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AHRS-21

User Manual

Abstract

This document introduces the AHRS-21 attitude and heading reference system.

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1. Product Introduction

The AHRS-21 is a compact attitude measurement device based on a six-axis MEMS IMU combined with a three-axis magnetometer, providing nine degrees of freedom. The device integrates quaternion-based attitude algorithms and an extended Kalman filter directly within its internal processor. It is a high-precision, small-sized (31 × 28 mm), and low-power attitude measurement solution. The AHRS-21 is suitable for applications such as robots, UAVs, and AGVs.

1.1 Functional Overview

In terms of functionality, the AHRS-21 attitude measurement device offers the following features:

✓ 3D attitude output (yaw, pitch, roll)

✓ Attitude data rate up to 500 Hz (configurable)

✓ Quaternion-based filtering algorithm

✓ Online sensor calibration and full-temperature error compensation model

✓ Preloaded global magnetic declination model

✓ ROS support

✓ Raw sensor data output

1.2 System Performance

Hardware Specifications		
Gyroscope	Maximum Range	±2000deg/s
	Angular Random Walk	$0.2deg/\sqrt{hr}$
	Bias Stability	3 deg/hr
	Bias Temperature Drift	±0.005 deg/s/°C
	Bias Repeatability (at 25 °C)	±1 deg/s
	Nonlinearity	±0.1%
Accelerometer	Maximum Range	±16g
	Velocity Random Walk	$0.3mg/\sqrt{hz}$
	Bias Stability	2.5mg
	Bias Temperature Drift	±0.1mg/°C
	Bias Repeatability (at 25 °C)	50mg
	Nonlinearity	±0.1%
Software Specifications		
Attitude Accuracy (1σ)	Pitch	0.3°
	Roll	0.3°

	Yaw	1.2°
Data Output Rate	configurable up to 500 Hz	
Online Sensor Calibration	< 10 s	

1.3 Electrical and Physical Characteristics

Table 1.2 Electrical and Physical Specifications

Power supply	4.5V – 24V DC
Power consumption	12mA (typical @ 12V)
Size	31.5mm×28mm×13mm (L*W*H)
Weight	10g±0.2g
Operating Temp.	-40℃ -- +85℃
Storage Temp.	-45℃ -- +90℃
Vibration	8g (20 – 2000Hz)
Shock	500g (20ms)

1.4 Data Interface

Table 1.3 Data Interface

I/O	RS232 (1 port), TTL (1 port) – used for output, configuration, and firmware upgrade
Output data	Proprietary protocol and binary

1.5 Hardware Pin Definitions

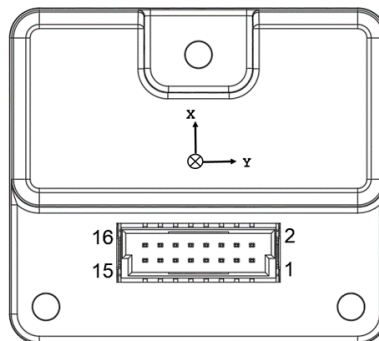The pin of the AHRS-21 are shown in Figure 1, with detailed definitions listed in Table 1.4.

Figure 1 AHRS-21 Pin definitions

Table 1.4 Pin definitions

No.	Name	I/O	Note
1	VIN	-	4.5V-24V
2	GND	-	Ground
3	reserved	-	Reserved
4	reserved	-	Reserved
5	RS232_TXD	O	RS232 TX
6	reserved	-	Reserved
7	RS232_RXD	I	RS232 RX
8	reserved	-	Reserved
9	GPIO-1	I/O	GPIO
10	reserved	-	Reserved
11	reserved	-	Reserved
12	reserved	-	Reserved
13	GPIO-2	I/O	GPIO IO
14	GND	-	Ground
15	UART_TXD	O	TTL TX
16	UART_RXD	I	TTLRX

1.6 Physical Size and Mounting Dimensions

Figure 2 shows the external and mounting dimensions of the AHRS-21.

Note: The product comes with mounting screws, and the mounting holes are designed for a secure fit with the platform.
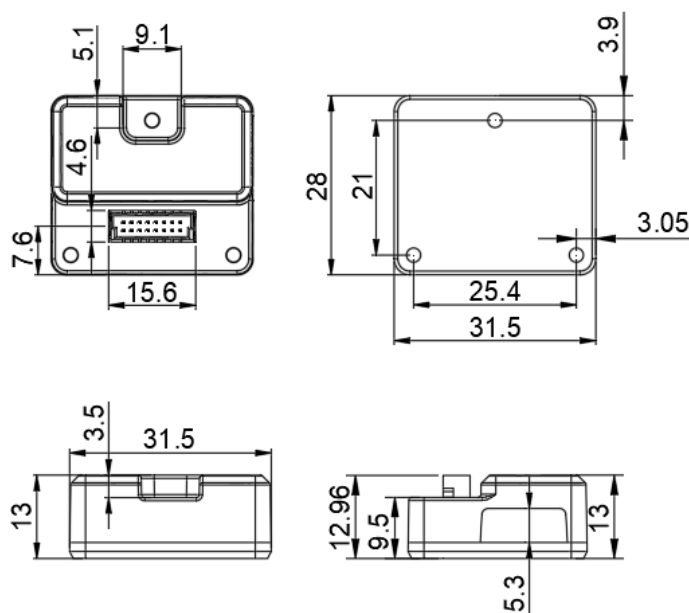
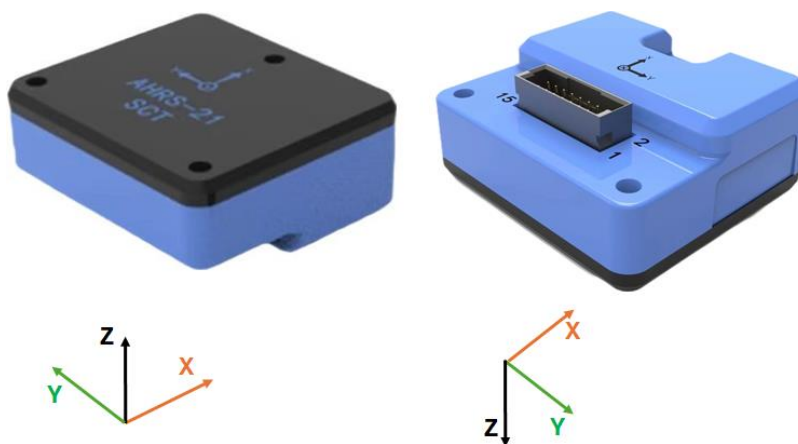Figure 2: AHRS-21 Physical and Mounting Dimensions

1.7 Definition of Axis

Figure 4：IMU Axis

2. Data Output

The AHRS-21 device accepts input configurations and can output 3D attitude and raw IMU data at rates from 1 Hz to 500 Hz. The output can be configured in either binary or text format, with RS232 and TTL interfaces providing identical data.

The following shows the default output of the AHRS-21 device. Configuration commands can modify the output data rate and content. For details, please refer to the AHRS-21 data protocol.

Table 2.1 Default Output Content

Item	Default
Data Rate	400Hz
Baud Rate	921600
Data format	binary