6-axis Inertial Navigation Module Specification

Customer：

Model Name： JWT180903

REV： 1.0

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DATE： 2018/06/04

Approved by ：	Check by：	Prepared by：
Customer check：		

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Introduction

JWT180903 is a applied in robot navigation of inertial navigation module, internal integration for six axis sensor (3 axis acceleration and 3 axis gyroscope sensor) and an applied to six axis of IMU inertial navigation processor, can complete the accelerometer and gyroscope sensor fusion processing, heading output by the stable and accurate.

Application

- Consumer floor care ROBOT
- Commercial robot
- Garden and lawn robots
- Logistics robot
- Medical-assisted robots
- Nursing robot
- Other mobile robots

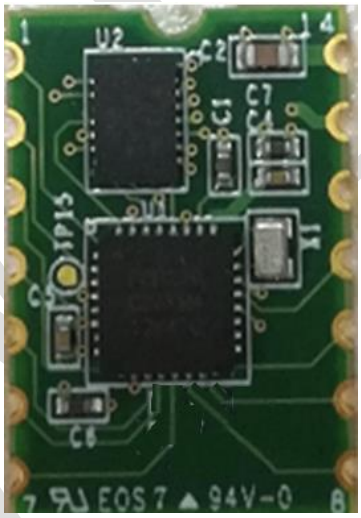


Figure 1 JWT180903 Module

Interfaces

- UART

Source	PS0	PS1
UART-RVC	1	0
UART-SHTP	0	1

Sheet 1

1. PIN out

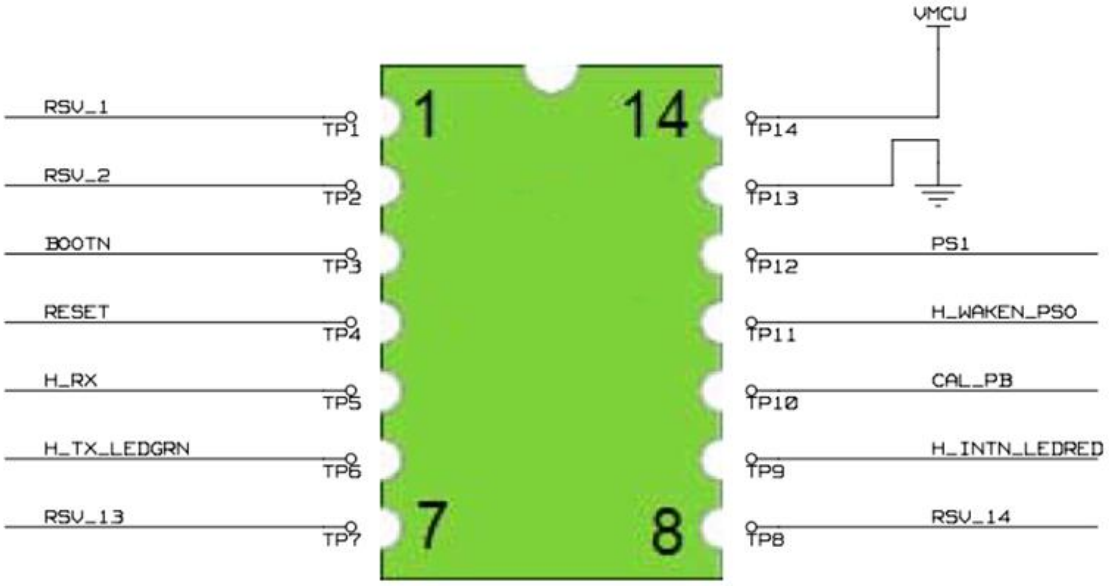


Figure 2 JWT180903 PIN Out

TP1	RSV_1	NC	TP14	VMCU	VDD
TP2	RSV_2	NC	TP13	GND	GND
TP3	BOOTN	Boot mode select . Active low.	TP12	PS1	Protocol select 1
TP4	RESET	Reset. Internal pullup.	TP11	H_WAKEN_PS0	Protocol select 0. UART-SHTP mode wake input (active low).
TP5	H_RX	UART receive data	TP10	CAL_PB	Calibration push button. Active low. Connect to DVDD if not used.
TP6	H_TX_LEDGRN	UART transmit data or calibration status	TP9	H_INTN_LEDRED	Host interrupt (active low) or calibration status
TP7	RSV13	NC	TP8	RSV_14	NC

Sheet 2

2. Absolute Maximum Electrical Ratings

Parameter	Symbol	Conditions	Rating	Unit
Voltage at supply pin	VDD		0 to 3.8	V
Electro Static Discharge	ESD	HBM	2	KV
Storage temperature	Tstg		-50 to 150	℃

Sheet 3

3. Recommended Operating Conditions

Parameter	Symbol	Conditions	Rating	Unit
Supply voltage	VDD		3.0 to 3.6	V
Operating temperature	Ta		-40 to 85	℃

Sheet 4

4. Performance Characteristics

Parameter	Performance Metric	Typical
Roll/Yaw	Resolution	0.01°
	Range	± 180 °
Pitch	Resolution	0.01°
	Range	± 90 °
Accelerometer	Range	± 8g
	Resolution	4 mg (12-bit)
	Noise density	150 μg/√Hz
	Scale error	1%
	Zero-g offset initial	70 mg
	Zero-g offset after dynamic calibration	20 mg

Gyroscope	Range	± 2000 ˚/s
	Resolution	0.06 ˚/s (16-bit)
	Noise density	0.014 ˚/s/√Hz
	Scale error @25˚C uncalibrated	1%
	Z-axis scale error calibrated	0.3%
	Scale error over aging	0.7%
	Scale error over temperature	0.03 %/˚C
	ZRO after dynamic calibration	0.006 ˚/s
Startup time	UART reports from reset	1.2 s
Composite Sensor	**Performance Metric**	**Typical**
Gaming Rotation Vector	Non-heading Error - dynamic	2.5°
	Non-heading Error - static	1.0°
	Heading Drift - dynamic	0.3°/min
Gravity	Angle Error - static	1.0°
Linear Acceleration	Accuracy - dynamic	0.35 m/s^2

Sheet 5

5. Reference circuit

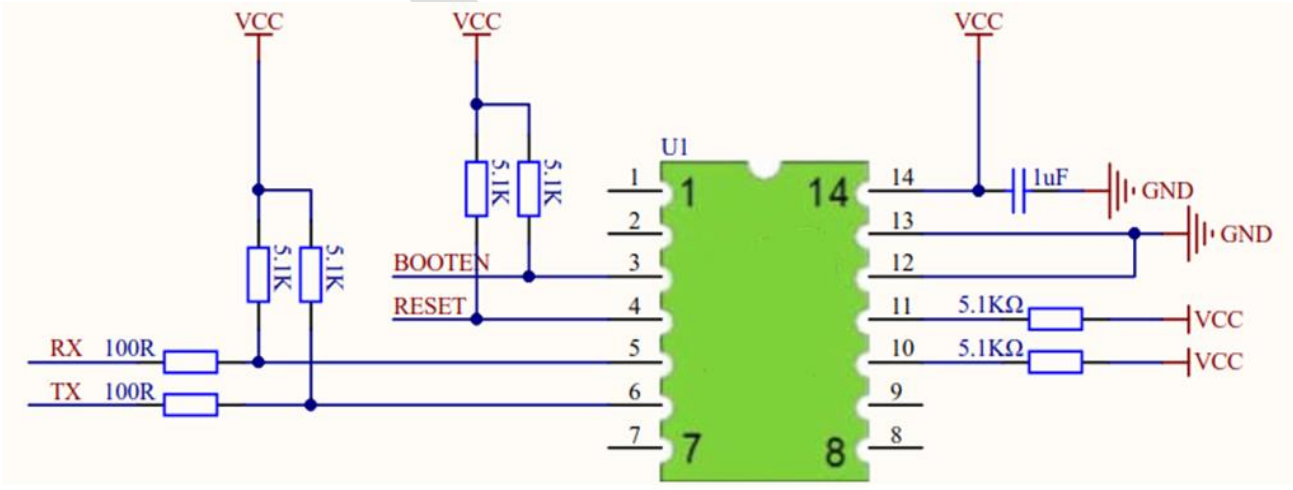
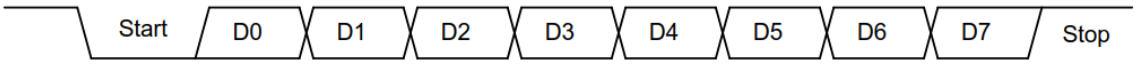


Figure 3 JWT180903 Reference circuit

6. UART-RVC Protocol

The UART operates at 115200 b/s, 8 data bits, 1 stop bit and no parity.



UART Signaling

The JWT180903 transmits the following data at a rate of 100Hz.

Header	Index	Yaw		Pitch		Roll		X-axis accel		Y-axis accel		Z-axis accel		Reserved			Csum
0xAAAA		LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	0	0	0	

UART-RVC packet format

The 19-byte message has the following fields:

Header	Each report is prefixed with a 0xAAAA header
Index	A monotonically increasing 8-bit count is provided (0-255) per report
Yaw	The yaw is a measure of the rotation around the Z-axis since reset. The yaw has a range of +/- 180˚ and is provided in 0.01˚ increments, i.e. a report of 8734 is equivalent to 87.34˚.
Pitch	The pitch is a measure of the rotation around the Y-axis. The pitch has a range of +/- 90˚ and is provided in 0.01˚ increments, i.e. a report of 1072 is equivalent to 10.72˚.
Roll	The roll is a measure of the rotation around the X-axis. The roll has a range of +/- 180˚ and is provided in 0.01˚ increments, i.e. a report of 1072 is equivalent to 10.72˚.
X-axis acceleration	The acceleration along the X-axis, presented in mg
Y-axis acceleration	The acceleration along the Y-axis, presented in mg
Z-axis acceleration	The acceleration along the Z-axis, presented in mg
Reserved	The message is terminated with three reserved bytes, currently set to zero
Checksum (Csum)	The Index, yaw, pitch, roll, acceleration and reserved data bytes are added to produce the 8 bit checksum.

7. Example

Header		Index	Yaw		Pitch		Roll		X-axis accel		Y-axis accel		Z-axis accel		Reserved			Csum
AA	AA	DE	01	00	92	FF	25	08	8D	FE	EC	FF	D1	03	0	0	0	E7

Index = 0xDE = 222
Yaw = 00.01˚ (1 = 0x0001)
Pitch = -1.10˚ (-110 = 0xFF92)
Roll = 20.85˚ (2085 = 0x0825)
X-acceleration = -371 mg = -3.638 m/s2 (-371 = 0xFE8D)
Y-acceleration = -20 mg = -0.196 m/s2 (-20 = 0xFFEC)
Z-acceleration = 977 mg = 9.581 m/s2 (977 = 0x03D1)
Checksum = 0xE7

8. Package Outline

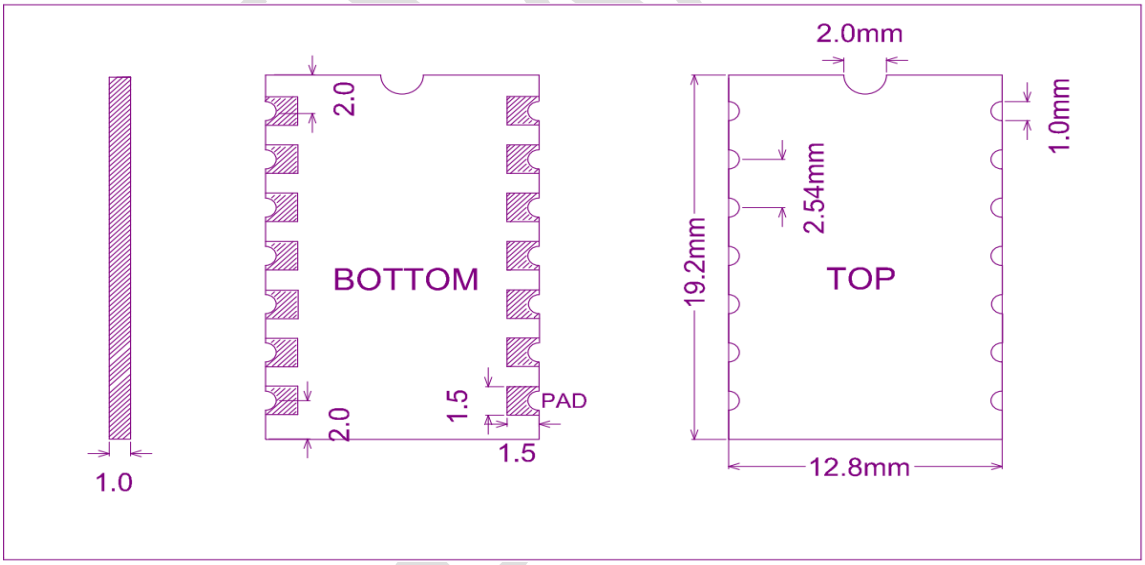


Figure 4 Package

9. Recommended Operations

- let the module sit for at least 2 seconds before the test begins:

When the robot is powered on, leaving the module still for at least two seconds before starting the motor will help to estimate accurately ZRO.

- Maintain power to the JWT180903 during power charge:

Temperature changes during power charge can impact the JWT180903 characteristics of ZRO. IMU uses the temperature data to dynamically calibrate ZRO. Keeping the JWT180903 running during the temperature changes will help to accurately estimate ZRO.

- Add 2 or more seconds pause during the navigation:

Two or more seconds pause during the navigation every 5 minutes or less will allow the dynamic calibration algorithm to complete accurate estimation of ZRO. The goal is to eliminate rotational motion for 1 to 2 seconds to allow the system to recalibrate ZRO.

- Use the reset pin to reset the JWT180903 after each navigation:

Use the reset pin to reset the JWT180903 whenever the device returns to the docking station after navigation. This will allow the dynamic calibration records to be saved into the JWT180903's non-volatile memory. This record will be used after power cycling of the device.

- Take extra rotation to "unwind" the turns during navigation:

Monitor the turns and unwind the motion to compensate turns during the navigation. This will cancel the scale error during the turns and improve the heading performance.

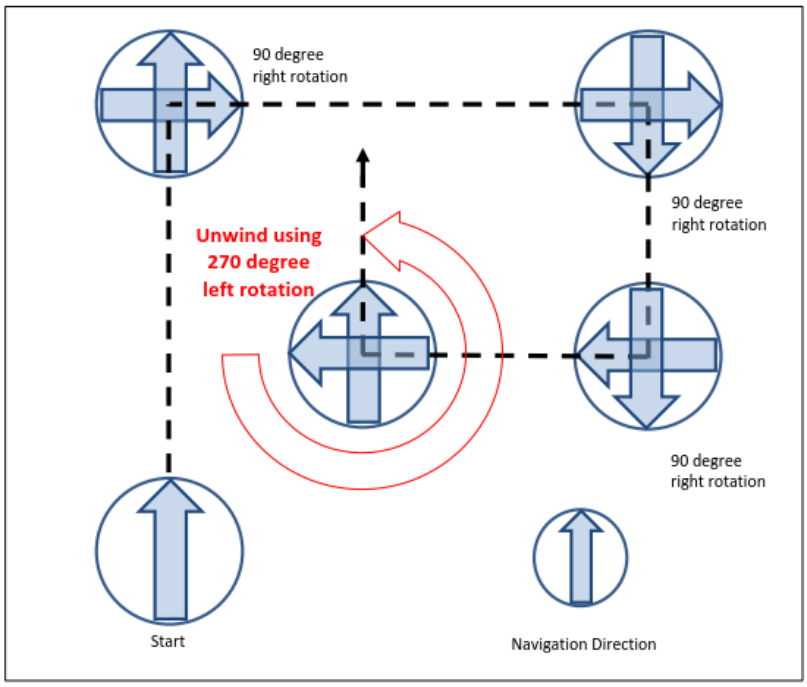


Figure 5: Compensated Turns during Navigation

10.Design Considerations

- Consider placing the JWT180903 away from the source of heat or vibration.
- Consider placing a thermal insulator to cover the JWT180903 to avoid rapid temperature changes.

11. Version History

Version	Changes	Date
V1.0	Initial release	2018.6.04