



ROHS, TS16949, ISO9001

ST216P

Dual Frequency High Precision RTK Positioning Module
Manual

Revision History

Version NO.	Version	Date
V.1	New	May, 2022

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Lead in

This manual provides users with information on the hardware features, performance specifications, and usage guidelines of the the ST216P, the dual frequency high precision RTK positioning module.

This manual is for the technical personnel use.

1. Product introduction

ST216P is a new generation of BDS/GPS/GLONASS/Galileo/QZSS dual-frequency high precision RTK positioning module in the system, and can track simultaneously BDS B1I/ B1C*/B2a /B2b*, GPS L1/L5, GLONASS L1, Galileo E1/E5a, QZSS L1/L5 and other signal frequency points. Module support UART, I2C*1, SPI* and other communication interfaces, can meet the needs of users in different scenarios.

ST216P module is of the 16.0x12.2x2.4mm compact size, adopts SMT pad, support the full automatic integration of the standard taking and placing and reflow welding.

The module supports the whole system dual frequency positioning or single system independent positioning, which is suitable for intelligent logistics, intelligent security, intelligent home, intelligent machinery, intelligent airport and other high-precision navigation and positioning fields.



Figure 1-1ST216P module pic.

Industrial level	System						Interface				Update rate
	GPS	BDS	GLONASS	Galileo	QZSS	SBAS	UART0	UART1	I2C*	SPI*	
low	low	low	low	low	low	low	low	low	low	low	1Hz~10Hz

Table 1-1 Key features of the ST216P module

¹Table: All * in this article indicates that this function is under development and may can not be supported for now.

1.1 Main features

- Support the whole system dual-frequency point on the chip RTK positioning calculating, positioning accuracy up to 1cm+1ppm (CEP)
- RTK update rate up to 10Hz
- Supports BDSB1I/B1C*/B2a/B2b*, GPSL1/L5, GLONASSL1, GalileoE1/E5a, QZSSL1/L5 and other frequency points
- Support dual frequency original observation output
- Ultra-low power consumption, dual-frequency RTK tracking, power consumption as low to 100mW
- Each satellite frequency independently tracking and 60dB narrow-band anti-jamming technology
- Can simultaneously support both reference station and mobile station application
- 16*12mm surface mounted

1.2. Technical specifications

GNSS performance		
Satellite system and frequency point	BDS: B1I, B1C*, B2a, B2b* GPS: L1C/A, L5 GLONASS: L1 Galileo: E1, E5a QZSS: L1, L5	
First positioning time	Cold start: 24s Hot start: 1s Recapture: 1s	
Sensitivity		GNSS
	Cold start Hot start Recapture Track	-148dBm -155dBm -155dBm -164dBm

Positioning accuracy	Horizontal	1.0m CEP (dual frequency system, Open sky area)		
	RTK accuracy	1cm+1ppm (CEP) (Open sky area)		
Accuracy of observation (RMS)	BDS	GPS	GLONASS	Galileo
B1I/ B1C*/ L1 C/A /E1/G1 pseudo distance	30cm	30cm	30cm	30cm
B1I/B1C*/ L1 C/A /E1/G1 carrier phase	1mm	1mm	1mm	1mm
B2a/L5/E5a pseudo-range	10cm	10cm		10cm
B2a/L5/E5a carrier phase	2mm	2mm		2mm
Velocity measurement accuracy	0.1 m/s			
Initialization time	< 5s (Recommended value)			
Initialization reliability	> 99.9%			
Data update rate	1Hz~10Hz			
Power supply				
Input voltage	+ 2.7V to 3.6V DC			
Power Consumption	100mW (four system dual frequency - capture) 100mW (four system dual frequency - tracking)			
RF input				
Input gain	15dB~30dB			
Input impedance	50 Ω			
Input power (Max.)	10dBm			
Physical Characteristics				
Size	16.0 mm x 12.2 mm x 2.4 mm			

Environmental Indicators	
Operating temperature	-40°C ~ +85°C
Storage temperature	-40°C ~ +85°C
Humidity	5% ~ 95% non-condensing
Vibration	GB2423.10
Impact	GB2423.5
Communication Interface	
UART	2, one of which is multiplexed with SPI interface pins
SPI*	1, multiplexed with UART/I2C pins
I2C*	1, multiplexed with SPI interface pin

Table 1-2 Technical specifications of ST216P module

2. Overview of the module

2.1. System Block Diagram

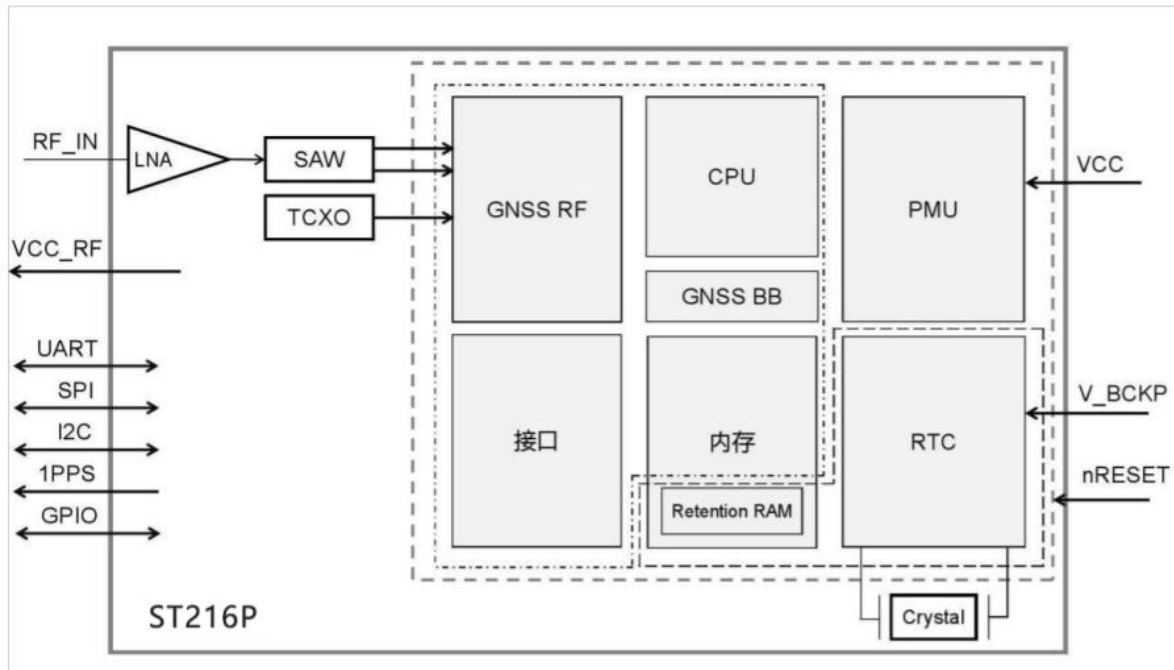


Figure 2-1 ST216P Module

2.1.1. Communication Interface

ST216P has 2 UART interfaces (UART0 and UART1), 1 way I2C and 1 way SPI interface.

- UART0

TXD0 and RXD0 pins, main serial port, multiplex pins with SPI interface;
 Default baud rate 115200bps, up to 921600bps, support adaptive baud rate or user configuration; support data transmission, firmware upgrade function;
 To support firmware upgrades, ensure that UART0 is connected to a PC or external processor.

- UART1

TXD1 and RXD1 pins, backup serial port;
 Only support data transmission, do not support firmware upgrade, mainly used for auxiliary information printing or debugging.

- I2C

Can be used for firmware loading and communication with the master;
 Protocols and electrical interfaces are compatible with 100kbps, 400kbps and 3.4Mbps.

- SPI

Support for loading firmware;
 Can be used as an optional means of host communication to transmit data;
 Maximum speed of 4Mbps when loading firmware;
 And a maximum SPI clock rate of 8MHz when transferring data.

Pins	UART0 pattern		SPI* Mode (Slave)		I2C* Mode (Slave)	
	signal	Directions	Signals	Directions	Signals	Directions
18	-		SPI_ CSN	Input	SDA	Bidirectional
19	-		SPI_ CLK	Input	SCL	Input
20	TXD0	Output	SPI_ MISO	Output	-	
21	RXD0	Input	SPI_ MOSI	Input	-	

Table 2-1 Digital Interface Pins Multiplexing

2.1.2. Second Pulse (1PPS)

Output signal, support 1 output pulse width and polarity adjustable 1PPS signal; The inherent maximum quantization error reaches +/-10ns level.

2.1.3. Reset (nRESET)

Input signal, effective in low level; Duration of Active in low is not less than 5ms.

3. Package and Pins Description

3.1. Pins Description

13	GND		GND	12
14	RTK_STAT/LNA_EN		RF_IN	11
15	RSV		GND	10
16	GEOF_STAT		VCC_RF	9
17	EINT	ST216P (Top View)	nRESET	8
18	SDA/SPI_CS _n		RSV	7
19	SCL/SPI_CLK		TXD1	6
20	TXD0/SPI_MISO		RXD1	5
21	RXD0/SPI_MOSI		RSV	4
22	V_BCKP		1PPS	3
23	VCC		DEL	2
24	GND		nRESET	1

Figure 3-1 Pin Distribution (TopView)

Serial NO.	Pin name	I/O	Level standard	Description
1	nRESET	I	LVTTTL	Reset pin, active in low Connect to master GPIO or be unconnected
2	DEL	I	-	Pin 18th to 21th multiplexing configurations: 0-----SPI interface mode 1/NC-- UART0 and I2C interface mode
3	1PPS	O	LVTTTL	Second pulse output
4	RSV	-	-	NC, be unconnected
5	RXD1	I	LVTTTL	UART1RXD, data reception
6	TXD1	O	LVTTTL	UART1TXD, data send
7	RSV	-	-	NC, be unconnected
8	nRESET	I	LVTTTL	Same function as Pin 1
9	VCC_RF	O		Antenna feed output Current range of Normal working 2.5~60mA, can also be used as antenna detection input, voltage is VCC -- ($I_{\text{antenna current}} * 10\Omega$)
10	GND	-		Ground
11	RF_IN	I		GNSS RF signal input; 50Ω impedance control
12	GND	-		Ground
13	GND	-		Ground
14	RTK_STAT/ LNA_EN	O	-	RTK status indicator or enable by the external LNA chip Connect LNA chip Enable Pin or master Interrupt or universal input pin. 1 ⁴ ---- Enable external LNA chip, or RTK fix; 0 ⁵ -- Turn off external LNA chip, or other state of RTK; Flash ---- is receiving and correcting data by using RTCM;

I/O direction: described from the Angle of ST216P module, I-- input, O-- output, I/O -- bidirectional;

LVTTTL: Refer to ST216P module I/O threshold characteristics Table

1: high level, VCC voltage domain

Serial NO.	Pin name	I/O ²	Level standard	Description
15	RSV	-	-	Be unconnected
16	GEOF_STAT	-	-	Electronic fence, user defined
17	EINT	-	-	External interrupt input
18	SDA/ SPI CS_N*	-	-	I ² C data (D_SEL=VCC or be unconnected)/ SPI Chip selects (D_SEL=GND)
19	SCL/SPI CLK*	-	-	I ² C data (D_SEL=VCC or be unconnected)/ SPI clock (D_SEL=GND)
20	TXD0/S PI MISO* -	O	LVTTTL	SPI interface, MISO signal (D_SEL=GND); UART TXD signal (D_SEL=VCC or be unconnected)
21	RXD0/S PI MOSI* -	I	LVTTTL	SPI interface, MOSI signal (D_SEL=GND); UART RXD signal (D_SEL=VCC or be unconnected)

22	V_BCKP	I	1.7 V ~ 3.6 V	Backup power, used for hot start function; When not using the hot start function, can be unconnected
23	VCC	-	2.7 V ~ 3.6 V	Power input
24	GND	-	-	Ground

Table 3-1 Pin Description

0: Low level, grounded directly or through resistance;

* indicates: the function is under development, currently not supported;

NC: unconnected.

3.2. Module mechanical dimensions

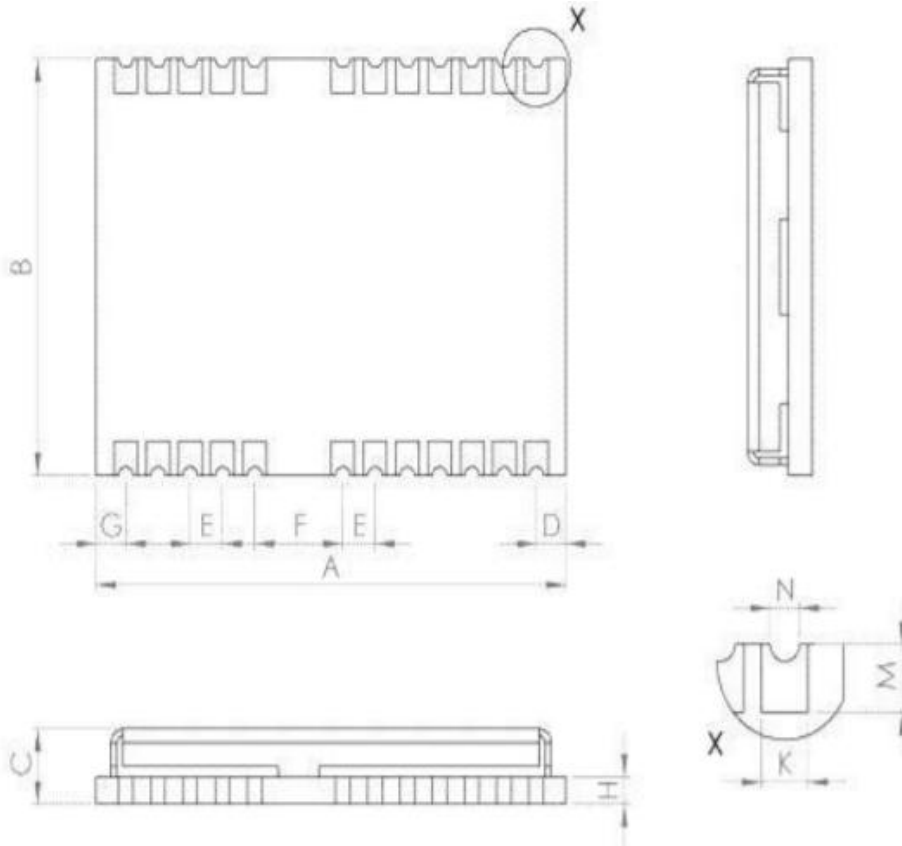


Figure 3-2 Mechanical Drawing of ST216P module

Parameters	Size instructions	Minimum value	Typical value	Maximum value
A	long	15.5	16.0	16.5
B	width	12.1	12.2	12.3
C	hight	2.2	2.4	2.6
D		0.9	1.0	1.3
E	Pin spacing	1.0	1.1	1.2
F		2.9	3.0	3.1
G		0.9	1.0	1.3
H	PCB thickness		0.8	
K	Pin width	0.7	0.8	0.9
M	Pin length	0.8	0.9	1.0
N	Pin hole diameter	0.4	0.5	0.6

Table 3-2 Mechanical Parameters (unit: mm)

4. Electrical characteristics

4.1. Maximum tolerance value

Parameters	Symbols	Minimum value	Maximum value	Units
Supply voltage	VCC	-0.3	3.6	V
Spare batteries	V_BCKP	1.7	3.6	V
Input pin voltage	Vin	-0.3	3.6	V
Antenna RF input power	RF_IN input power		10	dBm
External LNA power output	VCC_RF	-0.3	3.6	V
Storage temperature	Tstg	- 40	85	°C

Table 4-1 Absolute Ratings

4.2. Operating Conditions

Parameters	Symbols	Minimum value	Recommended value	Maximum value	Units	Conditions
Supply voltage	VCC	2.7		3.6	V	
VCC maximum ripple	Vrpp	-		50	mV	
Working current	Iopr		35	100	mA	VCC = 3.3 V
Operating temperature	Topr	- 40		85	°C	
Power consumption	P		100		mW	

Table 4-2 Recommended Operating Conditions

4.3. I/O Threshold Features

Parameters	Symbols	Minimum value	Typical value	Maximum value	Units	Conditions
Low level input	Vin_low	0		0.2 * VCC	V	

Note: Due to the capacitor installed inside the product, the impulse current will be generated at the time of power-on. In the actual application scenario, the impact of voltage drop caused by impulse current on the system should be evaluated and confirmed.

Parameters	Symbols	Minimum value	Typical value	Maximum value	Units	Conditions
High level input	Vin_high	0.7 * VCC		VCC+0.2	V	
Low level output	Vout_low	0		0.45	V	I _{out} =4mA
High level output	Vout_high	VCC-0.45		VCC	V	I _{out} =4mA

Table 4-3 I/O threshold Characteristics

4.4. Antenna Characteristics

Parameters	Symbols	Minimum value	Typical value	Maximum value	Units	Conditions
Input gain	Gant	15		30	dB	

Table 4-4 External Antenna Characteristics

4.5. External Antenna Feed Design

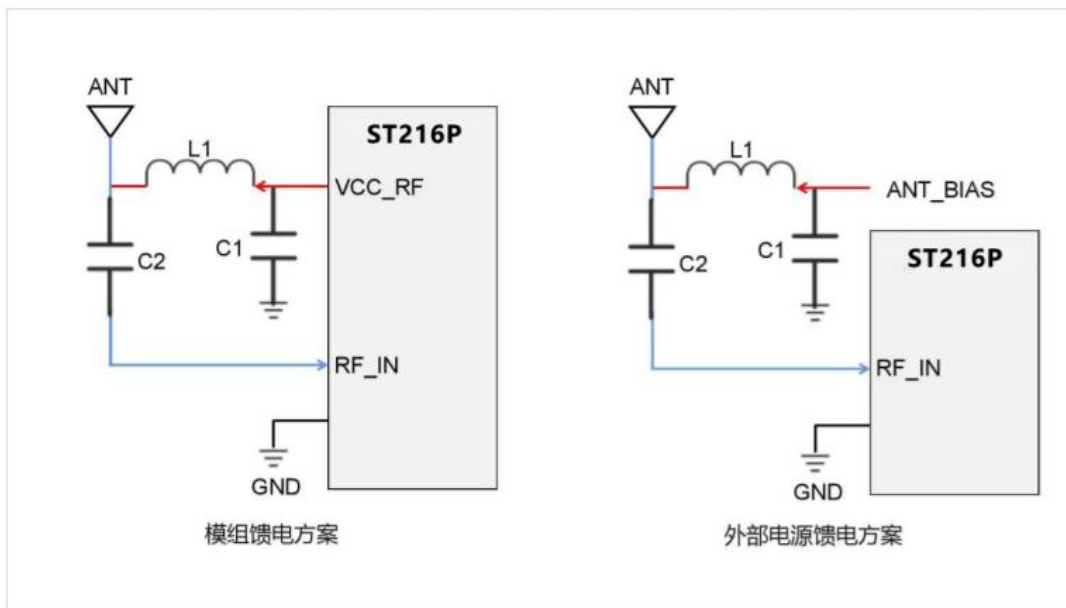


Figure 4-1 External Antenna Feed Design

Circuit L1, feed inductor, recommend 68nH RF inductor in 0603 package;●

- C1, decoupling capacitor, recommend each be in parallel by the 100nF/100pF two capacitors;
- C2, RF isolate direct coupling capacitor;
- L1, C1, C2 and ST216P modules should be placed close to the antenna feed point;
- External antenna feeding mode:

If antenna detection is required, use module VCC_RF to feed the external antenna (module feeding scheme);

If not antenna detection is required, it is recommended to use an external power supply to feed the external antenna directly (external power supply feeding scheme).

- Red line: The power supply line of antenna feeds;
- Blue line: RF wiring, requiring 50Ω impedance control;

5. Production Requirements

The recommended welding temperature curve is as follows:

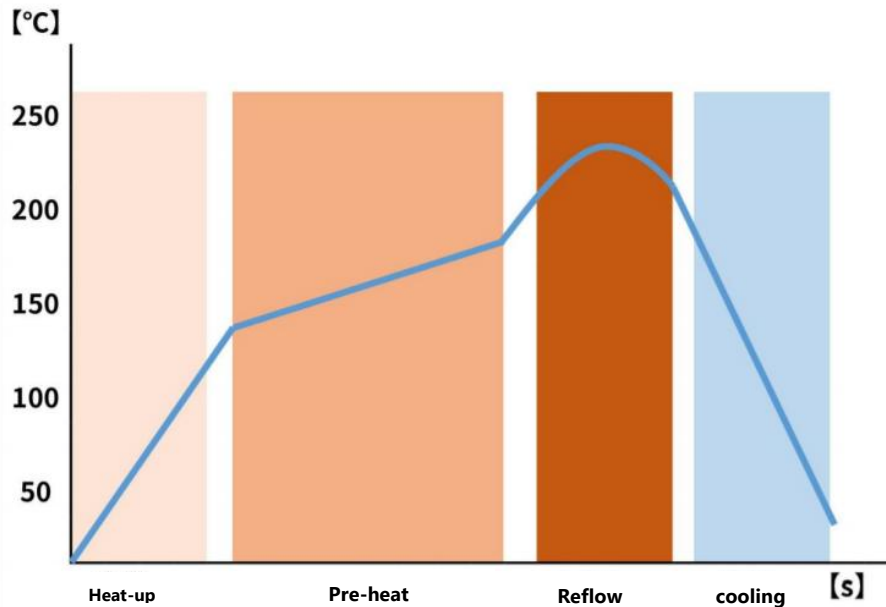


Figure 5-1 Furnace Temperature Curve of Lead-free Process

Lead-free Process	Heat up	Pre-heat	Reflow	Cooling
Temperature interval (°C)	50 ~ 150	150-180	>217 (melting point) <245	< 217
Temperature slope (° C /s)	< 3			< 4
Time of Duration (s)	~ 50	60 ~ 120	40 ~ 60 (> 217 ° C)	~ 40
Remarks	The warming slope less than 3 ° C /s		The peak welding temperature should not exceed 245°C	Cooling slope maximum 4 ° C /s

Table 5-1 ST216P lead-free process parameters

° C: Degrees Celsius;

° C /s: Celsius/second.



1. In order to prevent the module from falling off during welding, please do not design to weld the module on the back of the board, that is, it is best not to go through two welding cycles.
2. The setting of welding temperature depends on many factors of factory of the product, such as the nature of the motherboard, solder paste type, solder paste thickness, etc. Please refer to the relevant IPC standards and solder paste indicators at the same time.
3. Because the welding temperature of lead is relatively low, if use lead welding, please give priority to other components on the board.
4. The opening requirements of steel mesh need to meet the customer's own design requirements and inspection specifications.

The thickness of the steel mesh should be more than 0.15mm, and recommend 0.18mm.

6. Package

6.1. Label instructions



Figure 6-1 Label Description

6.2. Packaging instructions

The modules are packaged in a vacuum-sealed aluminum foil anti-static bag with desiccant for moisture protection using carrier tape and reel (suitable for mainstream surface mount equipment).

When the module is welded by reflow soldering process, please strictly comply with IPC standards to control the humidity of the module. Since the packaging materials such as the carrier tape can only withstand the temperature of 55 ° C, the module needs to be removed from the packaging during baking.

Parameters	Description
Qty	500 pieces/rolls
Reel Size	Tray: 13 inches Outer diameter 330mm, inner diameter 100mm, width 24mm, wall thickness 2.0mm
Carrier Band	Module spacing (center distance) : 20mm

Table 6-1 Packing Instructions for ST216P Reels

The MSL level of ST216P module is Level 3. Please refer to IPC/JEDEC standards for baking requirements.

The shelflife of the T216P module is one year.



1. When the vacuum sealing bag is opened, if the ambient temperature is < 30° and the humidity is < 60°, the SMT shall be finished within 48 hours;
2. When the original aluminum foil empty bag is completely packed (no damage, leakage), the storage period(shelflife) is one year, the storage environment requirements are between 18~28°C, and the humidity is below 60%(RH).

7. Order information

Model Number	Package size	Operating temperature	Grade	Features	Packaging
ST216P	16.0x 12.2x2.4mm	40 ~ 85 °C	Industrial code grade	RTK	Tape wrap, 500 pieces per roll

Table 7-1 ST216P Order Information Sheet

Shenzhen Simple Technology Electronics Co., LTD.



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