JINWEI
JINWEI INTEGRATED CIRCUIT

DM712 Series Modules

User Manual

We are committed to serve every person as a leading global provider of navigation and positioning services based on our homegrown chips

Document Information

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1. Introduction

1.1. General

DM712 series modules include three products: "DM712 All-Constellation Multi-frequency Positioning Module", "DM712D All-Constellation Positioning and Heading Module" and "DM712D-B All-Constellation GNSS/INS Integrated Positioning and Heading Module". The series are high-precision positioning and heading modules based on the "Dolphin III" chip independently developed by JINWEI INTEGRATED CIRCUIT, and support the tracking of Global Navigation Satellite System (GNSS) signals of all constellations and frequencies. Supporting multiple differential positioning modes (such as Real-Time Kinematic (RTK) and differential GNSS (DGNSS)) and the Precise Point Positioning (PPP) mode, DM712 series modules can provide positioning services to an accuracy of centimeter, decimeter and meter.

The series modules come with anti-multipath design. DM712D supports dual antenna heading solution. DM712D-B also supports the GNSS/INS integrated navigation. Products can be widely used in the professional markets such as surveying and mapping, deformation monitoring, precision agriculture, machinery control, intelligent driving, unmanned aerial vehicle, and lawn mower.

1.2. Product Features

- Adopts the high-precision and high-performance "Dolphin III" chip independently developed by JINWEI INTEGRATED CIRCUIT.
- Supports GPS, GALILEO, BDS, GLONASS and QZSS multi-frequency signals.
- Supports Low Density ParityCheck Code (LDPC) decoding accelerator (including Binary, Decimal, Octal, Hexadecimal,and so on).

- Provides the built-in high-performance processor and matrix accelerator. Supports on-board high-frequency positioning in RTK and Precise Point Positioning (optional) modes.
- Provides the original "Dolphin sound" interference detection and suppression algorithms, improving reliable data reception quality and RTK positioning performance in complex application scenarios.
- DM712D-B module has a built-in IMU, with the INS and GNSS/INS capabilities.

1.3. Technical Specifications

Table 1 DM712 series modules technical specifications

Performance index				
Module Model		DM712	DM712D	DM712D-B[1]
Number of channels		384		
Frequencies	GPS	L1CA/L1C/L2C/L5	L1CA/L2C	
	Galileo	E1/E5a/E5b	E1/E5b	
	BDS	B1I/B2I/B3I/B1C/B2a/B2b	B1I/B2I/B3I	
	GLONASS	L1/L2	L1/L2	
	QZSS	L1/L2 (optional)	L1/L2 (optional)	
	SBAS	L1 (optional)	L1 (optional)	
Update Rate	Raw data	10Hz	10Hz	5Hz (integrated navigation is on)
	RTK	10Hz	10Hz	5Hz (integrated navigation is on)
	Integrated navigation	-	-	100Hz
Single Point Positioning accuracy	Horizontal	≤ 1.5m (RMS)		
	Vertical	≤ 3.0m (RMS)		
DGNSS accuracy	Horizontal	≤ 0.3m + 10ppm (RMS)		
	Vertical	≤ 0.6m + 10ppm (RMS)		
RTK accuracy	Horizontal	≤ 8.0mm + 1ppm (RMS)		
	Vertical	≤ 15mm + 1ppm (RMS)		
Heading accuracy		-	≤0.2°/m (RMS)	
Dead reckoning accuracy (traveling distance < 1km or out-of-lock time < 2min)		-		2%* distance traveled
Timing accuracy		≤ 20ns (RMS)		

Velocity accuracy	≤ 0.05m/s (RMS)
Cold start time	≤ 45s
Recapture time	≤ 1s
RTK initialization time	≤ 5s (10 km baseline)
RTK initialization reliability	≥ 99.9% (10 km baseline)
Supported Protocols	RTCM2.X RTCM3.X NMEA-0183
Physical Characteristics	
Size	30mm×40mm×3.2mm(±0.2mm)
Weight	7.8g
Power Supply Voltagy	3.0V~3.6V DC
Average power consumption (RMS)	1W
Antenna Feed	3.3~5.5V (depending on input voltage), 0mA~200mA
Environmental Indicators	
Humidity	95% non-condensing
Operating temperature	-40℃~+85℃
Storage temperature	-45℃~+125℃
Module Interface	
Function interface	3×UART, 1×I2C, 1×PPS, 1×SPI, 1× EVENT
*Notes: 1. By default, the DM712D-B GNSS/INS function is not turned on. The function performance is the same as that of the DM712D when it is not turned on.	

1.4. Functional Block

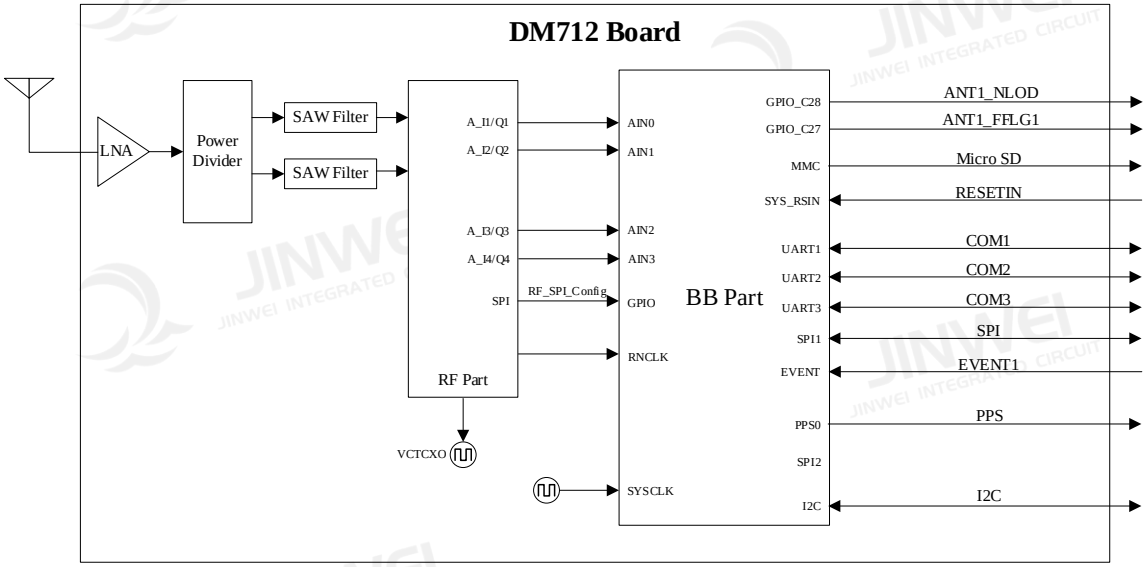

Figure 1 Function block of DM712

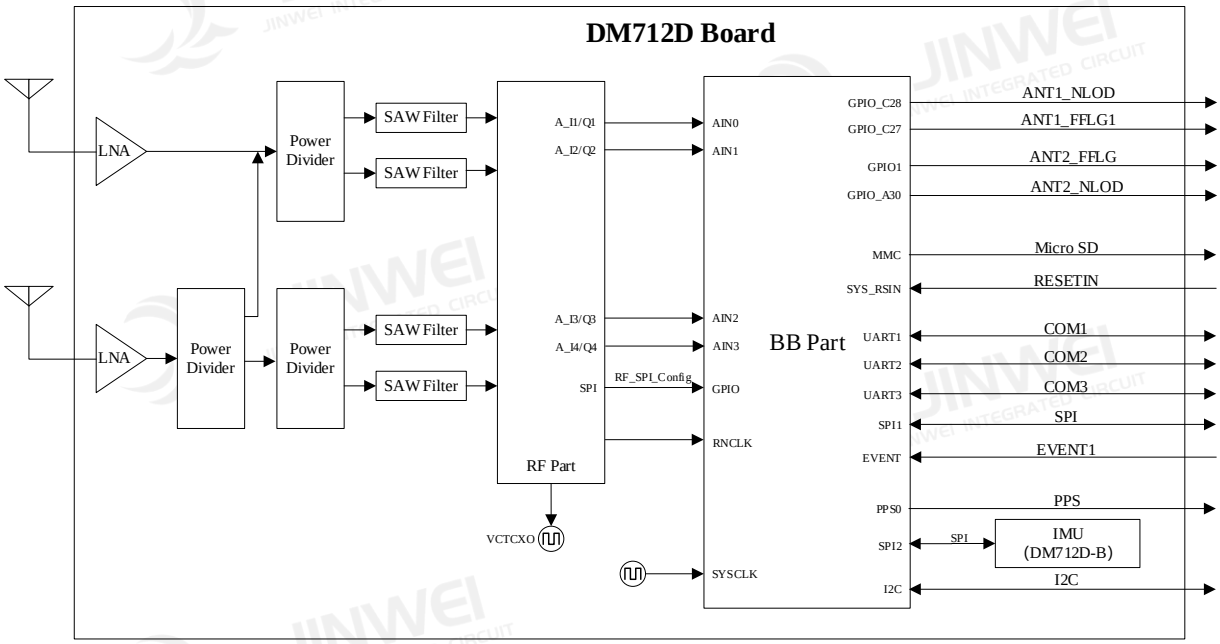

Figure 2 Functional block of DM712D and DM712D-B

(1) RF Part

The module obtains the GNSS signal from the antenna through the coaxial cable. Signals are amplified and filtered, down-converted to the IF signal through the RF chip, and then sent to the Dolphin III baseband chip for processing.

(2) BB Part

The baseband processor part is mainly composed of the Dolphin III navigation baseband chip and its peripheral circuits. The baseband part (BB Part) mainly completes functions such as satellite signal capture, tracking, navigation message coding and decoding, original observation extraction, PVT solution, protocol conversion and data communications.

(3) IMU

DM712D-B is integrated with the on-board MEMS chip, to effectively solves the problem of positioning interruption caused by satellite signal loss-of-lock, and ensure the continuity and reliability of positioning and heading output in complex environments such as high-rise buildings, tunnels and viaducts.

(4) External Interface

The product provides second pulse output (PPS), event input (EVENT) and reset (RESETIN) interfaces, as well as multiple serial ports, and SPI.

2. Hardware Components

2.1. Structural Size

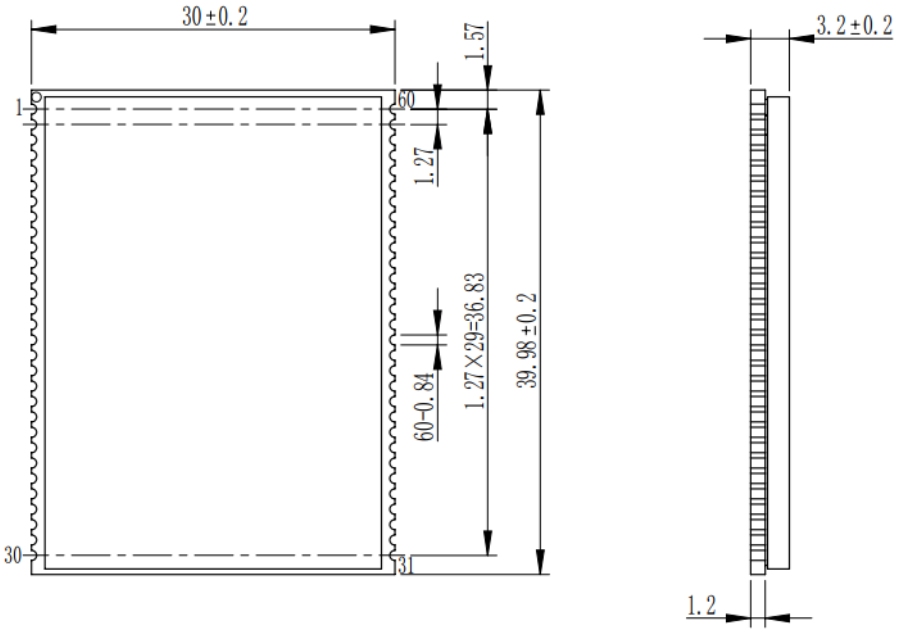

Figure 3 DM712 series modules size

2.2. Package Reference

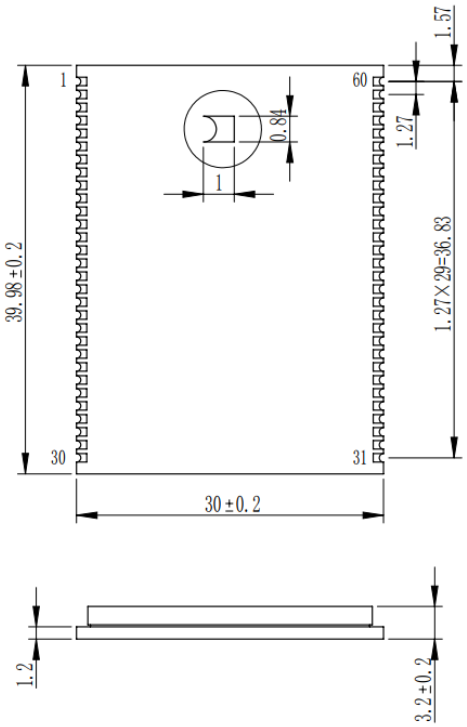

Figure 4 Package of DM712 series modules

2.3. Pin Definition

Table 2 Pin definition

PIN	Name	Type	Description	Remarks
1	GND	PWR	Signal and power grounding	GND
2	ANT1_IN1	I	Main antenna signal input	
3	GND	PWR	Signal and power grounding	GND
4	GND	PWR	Signal and power grounding	GND
5	ANT1_PWR	PWR	Master antenna power supply	Feed input
6	GND	PWR	Signal and power grounding	GND
7	ANT1_NLOD	O	Master antenna disconnection indication	Reserved
8	ANT1_FFLG	O	Master antenna short-circuit indication	Active low, internal pull-up, default high
9	GND	PWR	Signal and power grounding	GND
10	RESERVED	-	Reserved pin	Unused pins are left unconnected
11	RESERVED	-	Reserved pin	Unused pins are left unconnected
12	RESERVED	-	Reserved pin	Unused pins are left unconnected
13	RESERVED	-	Reserved pin	Unused pins are left unconnected
14	GND	PWR	Signal and power grounding	GND
15	SPEED	I	Odometer pulse	Reserved
16	FWR	I	Odometer heading	Reserved
17	V_BACKUP	PWR	RTC battery	
18	GND	PWR	Signal and power grounding	GND
19	PV_STAT	O	Differential indication	Default low, high and low levels flashing when receiving differential data
20	GPIO	I/O	General IO	
21	RESERVED	-	Reserved pin	
22	FRESET_N	I	Reset to factory mode	Active Low
23	ERR_STAT	O	Abnormality Indicator	Active High
24	RTK_STAT	O	RTK positioning indicator	Active high, output high level when RTK positioning, output low level in other states
25	GND	PWR	Signal and power grounding	GND
26	SPI_MISO	I	SPI data input	
27	SPI_MOSI	O	SPI Data Output	
28	SPI_CLK	O	SPI Clock	
29	SPI_SSO	O	SPI 片选 0	
30	SPI_SS1	O	SPI 片选 1	

PIN	Name	Type	Description	Remarks
31	VCC	PWR	Power Supply	3.3V
32	VCC	PWR	Power Supply	3.3V
33	GND	PWR	Signal and power grounding	GND
34	GND	PWR	Signal and power grounding	GND
35	TXD1	O	Serial port 1 data output	3.3V
36	RXD1	I	Serial port 1 data input	3.3V
37	TXD2	O	Serial port 2 data output	3.3V
38	RXD2	I	Serial port 2 data input	3.3V
39	TXD3	O	Serial port 3 data output	3.3V
40	RXD3	I	Serial port 3 data input	3.3V
41	I2C_SDA	I/O	I2C Data	
42	I2C_SCL	O	I2C Clock	
43	GND	PWR	Signal and power grounding	GND
44	PPS	O	1PPS output	
45	EVENT	I	EVENT input	
46	RST_N	I	Fast reset, without clearing user configuration	Active Low
47	GND	PWR	Signal and power grounding	GND
48	RESERVED	-	Reserved pin	Unused pins are left unconnected
49	RESERVED	-	Reserved pin	Unused pins are left unconnected
50	RESERVED	-	Reserved pin	Unused pins are left unconnected
51	RESERVED	-	Reserved pin	
52	GND	PWR	Signal and power grounding	GND
53	ANT2_FFLG	O	Slave antenna short-circuit indication	Active low, internal pull-up, default high
54	ANT2_NLOD	O	Slave antenna disconnection indication	Reserved
55	GND	PWR	Signal and power grounding	GND
56	ANT2_PWR	PWR	Slave antenna power supply	Feed input
57	GND	PWR	Signal and power grounding	GND
58	GND	PWR	Signal and power grounding	GND
59	ANT2_IN	I	Slave antenna signal input	
60	GND	PWR	Signal and power grounding	GND

Note: The DM712 module does not support relevant pins of slave antenna.

3. Electrical Features

3.1. Absolute Maximum Ratings

Table 3 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Power Supply Voltage	Vcc	-0.3	3.6	V
Input Voltage	Vin	-0.3	3.6	V
Antenna RF Input Power	ANT_IN input power		-10	dBm
Storage Temperature	Tstg	-45	125	℃

3.2. Operating conditions

Table 4 Operating conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Power Supply Voltage	VCC	3.0	3.3	3.6	V	
Power-on inrush current	ICCP	0.4	0.6	1	A	VCC=3.3V
Output high level voltage	VOH	2.4	3.3	3.3	V	
Output low level voltage	VOL	-0.3	0	0.3	V	
Input high level voltage	VIH	2.4	3.3	3.3	V	
Input low level voltage	VIL	-0.3	0	0.3	V	

3.3. Antenna Feature

Table 5 Antenna Feature

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Optimum Input Gain	Gant	20	30	42	dB	
GNSS antenna power supply	ANT_PWR	3.3	5.0	5.5	V	< 200mA

4. Hardware Integration

4.1. Basic Reference Design

DM712 series modules provide the function of feeding the antenna internally. For the stability of the antenna power supply and the ability to protect against lightning strikes and surges, it is recommended that users design external circuits to feed the antenna.

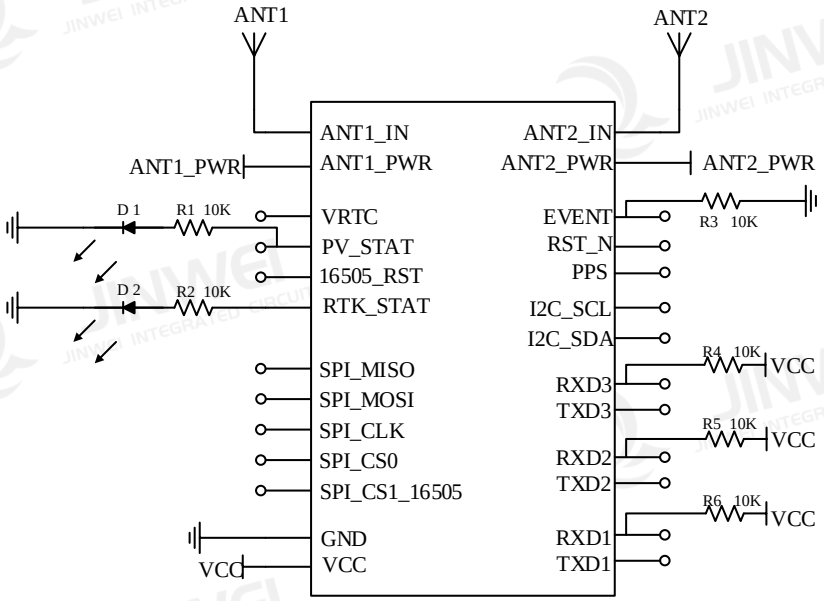

Figure 5 Reference Circuit of DM712 series module

Table 6 Recommended device for DM712 series modules

No.	Device	Description
1	R1-R6	Resistor, 10kΩ
2	D1-D2	LED

4.2. Precautions

1) The supply voltage must strictly follow the range specified by the electrical characteristics to avoid overvoltage. Otherwise, the module may be damaged or burnt.
2) The power supply scheme can be selected as required. In order to ensure stable performance, it is recommended that the peak-to-peak value of the power supply voltage ripple be controlled within 50 mVpp.
3) The RF layout should be arranged with the match of 50Ω impedance. The bend radius should be smoothing, instead of right-angle or sharp-angle. Maintain the consistency of the signal layer. Ensure that the adjacent layer below the connection line should have a complete ground plane.
4) In the process of PCB layout, sensitive signal lines should not be designed on the surface layer directly below the module.

5. Software Configuration

5.1. Data Interface Protocol

Table 7 Data Interface Protocol

No.	Interface	Supported protocol
1	UART	NMEA0183
		RTCM3.x
		Custom protocol

5.2. Working Mode

Whether in Base or Rover status, DM712 single antenna module provides two working modes: multi-frequency positioning and low power consumption positioning. In a Base or Rover, DM712D and DM712D-B dual-antenna positioning and heading modules provide three working modes: low power consumption positioning, B2I positioning and heading, and B3I positioning and heading. In each mode, the number of frequencies varies with power consumption. For details, see Table 8. Users can select as required.

Table 8 Working mode of DM712 series modules

Status	Module Model	Working mode	Code	Working frequency
Rover/Base	DM712	All-frequency positioning mode	1	B1I/B2I/B3I/B1C/B2a/B2b L1CA/L2C/L1C/L5 L1/L2 E1/E5b/E5a
	DM712 DM712D DM712D-B	Low power consumption positioning mode	2	B1I/B2I/B3I L1CA/L2C L1/L2 E1/E5b
	DM712D DM712D-B	B2I positioning and heading mode	3	B1I/B2I L1CA/L2C E1/E5b
		B3I positioning and heading mode	4	B1I/B2I/B3I L1CA/L2C E1/E5b

Note:

1. By default, DM712 operates in low power consumption mode, and DM712D and DM712D-B operate in B3I positioning and heading mode. You can switch the working mode by choosing CSHG MODE ROVER/BASE [code].

2. The GNSS/INS is support only in Rover mode.

5.3. Default Configuration

Table 9 Default configuration

No.	Parameter	Description	Rover	Base
1	obsfreq	Observation frequency	10Hz	10Hz
2	pvtfreq	PVT solution frequency	10Hz	10Hz
3	diffage	Effective age of differential data	120s	-
4	Serial port baud rate	COM1	115200	
5		COM2		
6		COM3		

NOTE: The hyphen ("-") indicates not-supported or invalid.

5.4. Base Configuration

Table 10 Common configuration commands of Base

Steps	Command	Description
1	cshg mode base	Set the module to Base mode
2	fix position 28.23525684216 112.86924711436 126.1347	Set coordinates, latitude, longitude, and geodetic height of a Base.
	fix auto	When there is no coordinate, set the positioning result to the coordinate of the Base.
3	log com2 rtcm1074 ontime 1	Set COM2 to output GPS differential data.
4	log com2 rtcm1084 ontime 1	Set COM2 to output GLO differential data.
5	log com2 rtcm1094 ontime 1	Set COM2 to output GAL differential data.
6	log com2 rtcm1124 ontime 1	Set COM2 to output BDS differential data.
7	log com2 rtcm1005 ontime 1	Set COM2 to output Base coordinates
8	saveconfig	Save the current configuration
9	log loglist	Query the current output states of all ports
10	log refstationa	Query the coordinate of the Base

5.5. Rover Configuration

Table 11 Common configuration commands of Rover

Steps	Command	Description
1	cshg mode rover	Set the module to Rover mode
2	log com3 gpgga ontime 1	Set COM3 to output GGA once per second
3	log com3 gpzda ontime 1	Set COM3 to output ZDA once per second
4	saveconfig	Save the current configuration
5	log loglist	Query the current output states of all ports

5.6. IMU Configuration

By default, the IMU in the series modules are not turned on. You need to send commands to turn it on manually. The device of the module should be connected rigidly to the vehicle. It should be noted that the installation direction should be correct and the IMU rotation parameters should be set correctly.

Table 12 Common command list of inertial navigation configuration

Command	Example	Description
CSHG INS on/off	CSHG INS on	Enable GNSS/INS. It is effective in real time Run saveconfig to save the configuration.
CSHG INS imuangle d1 d2 d1: 0/180 d2: 0/90/180/270	CSHG INS imuangle 0 0	Configure IMU rotation parameters; unit: degree Run saveconfig to save the configuration. Re-power on to take effect. d1: Z-axis direction, 0 is up, 180 is down. d2: Imu Y-axis direction counterclockwise to the angle of vehicle forward direction.
CSHG INS leverM x y z	CSHG INS leverM 0.0 0.0 0.0	Configure the parameter of IMU to main antenna lever. Run saveconfig to save the configuration. Re-power on to take effect.
CSHG INS leverS x y z	CSHG INS leverS 0.0 0.0 0.0	Configure the parameter from IMU to slave antenna lever. Run saveconfig to save the configuration. Re-power on to take effect.
CSHG INS initvec d1 d1: velocity value, unit: m/s	CSHG INS initvec 5	Configure inertial navigation calibration velocity threshold. Run saveconfig to save the configuration. Re-power on to take effect. If the terminal is connected to a single antenna and the velocity is lower than 5m/s, it is necessary to configure to the corresponding velocity.
CSHG INS Algo 0/1	CSHG INS Algo 0	Configure the on-board or airborne mode. 0 - On-board (default) 1 - Shipborne or airborne.
CSHG InsConfig	CSHG InsConfig	Query related inertial navigation configuration.

Note: For other protocols, see JINWEI INTEGRATED CIRCUIT_JWAN0025_ High-Precision Device Common Commands Protocol Manual.

5.7. Common Commands

In all series products, ASCII characters with case-insensitiveness are supported without CRC check. It is user-friendly.

Table 13 List of common commands

No.	Command	Description
1	cshg getmode	Query the working mode of the module
2	cshg mode base	Set the module to Base
3	cshg mode rover	Set the module to Rover
4	cshg sysen GPS GAL on/off	Enable/disable satellite systems. Support simultaneous control of GPS, GAL, BDS and GLO
5	cshg getworkfreq	Query the current working satellite frequency
6	fix auto	Set the current single-point positioning result as Base coordinate.
7	fix none	Clear the Base coordinates
8	fix position 28.23525684216 112.86924711436 126.1347	Set Base coordinates, latitude, longitude, altitude (geodetic height).
9	freset	Restore the default factory settings
10	log com3 gpgga ontime 1	Configure COM3 to output the GGA protocol once per second;
11	log com1 rtcm1005 ontime 1	Configure COM1 to output Base coordinates once per second
12	log com1 rtcm1074 ontime 1	Set COM1 to output GPS differential data once per second
13	log com1 rtcm1084 ontime 1	Set COM1 to output GLONASS differential data once per second
14	log com1 rtcm1094 ontime 1	Set COM1 to output Galileo differential data once per second
15	log com1 rtcm1124 ontime 1	Set COM1 to output BDS differential data once per second
16	log comconfig	Query the status of all ports
17	log diffage	Once the valid age of differential data
18	log loglist	Query serial port status and output statements
19	log obsfreq	Query the observation frequency
20	log pvtfreq	Query the frequency of PVT solution
21	log refstationa	Query the coordinate of the Base
22	log version	Query program version information
23	reset	Software reset
24	saveconfig	Save configuration
25	serialconfig com1 115200	Set COM1 baud rate to 115200
26	set diffage 60	Set the effective age of differential data to 60s
27	set pvtfreq 10	Set the PVT solution frequency to 10Hz
28	unlog com3 gpgga	Turns off the GGA statement output for COM3

No.	Command	Description
29	unlog gpgga	Turn off the GGA statement output for all ports
30	unlogall	Turn off the output of all ports
31	unlogall com1	Turn off the output of all COM1 protocols

6. Firmware Upgrade

For more information about the firmware upgrade, see "JINWEI INTEGRATED CIRCUIT_JWAN0028_OTA Upgrade Tool User Manual".

7. Production Soldering Requirements

7.1. Soldering Temperature Curve

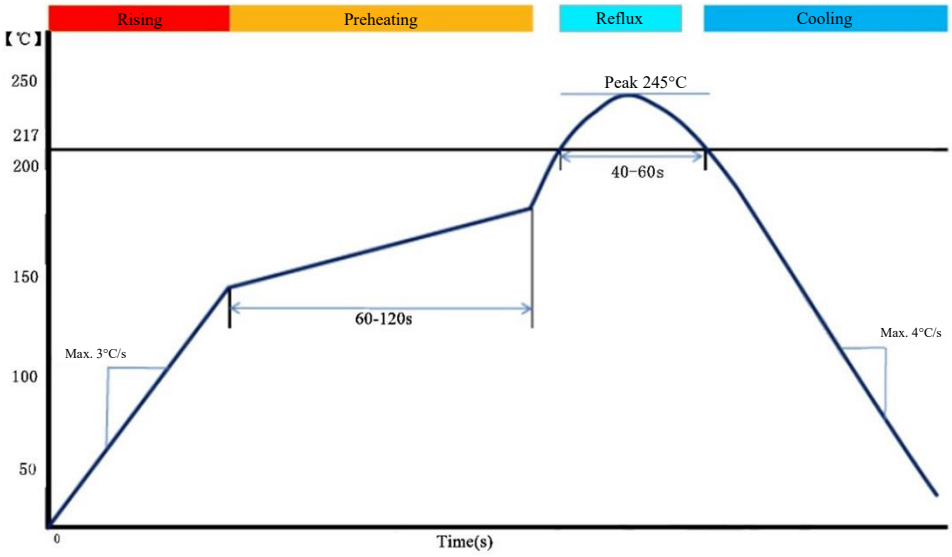

Figure 6 Soldering temperature curve

Table 14 Soldering parameters

No.	Stage	Temperature range	Description
1	Temperature rise stage	Rising temperature range: 50 °C ~ 150 °C	Rising slope: Max. 3 °C/s
2	Preheating stage	Preheating temperature range: 150 °C ~ 180 °C	Preheating time: 60s ~ 120s
3	Reflux stage	Peak temperature for soldering: no higher than 245 °C	Over melting temperature time: 40 - 60s
4	Cooling stage		Cooling slope: Max. 4°C/s

7.2. Soldering Precautions

(1) In order to prevent falling off during soldering of the module, do not solder it on the back of the board during design, and it is not recommended to go through soldering cycle twice.

(2) The setting of soldering temperature depends on many factors of the factory, such as board type, solder paste type, solder paste thickness etc. Please also refer to the relevant IPC standards and indicators of solder paste.

(3) There is a 1-pin mark on the module surface. Please pay attention to the mounting direction in the pick-place process.

(4) The module is manufactured in a lead-free process. Choose the process that matches it during the pick-place and repair.

(5) Before pick-place, it is recommended to bake the module. Baking requirements: 125 ℃ / 12H;

(6) The opening of the stencil needs to meet your design requirement and comply with the examine standards. The thickness of the stencil is recommended to be 0.18mm or above.

8. Packaging

DM712 series modules are packed with foam lining. It is suitable for commonly used surface mounting equipment.

Figure 7 Packaging of DM712 series modules

Table 15 Packaging of DM712 series modules

No.	Item	Description
1	Module quantity	50 pcs/box
2	Lining size	27.5cm*36.1cm

Appendix

The main manuals are as follows:

JINWEI INTEGRATED CIRCUIT_JWAN0001_DM711 Series Modules User Manual

JINWEI INTEGRATED CIRCUIT_JWAN0002_DM711 Series Modules Hardware Design Manual

JINWEI INTEGRATED CIRCUIT_JWAN0003_DM712 Series Modules User Manual

JINWEI INTEGRATED CIRCUIT_JWAN0004_DM712D Modules Hardware Design Manual

JINWEI INTEGRATED CIRCUIT_JWAN0005_7 Series Modules EVK Board User Manual

JINWEI INTEGRATED CIRCUIT_JWAN0025_High-Precision Device Common Commands Protocol Manual

JINWEI INTEGRATED CIRCUIT_JWAN0027_GNSS Evaluation Center Instruction Manual

JINWEI INTEGRATED CIRCUIT_JWAN0028_OTA Upgrade Tool Instruction Manual

Record of Revision

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1	V1.0	First release	2023.7

Make high-quality chips for positioning and navigation

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