00

- **Baud Rate**

115200: 50 42 EA 01 00 80 80 00 (default)

230400: 50 42 EA 01 00 84 84 00

460800: 50 42 EA 01 00 85 85 00

921600: 50 42 EA 01 00 86 86 00

Note 1: A data rate of 50 Hz or higher requires a baud rate of at least 230,400

Note 2: When upgrading the firmware, the baud rate must be set to 115,200

- **Switch between text and binary formats**

To text format: 50 42 EB 01 00 80 80 00

To binary format: 50 42 EB 01 00 81 81 00 (default)

- **Enable debug messages**

Disable: 50 42 E7 01 00 81 81 00

Enable: 50 42 E7 01 00 80 80 00

- **Default Axis Direction**

Forward-Left-Up

2 Text Format Data

The output data includes a checksum, with the checksum character separated from the preceding data by '*'. The checksum is calculated as the XOR of all characters from \$ up to, but not including, '*'.

2.1 Attitude Solution -- \$PBATS

<i>Field</i>	<i>Type</i>	<i>Description</i>
Message ID	String	\$PBATS
Timestamp	Integer	Unit: 0.1ms
Attitude Flag	Integer	0: invalid 1: valid
Attitude Mode	Integer	0x00: invalid mode Bit 0: valid roll and pitch Bit 1: relative heading/yaw valid, 相对航向有效 Bit 2: absolute heading valid Others: reserved
Roll	Integer	Unit: degree, scaled by 100, right-hand definition
Pitch	Integer	Unit: degree, scaled by 100, right-hand definition
Heading	Integer	Unit: degree, scaled by 100, right-hand definition
Reserved		
Gyro-X	Integer	Unit: deg/s, scaled by 1000
Gyro-Y	Integer	Unit: deg/s, scaled by 1000
Gyro-Z	Integer	Unit: deg/s, scaled by 1000
Accel-X	Integer	Unit: m/s ² , scaled by 1000
Accel-Y	Integer	Unit: m/s ² , scaled by 1000
Accel-Z	Integer	Unit: m/s ² , scaled by 1000
Mag-X	Integer	Unit: uT, scaled by 10
Mag-Y	Integer	Unit: uT, scaled by 10
Mag-Z	Integer	Unit: uT, scaled by 10
Checksum	*Hex	

3 Binary Format Data

Binary data is output in **big-endian** format.

Field	Data	Type	Description	Byte offset
XBus Header	0xFA	U8	Preamble	0
	0xFF	U8	Sync heading	1
	0x36	U8	MTData2	2
	0x36	U8	Data block length (exclude header and CS)	3
Packet Counter	0x10	U8	ID	4
	0x20	U8	ID	5
	0x02	U8		6
	Counter	U16	Increment by 1 each time	7
Quaternion	0x20	U8	Quaternion ID-1	9
	0x10	U8	Quaternion ID-2	10
	0x10	U8	the packet length	11
	Quat[0]	FLOAT32		12
	Quat[1]	FLOAT32		16
	Quat[2]	FLOAT32		20
	Quat[3]	FLOAT32		24
Acceleration along body frame (Forward-left- up)	0x40	U8	Acceleration ID-1	28
	0x20	U8	Acceleration ID-2	29
	0x0C	U8	the packet length	30
	X	FLOAT32	m/s^2	31
	Y	FLOAT32	m/s^2	35
	Z	FLOAT32	m/s^2	39
Angular rate along body frame (Forward-left- up)	0x80	U8	Angular rate ID-1	43
	0x20	U8	Angular rate ID-2	44
	0x0C	U8	the packet length	45
	X	FLOAT32	Rad/s	46
	Y	FLOAT32	Rad/s	50
	Z	FLOAT32	Rad/s	54
checksum	CS	U8		58

Check Sum computation: CS = 0x00 – Data for each byte (exclude Preamble)

Note: The quaternion output order is W-X-Y-Z.

Corresponding Euler angles are defined using a right-handed coordinate system.