DaLang

AK995

Dalang Communication Technology Co., Ltd product specification

Product Name:	RTK board
Product model:	AK995
Version number:	V 1.0
Revision Date:	2025.1.18

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catalogue

1 Product application scenarios

The AK995 module is a high-precision RTK positioning module that supports BDS, GPS, GLONASS, Galileo, and QZSS across the entire system and frequency range. This module is based on Nebula IV ™ SoC chip integrates RF baseband and high-precision algorithms, with 2G dual core CPU, high-speed floating-point processor, and RTK dedicated coprocessor. Simultaneously using 22nm technology, with 1408 super channels, achieving 20Hz RTK positioning output. Built in JamShield technology optimizes the multi frequency RTK engine, improving initialization speed and accuracy in complex environments. Supports multiple communication interfaces, suitable for applications such as drones, precision agriculture, surveying, and intelligent driving. Refer to Figure 1 for details.

Figure 1 Product Application Scenarios

2 functions

In this chapter, we will delve into and elaborate on the functions and working principles of AK995, detailing how it plays a key role in different applications, as follows:

1. progressiveness technology: based on UM980 series product design and the latest generation NebulasIV ™ Integrated GNSS SoC chip with RF baseband and high-precision algorithm.

2. Multi system frequency support: With high compatibility and flexibility, it can receive and process signals from multiple satellite navigation systems, such as BDS, GPS, GLONASS, Galileo, QZSS, and SBAS, enhancing the global coverage and accuracy of positioning.

3. Support RTK positioning calculation across the entire system and frequency range: demonstrating excellent integration and fast positioning initialization capabilities, ensuring positioning speed and accuracy in various environments.

4.20Hz data output rate: displays high-performance processing capability, able to quickly respond and adapt to dynamically changing environments, especially suitable for applications such as drones that require rapid positioning updates.

5. Instant RTK initialization technology: It can achieve high-precision positioning within seconds, improving the success rate and stability rate of initialization in obstructed environments.

6. Independent tracking and 60dB narrowband anti-interference technology for each frequency point of the satellite: emphasizing independent tracking of satellite signals in different frequency bands, this technology can effectively improve signal quality and positioning accuracy in complex environments.

7. Full System Full Frequency RTK Engine "UGypsophila" Starry Sky RTK Technology: It supports all satellite navigation systems and frequencies worldwide, enabling more accurate and stable positioning. By integrating data from multiple satellite systems, it can provide more reliable and continuous positioning services, especially in professional surveying and mapping fields that require high precision and reliability.

3 Structural characteristics

In this chapter, we will delve into and analyze the design details of the product, depicting its appearance features through detailed images. This view provides a compre hensive perspective for understanding the structure of the product. Refer to Figure 2, Table 1, and Table 2 for details.

Figure 2 Dimensional drawing (unit: mm）

Table 1 PIN Foot Function

NO.	signal name	Signal Description
1	VCC	Power input, DC+5V
2	GND	grounding
3	RX1	Main serial port (COM1) data transmission, output NMEA0183 format positioning results when configured as "mobile station", and output RTCM2. x/3. x format differential data stream when configured as "reference station".
4	TX1	Main serial port (COM1) data reception, configure command input port.
5	RX2	COM2 output interface
6	TX2	COM2 differential serial port (COM2) data input, only valid when configured as "mobile station", accepts RTCM2. x/3. x format differential data input.
7	TYPE-C interface	COM3 output interface

Table 2 Interface Definition

NO.	Name	Symbol	Minimum value	Typical values	Maximum value	Unit
1	main power supply	Vcc	2.7	5.0	5.5	V
2	RF port feeding	VRF	3.0	3.1	3.3	V
3	Input High Level	VIH	2.0			V
4	Input low level	VIL			0.7	V
5	Output High Level	VOH	3.2			V
6	Input low level	VOL			0.1	V
7	Main serial port baud rate	Baud		115200		bps
8	Differential wave	Baud		115200		bps

4 Specification parameters

In this chapter, we will provide a detailed list and explanation of the product chip characteristics, sensitivity, accuracy, working principle, and other technical details, as shown in Table 3.

Table 3 Product Specification Parameters

<table>
<tr><td rowspan="3">Working characteristics</td><td>chip</td><td colspan="4">UM980</td></tr>
<tr><td>working frequency</td><td colspan="4">BDS: B1I B2I B3I B1C B2a B2b
GPS: L1 C/A L1C L2P (Y) L2C L5
GLONASS: L1 L2
Galileo: E1 E5a E5b E6
QZSS: L1 L2 L5 L6</td></tr>
<tr><td>Receiving channel</td><td colspan="4">1408 channel</td></tr>
<tr><td rowspan="12">Accuracy</td><td rowspan="2">Single point positioning (RMS)</td><td colspan="4">Plane: 1.5m</td></tr>
<tr><td colspan="4">Elevation: 2.5m</td></tr>
<tr><td rowspan="2">DGPS(RMS)</td><td colspan="4">Plane: 0.4m</td></tr>
<tr><td colspan="4">Elevation: 0.8m</td></tr>
<tr><td rowspan="2">RTK(RMS)</td><td colspan="4">Flat: 0.8cm+1ppm</td></tr>
<tr><td colspan="4">Elevation: 1.5cm+1ppm</td></tr>
<tr><td>Observation accuracy (RMS)</td><td>BDS</td><td>GPS</td><td>GLONASS</td><td>Galileo</td></tr>
<tr><td>B1I/B1C/L1C/L1 C/A/E1/G1 pseudorange</td><td>10cm</td><td>10cm</td><td>10cm</td><td>10cm</td></tr>
<tr><td>B1I/B1C/L1C/L1 C/A/E1/G1 Carrier Phase</td><td>1mm</td><td>1mm</td><td>1mm</td><td>1mm</td></tr>
<tr><td>B3I/L2P(Y)/L2C/G2 pseudorange</td><td>10cm</td><td>10cm</td><td>10cm</td><td>10cm</td></tr>
<tr><td>B3I/L2P(Y)/L2C/G2 Carrier Phase</td><td>1mm</td><td>1mm</td><td>1mm</td><td>1mm</td></tr>
<tr><td>B2I/B2a/ B2b/L5/E5a/E5b pseudorange</td><td>10cm</td><td>10cm</td><td>10cm</td><td>10cm</td></tr>
</table>

	B2I/B2a/ B2b/L5/E5a/E5b Carrier Phase	1mm	1mm	1mm	1mm
	Time accuracy (RMS)	10 ns			
	Speed accuracy (RMS)	0.03m/s			
Start Time	cold boot	＜10s			
	Initialization time	<5s(typical value)			
	Initialize reliability	＞99.9%			
Output data	Baud rate	115200bps (default) [Optional: 4800-921600]			
	Output interface	TTL / USB			
	Output Protocol	NMEA0183、RTCM 3.3			
	update frequency	1Hz-20Hz (default 1Hz)			
Differential data	Differential data	RTCM 3.3/3.2/3.1/3.0			
	Carrier phase output	Support, output RAWX statement			
	FLASH	built-in			
Electrical specifications	working voltage	5V DC			
	power consumption	800mW			
Physical parameters	size	42*29*13mm			
	weight	24.4g			
	Housing material	aluminium			
	connector	TYPE-C/GH1.25mm 6pin			
	Connector	SSMB			
Environment	operation temperature	-35℃-80℃			
	storage temperature	-40℃-95℃			

5 Product physical pictures

In this chapter, we will present real-life photos of the product, as shown in Figure 3. Through these pictures, you can see our products from different angles and details. We believe that through authentic display, we can better convey the value and philosophy of the product, thereby enhancing your trust and satisfaction with the product.

Figure 3 Product Physical Picture

6 Common Configuration Instructions

NO.	Instruction content	Function Description	Notes
1	VERSIONA	Version query	
2	CONFIG	Query receiver configuration	
3	SAVECONFIG	Save configuration	After configuring the receiver, a save command needs to be sent, otherwise the receiver will return to its factory state after being powered on again
4	CONFIG COM1 115200	Configure COM1 baud rate to 115200	
5	UNLOG	Stop all information output from the current serial port	
6	UNLOG COM1	Stop all output from COM1 serial port	This command can be sent on any serial port
7	UNLOG COM2 GPGGA	Stop COM2 serial port output of GPGGA data	If no serial port number is added, it will be the current serial port
8	GPGGA COM1 1	Output GGA data on COM1 serial port	If COM1 (such as GPGGA 1) is not input, it will be the current serial port. If you want to output other data, such as "GSV", simply change the "GGA" in the instruction to "GSV" (the output information includes DTM, GBS, GGA, GLL, GNS, GRS, GSA, GST, GSV, THS, RMC, ROT, VTG, ZDA)
9	GPGGAH 1	Output satellite positioning GGA data calculated from the antenna from the current serial port	UM982 dual antenna module is only supported
10	freset	Restore factory settings	Note: The factory set baud rate is 115200
11	mode base	Set as reference station	
12	mode rover	Set as mobile station	This instruction can switch the receiver from base station mode to mobile station mode
13	gpgga comx 1	Set 1Hz output GGA message	COMX can be specified as COM1 Either COM2 or COM3
14	gpths comx 1	Output current heading information	COMX can be specified as COM1 Either COM2 or COM4
15	freset mode base time 60 1.5 2.5 rtcm1006 comX 10 rtcm1033 comX 10 rtcm1074 comX 1 rtcm1124 comX 1 rtcm1084 comX 1 rtcm1094 comX 1 saveconfig	Configure base station mode	COMX can be specified as COM1 Either COM2 or COM3

7 Common message parsing

1、 GPGGA (Longitude and latitude coordinate information)

$GPGGA,062938.00,3110.4700719,N,12123.2657056,E,1,25,0.6,58.9666,M,0.000,M,99,AAAA*50

Data parsing:

$GPGGA,hhmmss,llll.lllllll,a,yyyyy.yyyyyyy,b,q,n,x.x,h.h,M,dd,xxxx*CC

NO.	Name	Describe	Symbol	Give an example
1	$GPGGA	Log header		$GPGGA
2	utc	UTC time (hour/minute/second)	hhmmss.ss	202134.00
3	lat	Latitude: -90~90 degrees	llll.lllllll	3110.4693903
4	latdir	Latitude direction: N： North; S： south	a	N
5	lon	Longitude: -180~180 degrees	yyyyy.yyyyyyy	12123.2621695
6	londir	Longitude direction: E： East; W： west	b	W
7	QF	Solution state 0: Invalid solution; 1: Single point positioning solution; 2: Pseudorange difference; 4: Fixed solution; 5: Floating solution;	q	4
8	sat No.	number of satellites	n	14
9	hdop	Horizontal DOP value	x.x	1.0
10	alt	elevation	h.h	50.22
11	a-units	Elevation Units	M	M
14	age	Differential Delay	dd	1
15	stn ID	Base station number: 0000-1023, when operating alone: AAAA	xxxx	1
16	*xx	Checksum	*hh	
17	[CR][LF]	Sentence terminator		[CR][LF]

2、 GPRMC data analysis

$GNRMC,064401.65,A,3110.4706987,N,12123.2653375,E,0.604,243.2,300713,0.0, W,A*3E

Data example:
$GPRMC,014350.00,A,3110.4854911,N,12123.9129278,E,0.029,108.5,010909,0.0,E*57

NO.	Name	Describe	Symbol	Give an example
1	$GPRMC	Log header		$GPRMC
2	utc	UTC time (hour/minute/second)	hhmmss.ss	143550.00
3	Pos status	Solution status: A=effective positioning V=invalid positioning	A	A
4	lat	Latitude: -90~90 degrees	llll.lllllll	3110.4854911
5	latdir	Latitude direction: N： North; S： south	a	N
6	lon	Longitude: -180~180 degrees	yyyyy.yyyyyyy	12123.9129278
7	londir	Longitude direction: E： East; W： west	b	E
8	SPEED IN	Ground speed	q	0.29
9	Track Ture	Ground heading angle	n	108.5
10	Date	UTC date	ddmmyy	010909
11	Mag var	Magnetic declination (000.0~180.0 degrees, if the leading digit is insufficient, add 0)	0.0	0.0
12	Vardir	Magnetic declination direction, E (east) or W (west)	M	M
13	Mode ind	Mode indication (only NMEA0183 version 3.00 output, A=autonomous) Positioning, D=difference, E=estimation, N=Invalid data)	a	A
14	*xx	Checksum	*hh	*57
15	[CR][LF]	Sentence terminator		[CR][LF]

3、 GPNTR (distance information from reference station)

Example data:
$GPNTR,024404.00,1,17253.242,+5210.449,-16447.587,-49.685,0004*40

Data parsing:

NO.	Name	Describe	Symbol	Give an example
1	$GPNTR	Headers		$GPNTR
2	utc	UTC time	hhmmss.ss	024404.00
3	pos status	Solution state 0: Invalid solution; 1: Single point positioning solution; 2: Pseudorange difference; 4: Fixed solution; 5: Floating solution;	I	1
4	distance	Diagonal distance from the reference station (meters)	dddd.ddd	17253.242
5	distance in north	Horizontal distance in X direction: +Indicate in the north direction of the base station -Indicate in the south direction of the base station	dddd.ddd	+5210.449
6	distance in east	Y-direction horizontal distance: +Indicate that the base station is facing east -Indicate that the base station is facing west	dddd.ddd	-16447.587
7	Distance in Vertical dimension	Horizontal distance in H direction: +Indicate above the base station -Indicate below the base station	dddd.ddd	49.685
8	stn ID	Base station number	xxxx	0004
9	*xx	Checksum	*hh	
10	[CR][LF]	End		[CR][LF]

4. GPVTG (Ground Velocity Information)

GPS with BD2

$GNVTG,46.954,T,46.954,M,0.436,N,0.807,K,A*33

Single BD2

$BDVTG,150.455,T,150.455,M,0.233,N,0.432,K,A*35

Example data:
$GPVTG,213.710,T,213.710,M,0.304,N,0.563,K,A*24

Data parsing:

NO.	Name	Describe	Symbol	Give an example
1	$GPVTG	Headers		$GPVTG
2	track true	Motion angle	000-359, (If the leading digit is insufficient, add 0)	213.710
3	T	True North Reference Frame	T	T
4	track mag	Motion angle	000-359, (If the leading digit is insufficient, add 0)	213.710
5	M	Magnetic north reference frame	M	M
6	speed Kn	Horizontal movement speed	0.00 (If the leading digit is insufficient, add 0)	0.304
7	N	Knots	N	N
8	speed Km	Horizontal movement speed	0.00 (If the leading digit is insufficient, add 0)	0.563
9	K	Kilometers per hour, km/h	K	K
10	mode ind	position	a	A
11	*xx	Checksum	*hh	*24
12	[CR][LF]	End		[CR][LF]

5、GPGSV statement (visible satellite information)

GPS+BD2+GLONASS

$GPGSV,2,1,06,29,32,090,44,26,34,124,44,14,59,116,45,30,25,042,42*71
$GPGSV,3,1,09,01,34,042,43,09,14,216,43,32,33,060,42,04,27,248,42*73
$GPGSV,3,2,09,17,47,323,44,08,16,207,43,20,56,094,48,11,17,061,38*71
$GPGSV,3,3,09,28,81,228,46,,,,,,,,,,,*49
$BDGSV,2,1,08,141,47,148,48,142,32,238,43,143,52,201,48,146,53,179,48*65
$BDGSV,2,2,08,147,05,192,40,148,67,026,46,149,26,196,44,150,13,219,39*63
$GLGSV,3,1,09,47,07,193,46,43,46,101,50,59,28,309,45,49,28,305,43*68
$GLGSV,3,2,09,48,35,239,45,42,21,040,44,57,24,063,39,44,24,161,47*67
$GLGSV,3,3,09,58,46,012,45,,,,,,,,,,,*51

Example data:

$GPGSV,<1>,<2>,<3>,<4>,<5>,<6>,<7>,…<4>,<5>,<6>,<7>*hh<CR><LF>
Note: Information for<4>,<5>,<6>, and<7>will be displayed in a loop for each satellite, and each GSV statement can display information for up to 4 satellites. Other satellite information will be output in the NMEA0183 statement of the next sequence.
$GPGSV,2,1,06,29,32,090,44,26,34,124,44,14,59,116,45,30,25,042,42*71

Data parsing:

NO.	Name	Describe	Symbol	Give an example
1	$GPGSV	Headers		$GPGSV
2	# msgs	The total number of GSV statements	X	2
3	Msg #	GSV number	X	1
4	# sats	The total number of satellites	XX	6
5	prn	Satellite PRN number GPS = 1 to 32 SBAS = 33 to 64 (add 87 for PRN#s) GLO = 65 to 96 BD2 = 141~177	XX	29
6	elev	Satellite elevation angle	XX	32
7	azimuth	Satellite azimuth	XXX	090
8	SNR	Signal to noise ratio (00~99dB)	XX	44
9	………	Each satellite displays in a loop		
10	*xx	Checksum	*hh	
11	[CR][LF]	End		[CR][LF]

6、GPGSA statement (precision factor, satellite information)

GPS+BD2+GLONASS

$GNGSA,M,3,27,03,16,21,06,19,31,13,23,,,,1.0,0.6,0.8*22
$GNGSA,M,3,141,142,143,144,147,148,150,,,,,,1.0,0.6,0.8*10
$GNGSA,M,3,47,56,55,46,53,44,57,,,,,,1.0,0.6,0.8*29

Single GPS

$GPGSA,M,3,25,14,15,18,31,27,09,21,22,12,,,1.5,0.9,1.3*30

Single BD2

$BDGSA,M,3,141,143,144,146,147,148,149,150,,,,,2.7,1.7,2.2*2B

Single GLONASS

$GLGSA,M,3,47,58,55,46,53,57,56,,,,,,1.7,1.1,1.3*2D

Example data:
$GPGSA,<1>,<2>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<4>,<5>,<6>*

hh<CR><LF>
$GNGSA,M,3,27,03,16,21,06,19,31,13,23,,,,1.0,0.6,0.8*22

Data parsing:

NO.	Name	Describe	Symbol	Give an example
1	$GPGSA	Headers		$GPGSA
2	mode MA	Mode, M=manual, A=automatic	X	M
3	mode 123	Positioning type, 1=no positioning, 2 =2D positioning, 3=3D positioning	X	3

4-15	prn	Satellite number
		GPS = 1 to 32
		SBAS = 33 to 64 (add 87 for PRN #s)
		GLO = 65 to 96
		BD2 = 141~177
			XX	27,03,16,21,06,19,31,13,23,,,,

16	pdop	Position accuracy factor (0.5~99.9)	XX	1.0
17	hdop	Horizontal accuracy factor (0.5~99.9)	XX	0.6
18	vdop	Vertical accuracy factor (0.5~99.9)	XXX	1.8
19	*xx	Checksum	XX	*3F
	[CR][LF]	End		[CR][LF]
20				

7、GPTRA (azimuth information) requires dual antennas

Example data:

$GPTRA,063027.30,101.78,071.19,-00.00,4,10,0.00,0004*51

Data parsing:

$GPTRA,hhmmss.ss,hhh.hh,ppp.pp,rrr.rr,q,n,dd.dd,xxxx*CC<CR><LF>

NO.	Name	Describe	Symbol	Give an example
1	$GPTRA	Headers		$GPTRA
2	utc	UTC time	hhmmss.ss	104252.00
3	heading	Direction angle, 0~360 degrees	hhh.hh	044.56
4	pitch	Pitch angle: -90~90 degrees	ppp.pp	-09.74
5	roll	Roll angle: -90~90 degrees	rrr.rr	0
6	QF	Solution state 0: Invalid solution; 1: Single point positioning solution; 2: Pseudorange difference; 4: Fixed solution; 5: Floating solution;	q	4
7	sat No.	number of satellites	n	15
8	age	Differential Delay	dd.dd	
9	stn ID	Base station number	xxxx	4
10	*xx	Checksum	*hh	
11	[CR][LF]	End		[CR][LF]

8、Headinga requires dual antennas for azimuth information

Data example:

#HEADINGA,COM1,0,60.0,FINESTEERING,1709,270809.100,00000000,0000,1114;S

OL_COMPUTED,NARROW_INT,1.396890879,200.623992920,-6.505328655,0.0,0.01 58,0.
0169,"0004",12,12,12,12,0,0,0,0*9fe42a98

Data parsing:

NO.	Field type	Descriptives	Data examples
1	Heading header	Data header	#HEADINGA… …
2	sol stat	Solution status (see Table 19 for details)	SOL_COMPUTED
3	pos type	Positioning type (see Table 20 for details)	NARROW_INT
4	Length	Baseline length (meters)	1.396890879
5	heading	Azimuth angle (0 ° to 360 °)	200.623992920
6	pitch	Tilt angle (0 ° to 90 °)	-6.505328655
7	reserved	reserve	0.0
8	hdg std dev	Azimuth standard deviation (unit: °)	0.0158
9	ptch std dev	Standard deviation of inclination angle (unit: °)	0.0169
10	stn id	Reference value ID	"0004"
11	#SVs	Number of tracked satellites	12
12	#solnSVs	Number of satellites involved in RTK calculation	12
13	#obs	Number of satellites above the cut-off elevation angle	12
14	#multi	Number of satellites tracked to L2 above the cut-off elevation angle	12
17	Reserved	reserve	0
18	Ext sol sta	Extended solution state	0
19	Reserved	reserve	0
20	Sig mask	Signal involved in solving	0
21	CRC	32-bit CRC code	*9fe42a98

Table A Explanation of Solution Status：

Solution state	Describe
SOL_COMPUTED	Complete solution
INSUFFICIENT_OBS	Insufficient observation quantity
COLD_START	Cold start, not fully solved yet

Table B Description of Positioning Status：

Positioning status	Describe
NONE	Unsolved
FIXEDPOS	Fixed coordinates have been set
SINGLE	Single point positioning solution
PSRDIFF	Pseudo range differential positioning solution
NARROW_FLOAT	Float solution
WIDE_INT	Broadband fixed solution
NARROW_INT	Narrowband fixed solution
SUPER WIDE-LANE	Ultra wideband solution

9、 Bestposa(Position coordinate information)

Data example:

#BESTPOSA,COM1,0,60.0,FINESTEERING,1709,270776.300,00000000,0000,1114;SO L_COMPUTED,NARROW_INT,31.92829656994,118.86502034494,7.7675,,WGS84,0.0052,0.0052,0.0094,"0004",0.000,6223.000,12,11,12,12,0,0,0,0*292eba23

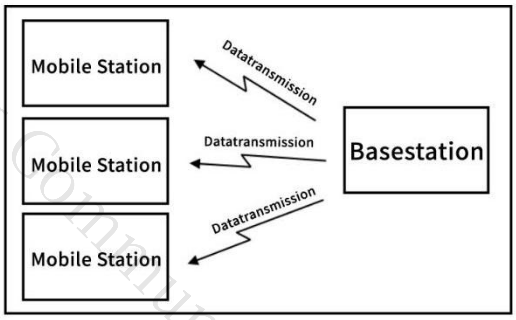
Data parsing:

NO.	Field type	Descriptives	Data examples
1	bestpos header	Data header	#BESTPOSA……
2	sol stat	Solution status (see Table 19 for details)	SOL_COMPUTED
3	pos type	Positioning type (see Table 20 for details)	NARROW_INT
4	Lat	latitude	31.92829656994
5	Lon	longitude	118.86502034494
6	hgt	High altitude	7.7675
7	undulation	Difference in geoid	empty
8	Datum id#	Coordinate system	WGS84
9	Latσ	Latitude standard deviation	0.0052
10	Lonσ	Longitude standard deviation	0.0052
11	hgtσ	Elevation standard deviation	0.0094
12	stn id	Reference value ID	"0004"
13	Diff_age	Differential Age (in seconds)	0.000
14	sol_age	Solution time (in seconds)	6223.000
15	#SVs	Number of tracked satellites	12
16	#solnSVs	Number of satellites involved in RTK calculation	11
17	#ggL1	Number of satellites involved in PVT calculation for L1	12
18	#ggL1L2	Number of satellites involved in PVT calculation for L1 and L2	12
19	Reserved	reserve	0
20	Ext sol sta	Extended solution state	0
21	Reserved	reserve	0
22	Sig mask	Signal involved in solving	0
23	CRC	32-bit CRC code	*292eba23

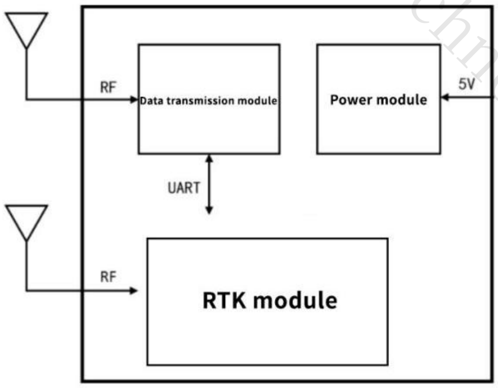
8 Typical Applications

8.1 Application of high-precision positioning for medium and short distances

In high-precision positioning applications for medium to short distances (<3km), the module can be combined with a data transmission module to form a complete high-precision positioning system with only a small amount of external circuits. It is suitable for applications with a large number of mobile stations in a small range, and the module is fully compatible with other automatic flight control systems such as Pixhawk and APM. The schematic diagram is as follows:



The reference station is stationary and fixed, and differential data is broadcasted to all mobile stations through a data transmission module. The circuit diagrams of the mobile station and the reference station are as follows:



3) If the antenna coordinates have been accurately determined through other surveying methods, please use the # set position command to input the antenna coordinates into the reference station module in latitude, longitude, and altitude format;

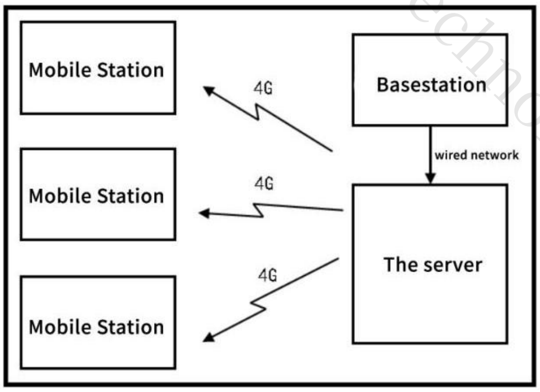
4) If the antenna coordinates are unknown, please wait patiently for about 5 minutes. The module will calculate the antenna position as accurately as possible. After th

e calculation is completed, the differential data port will begin to output data. At this point, the base station has already recorded the coordinates and broadcasted them wire lessly to ensure that the base station does not lose power, as the coordinates will be r ecalculated after a power outage and the repeatability of the mobile station measureme nt points cannot be guaranteed;

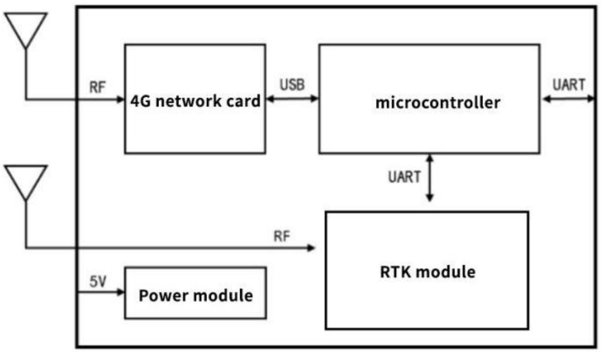
5) Install the mobile station antenna on the mobile carrier, confirm receipt of diff erential data, and wait for about 120 seconds to obtain high-precision positioning resul ts.

8.2 Application of Medium to Long Range High Precision Positioning

In the application of high-precision positioning over medium to long distances (<1 0km), common data transmission modules are difficult to provide reliable differential d ata connections and suffer from serious packet loss problems. For this purpose, the co mpany provides a solution based on 4G network (as shown in the figure below). The benchmark station sends differential data to the server through a wired network and i s cached by the server. Mobile stations access servers through 4G networks to obtain differential data. This solution can greatly expand the coverage area of base stations, a nd mobile stations equipped with 4G network cards can simultaneously transmit positi oning results back to designated servers.



The circuit diagram of the mobile station is as follows:



In practical applications, the number of mobile stations that a server can access simultaneously is limited only by server performance and is more suitable for a large number of users. Requirements between the server and the base station: the server can be directly accessed from the public network (with a public IP address), and a network connection can be established between the base station and the server (either through the public network or local area network).

8.3 High precision positioning application without reference station

In high-precision positioning applications without reference stations, the module needs to cooperate with the 4G communication module to obtain differential data. We provide Qianxun with differential data sources nationwide, and users can obtain high-precision positioning results without deploying base stations. The circuit diagram is as follows: