P20D RTK
Positioning and Heading
Module

V1.4

REVISIONS

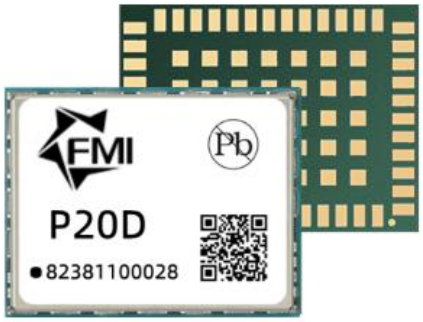
Version	Release notes	Dates
R1.0	Beta version	2022-12-09
R1.1	Add protocols GPHPR, GPIMU	2023-03-14
R1.2	Add protocols HDT, ROT, SXT	2023-03-23
R1.3	Add protocol FMI, add dual antenna installation notes, add module picture	2023-06-06
R1.4	Add support for 10Hz RTK, enable 3 UART outputs	2023-09-04

Table of Contents

1. Introductions

P20D is a high-precision GNSS RTK positioning and heading module. It can simultaneously track multiple frequencies of all GNSS constellations (GPS, BDS2, BDS3, GALILEO, GLONASS, QZSS), and the module can perform on-chip RTK positioning and dual-antenna heading calculation. P20D has integrated an industrial 6-axis IMU sensor that can maintain correct heading and attitude information for harsh GNSS signal reception environment.

P20D is a perfect choice for high-precision navigation and Positioning applications such as UAV, machine control, precision agriculture and marine, that demands the highest stability and integrity in heading and attitude.



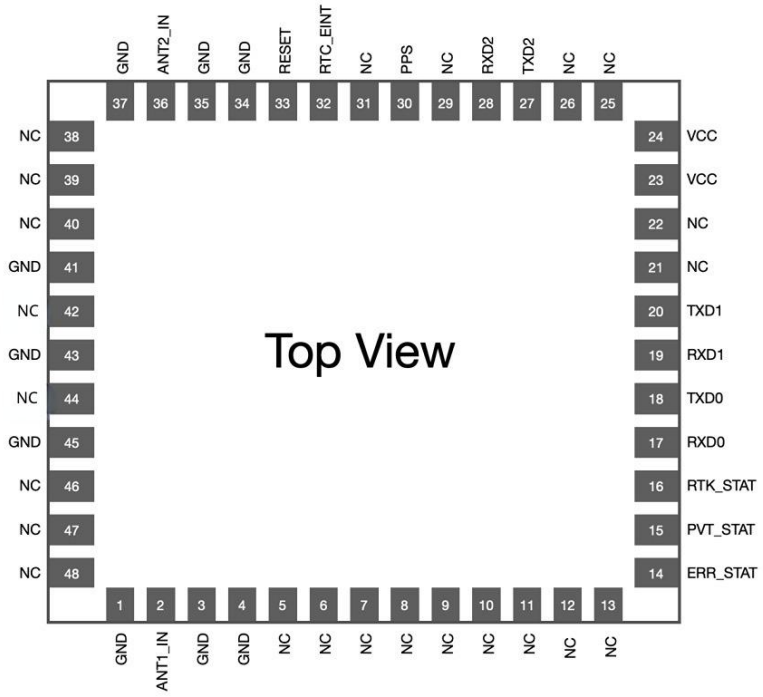
2. Features

- 12nm technology, most advanced in industry.
- Supports RTK between master and slave antenna for heading operation, with antenna separation as close as 5 cm
- 21 mm x 16 mm x 2.6 mm, the smallest integrated heading module
- Lowest power RTK&heading module (100mW peak power) in the world
- Supports dual mode operation (base station/rover mode)
- Full constellations and multiple frequencies

3. Parameters

Category	Performance index	
Receive Type	GPS/QZSS: L1/L5	
	BeiDou: B1I/B2a	
	GALILEO: E1/E5a	
	GLONASS: G1	
Nav. update rate	RTK: 1Hz/2Hz/5Hz/10Hz IMU: 50Hz/100Hz	
sensitivity	Tracking & Nav.	-165dBm
	Reacquisition	-160dBm
	Capture sensitivity	-148dBm
Acquisition	cold starts	27s 5s with AGNSS
	hot starts	1s
Heading accuracy	0.2 degrees/1m baseline	
Position accuracy	1cm + 1ppm	
Altitude accuracy	2cm + 1ppm	
Operational limits	Velocity	515m/s
	Altitude	18km
Interface	UART	3 (default baud rate 115200)
	PPS	1
Protocols	NMEA 0183	
	RTCM 3.3	
Electrical data	Supply voltage	2.8V~4.3V (3.3V recommended)
	RF Antenna voltage	3.3V
	Serial voltage	2.8V
	PPS	2.8V
power	30mA*3.3V	
Operating temp	-40°C to 85°C	
Storage temp	-40°C to 90°C	
humidity	95% non-condensing	
Package	21 mm x 16 mm x 2.6 mm	

4. Pin definition



Pin NO	name	I/O	Descriptive
1	GND	-	Ground
2	ANT1_IN	I	GNSS antenna signal input (main antenna)
3~4	GND	-	ground
5~11	NC	-	vacancy
12	WIT	I/O	USB data
13	DIR	I	USB power
14	ERR_STAT	O	Abnormal status output, active high
15	PVT_STAT	O	PVT positioning indication, active high
16	RTK_STAT	O	RTK position indication, active high
17	RXD0	I	Serial 0 receive
18	TXD0	O	Serial 0 Transmit
19	RXD1	I	Serial port 1 receive
20	TXD1	O	Serial port 1 Transmit
21~22	NC	-	vacancy
23	VCC	POWER	Voltage supply 3.3V
24	VCC	POWER	Voltage supply 3.3V
25~26	NC	-	vacancy

27	TXD2	O	Serial port 2 Transmit
28	RXD2	I	Serial port 2 receive
29	NC	-	vacancy
30	PPS	O	second pulse (physics)
31	NC	-	vacancy
32	RTC_EINT	I	Low Power Wakeup
33	RESET	I	system reset
34~35	GND	-	ground
36	ANT2_IN	I	GNSS antenna signal input (from antenna)
37	GND	-	ground
38~40	NC	-	vacancy
41	GND	-	ground
42	NC	-	vacancy
43	GND	-	ground
44	NC	-	vacancy
45	GND	-	ground
46~48	NC	-	vacancy

5. Antenna features

Parameters	min	max	unit
Input Gain	18	23	dB

6. Commands

AT+GPGGA=n	Select serial port to output GGA every n epochs
AT+GPRMC=n	Select serial port to output RMC every n epochs
AT+GPSAT=n	Select serial port to output GSV/GSA every n epochs
AT+GPGST=n	Select serial port to output GST every n epochs
AT+GPGLL=n	Select serial port to output GLL every n epochs
AT+GPVTG=n	Select serial port to output VTG every n epochs
AT+GPZDA=n	Select serial port to output ZDA every n epochs
AT+GPHDT=n	Select serial port to output HDT every n epochs
AT+GPROT=n	Select serial port to output ROT every n epochs
AT+GPTHS=n	Select serial port to output THS every n epochs
AT+GPSXT=n	Select serial port to output SXT every n epochs
AT+GPFMI=n	Select serial port to output FMI every n epochs (upgrade to new firmware version required)
AT+GPHPR=n	Select serial port to output HPR every n epochs(1~100Hz)
AT+GPIMU=n	Select serial port to output IMU every n epochs(1~100Hz) (1~100Hz)
AT+IMU_RATE=100	Set internal IMU update frequency (50Hz, 100Hz) Default 50Hz
AT+IMU_ANGLE=x,y,z	Setting the module mounting angle, see the module mounting help manual for details, reboot required
AT+YAW_ANGLE=0,0,z	Set the dual antenna mounting rotation angle (z is the rotation angle) (following a right-handed coordinate system, with the thumb pointing in the positive direction of the z-axis, clockwise is positive, and the dual antenna direction is steered in the direction of carrier motion)
AT+RTCM=1/0	Output RTCM3 Obs Data (1:open,0:close)
AT+NAVI_RATE=1	Set Nav update rate 1Hz Support 1/2/5Hz, need cold restart
AT+UARTOFF=UART0/1	Stop all output of the select serial port
AT+BAUD_RATE=115200	Set the serial port baud rate Need cold restar (supports 460800, 921600)
AT+READ_PARA	Read mode parameters
AT+THIS_PORT	Read the current serial port number

AT+WARM_RESET	Warm restart
AT+COLD_RESET	Cold restart (some commands require Cold restart to take effect)
AT+RTC_MODE=n	enter standby mode, n is the time (in seconds) to keep the RTC in sleep mode, the Minimum valid time is 10 seconds, if set to 0, hardware wakeup is required.
AT+NMEA_HEAD=0/1	0: statements such as GGA begin with GN, 1: begin with GP (default 0)
Default baud rate 115200, commands end in \r\n. Compatible P20M Command Format	

Notes on module and dual antenna installation:

1. P20D has an integrated imu, therefore the module needs to be rigidly installed with the host vehicle. There should be no relative motion between P20D module and the master/slave antennas.

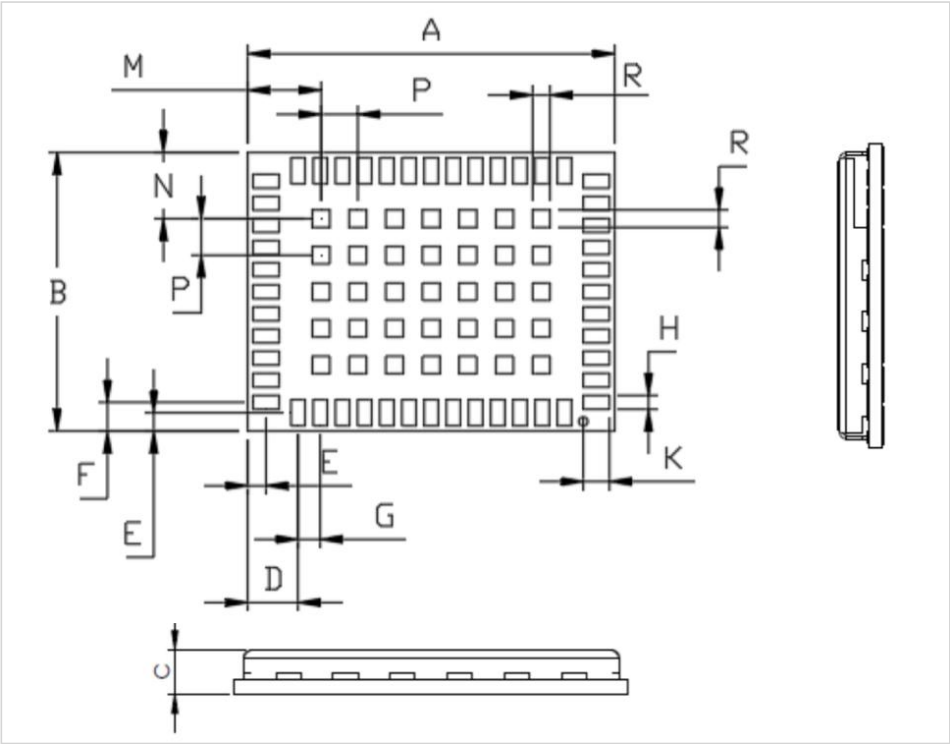
2. The default orientation when installing the module is where the arrow on the module label is pointing (as shown in the picture below) towards the direction of the carrier's movement, with the top of the module pointing towards the sky and the back of the module pointing towards the ground.

3. Configuration Commands exist to allow for different orientations when the above installations can not be made.

AT + IMU_ANGLE = x,y,z for the module mounting angle configuration (you can refer to the P20X module mounting user manual)

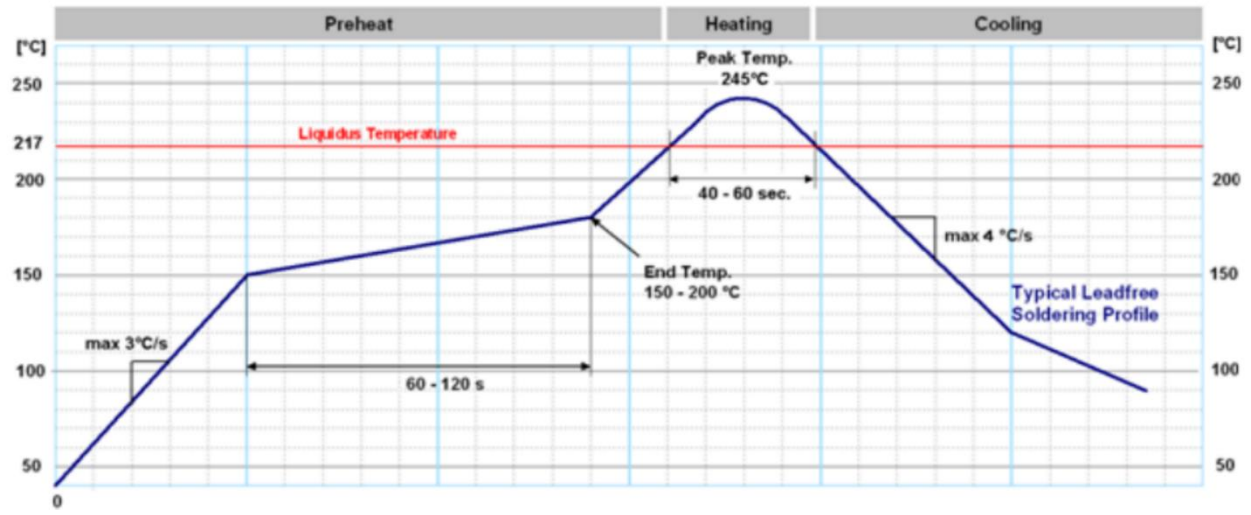
4. If the dual-antenna direction is not consistent with the forward direction of the vehicle, it is necessary to adjust the dual-antenna angle to ensure that it is consistent with the direction of the vehicle, send the command AT+YAW_ANGLE=0,0,z to configure (z is the angle of rotation, following the right-handed coordinate system, with the thumb pointing in the positive direction of the z-axis, and the clockwise direction is positive, and the direction of the dual-antenna is shifted towards the direction of the vehicle movement)

7. Packaging



Symbol	Min.(mm)	Typ.(mm)	Max.(mm)
A	20.80	21.00	21.50
B	15.80	16.00	16.50
C	2.40	2.60	2.80
D	2.78	2.88	2.98
E	0.95	1.05	1.15
F	1.55	1.65	1.75
G	1.17	1.27	1.37
H	0.70	0.80	0.90
K	1.40	1.50	1.60
M	4.10	4.20	4.30
N	3.70	3.80	3.90
P	2.05	2.10	2.15
R	0.90	1.00	1.10

8. Manufacturing Requirements



Furnace Temperature Schematic

Warm-up phase:

Temperature rise rate: max 3°C/S. If the temperature rise is too fast, it may result in a larger paste slump.

Preheating time: 60~120 S. Insufficient preheating will produce large solder balls, on the contrary, if preheating is too long, solder balls will be gathered and produced.

Termination temperature: 150°C to 200°C. Too low a temperature and some areas with a high amount of hot melt will not melt.

Heating-Reflow stage:

Liquid temperature above 217°C. Avoid a sudden rise in temperature, which may cause the material to collapse.

Time over 217°C: 40-60S.

Peak temperature: 245°C.

Cooling phase:

Cooling control mainly avoids solder becoming more brittle and possible mechanical tension in the solder.

Cooling rate: max 4°C/S

9. Message protocols

(1) GPHPR

$GPHPR,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>*<10><CR><LF>

<1> UTC time in the format hhmmss.sss

<2> Tow seconds in a week

<3> Roll angle (°)

<4> Pitch angle (°)

<5> Heading angle (°)

<6> Standard deviation of roll angle

<7> Standard deviation of pitch angle

<8> Standard deviation of heading angle

<9> Synchronized age

<10> heteroskedastic checksum

Example statement:

$GNHPR,054913.004,193771.004,-0.391,0.009,69.434,0.123,0.123,0.018,0.204*5D

(2) GPIMU

$GPIMU,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>*<9><CR><LF>

<1> UTC time in the format hhmmss.sss

<2> x-axis acceleration (g)

<3> y-axis acceleration (g)

<4> z-axis acceleration (g)

<5> Gyro x-axis orientation (°/s)

<6> Gyro y-axis orientation (°/s)

<7> Gyro z-axis orientation (°/s)

<8> Sensor temperature (°C)

<9> heteroskedastic checksum

Example statement:

$GPIMU,054752.002,0.000,0.007,-1.032,-0.003,0.053,-0.016,26.00*59

(3) GNSXT

$GNSXT,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>*<11><CR>& LF>

<1> utc time hhmmss.sss

<2> Distance from antenna to main antenna (m)

<3> North-facing position with the main antenna as origin (m)

<4> Easterly position with the main antenna as origin (m)

<5> Zenithward position with the main antenna as origin (m)

<6> Standard deviation of the northward position

<7> Standard deviation of the eastward position

<8> Standard deviation of zenith to position

<9> Number of satellites used for settlement from antennas

<10> Localization quality from antenna (0: not available, 4: fixed solution)

<11> checksum

Example statement:

$GNSXT,032423.200,9.903,3.484,9.270,-0.003,0.012,0.022,0.015,31,4*7B

(4) GPFMI

$GPFMI,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>.
<13>,<14>,<15>,<16>,<17>,<18>,<19>,<20>,<21>,<22>,<23>[,<E1&
gt;~<E10>]*<24><CR><LF>

<1> UTC time in the format hhmmss.ss. ss

<2> Week number.

<3> Time of week, seconds of week, in the format (ss.mmm)

<4> Latitude in degrees. Positive numbers are north latitude, negative numbers are south latitude

<5> Longitude, in degrees. Positive numbers are east longitude, negative numbers are west longitude.

<6> Elevation, in meters

<7> Standard deviation of latitude, in meters

<8> Standard deviation of longitude, in meters

<9> Standard deviation of elevation, in meters

<10> Velocity eastward in meters per second (m/s)

<11> Velocity northward in meters per second (m/s)

<12> Velocity in zenith direction, in meters per second (m/s)

<13> Standard deviation of horizontal velocity, in m/s

<14> Angle of heading, in degrees

<15> Pitch angle, in degrees

<16> Traverse roll angle, in degrees

<17> Standard deviation of heading angle, in degrees

<18> Standard deviation of pitch angle, in degrees

<19> Standard deviation of roll angle, in degrees

<20> Baseline distance in meters

<21> Number of satellites visible from the antenna

<22> The number of observations fixed throughout the carrier week is only meaningful for fixed solutions

<23> Positioning quality indication, 0=invalid solution, 1=single point solution, 2=differential solution, 4=fixed solution, 5=floating point solution, 6=inertial guidance solution

If you set the FMI statement to expand, you will append 10 expansion fields

<E1> Fixed solution reference Ratio

<E2> Number of fixed-solution AR double-difference fuzzy degrees

<E3> Carrier-to-noise ratio average

<E4> Number of carrier non-integer observations

<E5> Number of delta observations

<E6> Reserved

<E7> Reserved

<E8> Reserved

<E9> Reserved

<E10> Reserved

<24> heteroskedastic checksum

Sample Statement (with Extended Fields)

$GPFMI,092900.20,2248,466158.200,42.06414612,106.22805621,154.305,0.0077,0.0068,0.0166,-0.006,0.005,0.033,0.012,0.00,0.00,0.00, - 1.0000,-1.0000,-1.0000,185.578,38,40,4,1.74,19,43,,,,,,,*4C