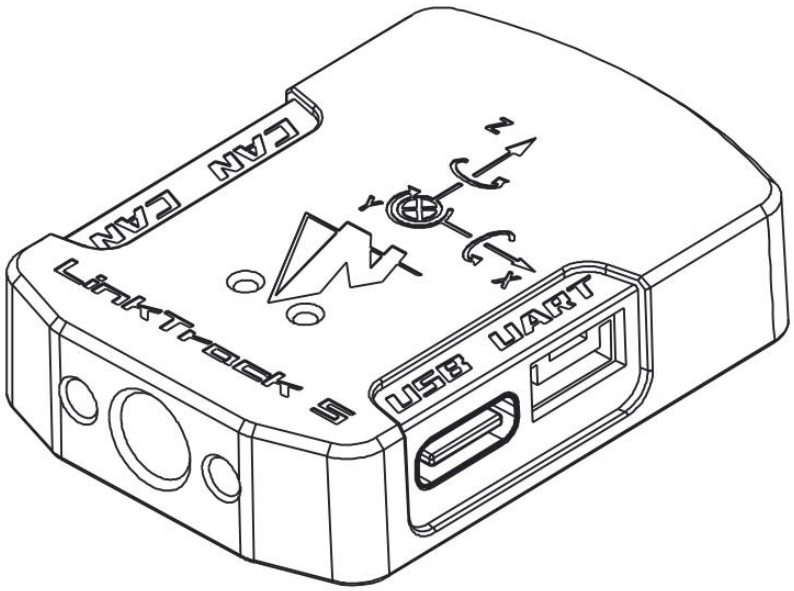
LinkTrack Datasheet V2.1



Language: English

Firmware: V4.0.1

NLink: V1.3

Product Series: LinkTrack S, LinkTrack P, LinkTrack SS, LinkTrack PS

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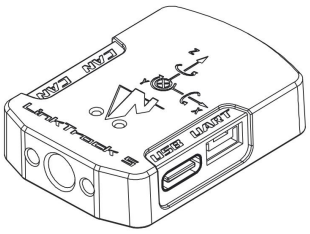
1 Introduction

1.1 Product Overview

LinkTrack Datasheet

Overview



LinkTrack is a multi-function system based on UWB technology, which supports LP (Local Positioning), DR (Distributed Ranging) and DT (Data Transmission) modes, and supports multiple roles such as TAG and ACNHOR.

LP is a real-time positioning mode that supports the integration of Positioning, Navigation, Timing and Communication (PNTC), which consists of three roles: TAG, ANCHOR and CONSOLE. It can carry out real-time TAG measurement and calculate coordinate, and output its own ranging, coordinates and other information, and the ANCHOR and CONSOLE can output the positioning information of all tags in real time. 1-D, 2-D and 3-D positioning are supported. Typical 1-D and 2-D positioning accuracy is 10cm, typical 3-D positioning accuracy is 30cm；The positioning update rate is as high as 200Hz, the ANCHOR's capacity is up to 120, and the TAG capacity is more than 200 (40 TAGs are enabled by default, and more TAGs need to be activated by application).

DR is a distributed ranging mode that supports the integration of ranging, timing and communication, with only one role of nodes. The typical ranging accuracy is 10cm, the update frequency is as high as 200Hz, and the capacity of nodes is up to 50.

DT is a wireless data transmission mode, which is divided into two roles: MASTER and SLAVE. The bandwidth of data transmission is as high as 3Mbps and the delay is less than 0.5ms.

Key Features

- Communication Technology based on UWB (Ultra Wideband)
- Three modes: local positioning, distributed ranging and data transmission.
- Nodes connected wirelessly without network cable.
- Run without a server, real-time computation inside each module.
- positioning, navigation, timing and communication (PNTC) all in one.
- Role (TAG, base, or others) interchangeable for the same hardware.
- High capacity and high refresh frequency: 40 tags / 8 ANCHOR / 1 console @ 50Hz.
- Maximum refresh frequency of ranging and positioning: 200Hz.
- Maximum number of tag: 200； Maximum number of
- UART and USB interfaces
- Voltage monitoring, anti-reverse protection.
- Power supply [3.6,5.5]V@LTS，[4.7,5.2]V@LTP
- Power consumption 1W@LTS；1.35W@LTP
- Six RF bands from 3.5GHz to 6.5GHz.
- Adjustable range of transmission gain from 0 to 33.5dB.
- Unique ID, encrypted transmission

Applications

- Cluster formation (UAV, robot formation, etc.).
- Navigation and positioning of robots, drones and unmanned vehicles.
- Track monitoring and capture (tracking lights, etc.).
- Multi-machine ranging, interaction, anti-collision (crane, mine car, etc.).
- Research in colleges and universities.

TAG: 200 (40 activated by default).

- Typical positioning accuracy of 1-D and 2-D: 10 cm, Typical 3-D positioning accuracy: 30cm.
- Independent high-speed and low-delay data transmission mode, bandwidth 3Mbps.
- Embedded with a three-axis gyroscope and a three-axis accelerometer.
- TAG Output IMU Raw data, Euler Angle, Quaternion.
- Maximum distance @ LTS: 80m, Maximum distance @LTP: 500m.
- Support instantaneous ANCHOR coordinates calibration, firmware OTA upgrade.
- Wireless parameters configuration.
- Fake-GPS applications that support NMEA-0183 protocol output
- One-dimensional positioning.
- Wireless data transmission with high speed and low delay

1.2 Naming Rules

Table 1: Naming Rules

Name	Abbreviation	Note
LinkTrack S	LTS	S represents Standard
LinkTrack P	LTP	P represents Plus
LinkTrack S	LTSS	The first S represents Standard，the second S represents Small
LinkTrack PS	LTPS	P represents Plus，the second S represents Small

1.3 Product Structure

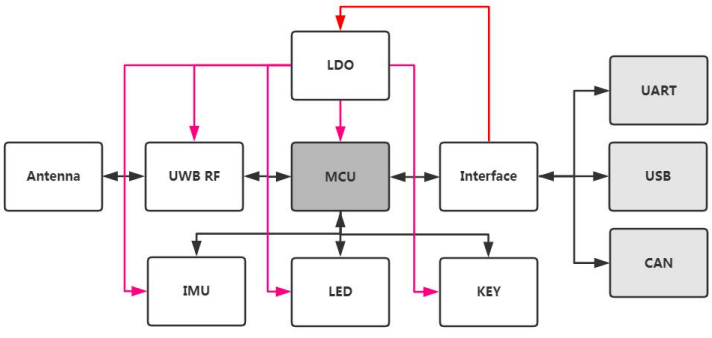


Fig. 1. LinkTrack Structural Diagram

Fig. 1 is the schematic diagram of LinkTrack system. noted that LTS, LTSS and LTPS Module has integrated on-board antennas, LTP has the external SMA style antenna

Communication Port

LinkTrack supports three kinds of communication ports, which are UART, USB and CAN. In Fig. 2, Fig. 3, Fig. 4, and Fig. 5:

UART： The port line sequence is abbreviated as "V G R T", corresponding to VCC, GND, RX and TX. The line sequence corresponds to the port one by one from top to bottom (from left to right). There is a UART port for LTS and LTP, and two UART interfaces with the same electrical connection for LTSS and LTPS.

USB： The port line sequence is consistent with the Type-C 3.1standard. Only LTS and LTP have USB ports.

CAN：Warning that current version did not support CAN port just yet, this feature will be released soon. The port wire sequence is abbreviated as "V G H L", corresponding to VCC, GND, CAN_H, CAN_L. The line sequence in the figure corresponds to the port one by one from top to bottom. There are two actual physical ports for CAN to facilitate the expansion of cascading in the future. Only LTS and LTP have CAN ports.

Among them, VCC is the power supply, and GND is the power ground.

Power Supply Mechanism

The power connections of all communication ports are consistent, that is, their power supplies are connected to each other.

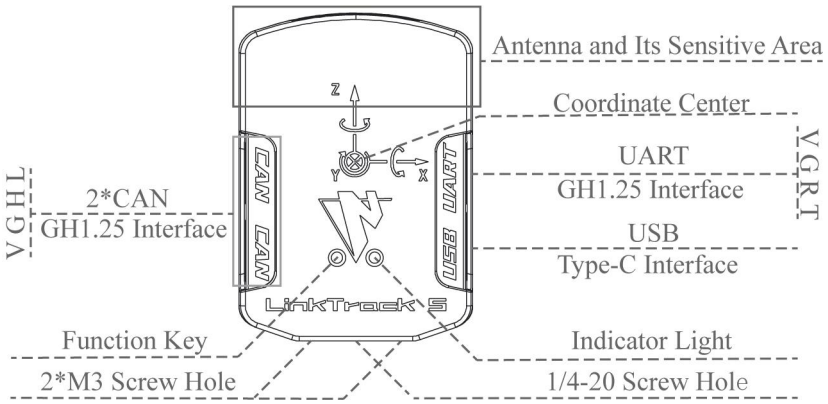


Fig. 2. LinkTrack S Port Diagram

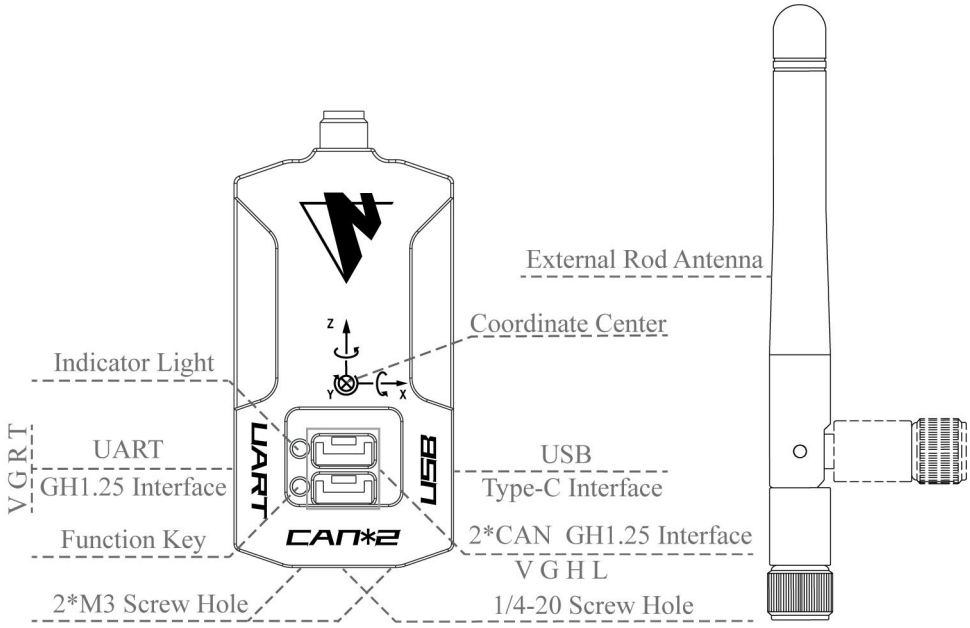


Fig. 3. LinkTrack P Port Diagram

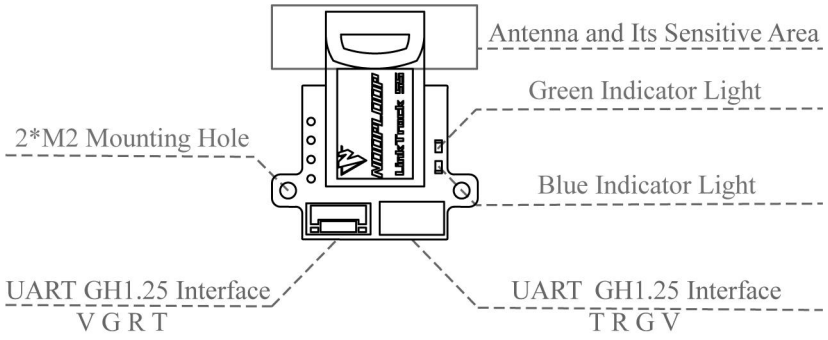


Fig. 4. LinkTrack SS Port Diagram

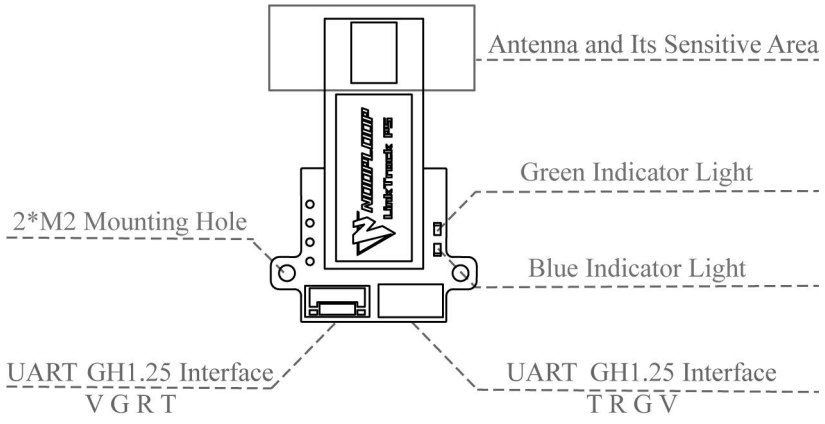


Fig. 5. LinkTrack PS Port Diagram

1. 4 Technology Overview

UWB is a carrier-free communication technology that transmits data by using non-sinusoidal

narrow pulses of nanoseconds to microseconds. UWB has the advantages of high time resolution, strong penetration, low power consumption, good anti-multipath effect, high security and so on, so it is often used in the field of communication and positioning, especially in situations where GNSS (such as GPS, BDS, Glonass, Galileo) signals cannot be covered.

The principle of UWB positioning is similar to that of GPS, in which ANCHOR is equivalent to a satellite in the sky, TAG is equivalent to a GNSS receiver at the user end, and CONSOLE is equivalent to a monitoring station on the ground. ANCHOR is generally used as a reference point, and it is generally installed at a fixed reference point. TAG is generally used as a point to be located, and it is generally installed on the carrier to be located (such as UAV, unmanned vehicle). CONSOLE is generally used to monitor the running status of the system and send instructions to other nodes (ANCHOR, TAG), and it is generally connected to the Terminal (terminal), such as computers, tablets and so on.

UWB belongs to electromagnetic wave, which propagates at the same speed as light in vacuum. Measure the TOF (time of flight) from TAG to ANCHOR, then multiply it by the speed of light, and TAG can get the distance to ANCHOR. Through the coordinates of multiple ANCHOR distances and reference ANCHOR, several sets of spherical equations can be listed, and then the coordinates of the TAG can be solved by mathematical method. Fig. 6 is a schematic diagram of the common trilateral positioning principle.

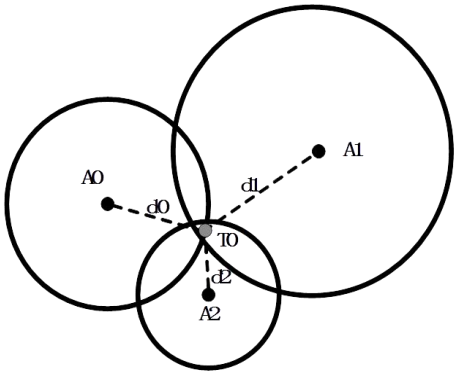


Fig. 6. Schematic diagram of UWB trilateral positioning principle

After obtaining the positioning information, the real-time navigation function can be realized if the environmental information (such as the location of the obstacle and the walkable path) is known, and the desired location is known at the same time.

In the same set of positioning system, all nodes working in the system are strictly synchronized to satisfy the orderly work of multiple nodes at the same time, and the node send out the synchronized timestamps to achieve the time service function.

Furthermore, the user data is transmitted to other nodes through wireless messages based on the nature of UWB wireless communication, to realize the communication function between nodes.

1.5 Mode Overview

LinkTrack supports three operating modes, LP, DR and DT Mode, as described in Table 2.

Table 2: Mode Overview

Mode		Description
LP	LP_MODE0	Positioning, Navigation, Timing, Communication.
	LP_MODE1	
	LP_MODE2	
	LP_MODE3	
	LP_MODE4	
	LP_MODE5	
DR	DR_MODE0	Distributed Ranging, Communication, Timing.
DT	DT_MODE0	One-to-Multi broadcast and one-to-one two-way communication； the MASTER input is protocol frame data, and the MASTER output and SLAVE input or output are transparent transmission data.
	DT_MODE1	One-to-one two-way communication: MASTER and SLAVE input or output are all transparent transmission data.
	DT_MODE2	One-to-one two-way communication: MASTER and SLAVE input or output are all transparent transmission data.

1.5.1 LP Mode

LP Mode is a local positioning mode, which is divided into three roles: TAG, ANCHOR and CONSOLE. In general, TAG and ANCHOR are necessary roles, and CONSOLE is an optional role. The naming rules are as follows:

TAG Naming Rules： Generally, if the ID of a certain TAG is i, it is abbreviated as Ti. For example, a TAG with an ID of 0 is abbreviated as T0.

ANCHOR Naming Rules： Generally, if the ID of an ANCHOR is i, it is abbreviated as Ai. For example, an ANCHOR with an ID of 0 is abbreviated as A0

CONSOLE Naming Rules： Generally, if the ID of a CONSOLE is i, it is abbreviated as Ci. For example, a CONSOLE with an ID of 0 is abbreviated as C0

The schematic diagram of the work is shown in Fig. 7.

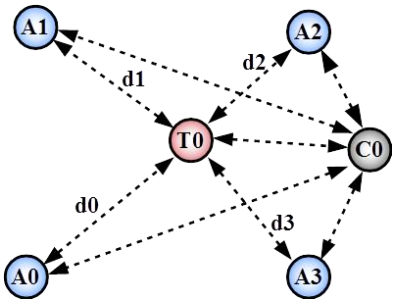


Fig. 7. LP Mode Schematic Diagram

The picture shows 1 TAG T0, 4 ANCHORs A0~A3, and 1 CONSOLE C0. The working mechanism is as follows:

T0 measures the TOF (time of flight) to four ANCHOR respectively and multiplies it by the speed of light to get the distance from T0 to each ANCHOR, and then carries out mathematical calculation to solve its own coordinates. The solved coordinates will be filtered, and even fused with IMU to get a better positioning accuracy, and then output (through the communication interface). Fig. 8 shows the frame diagram of the tag positioning algorithm. At the same time, T0 sends its own coordinates to the ANCHOR and console within the signal range through UWB wireless telegraphy, so that A0~A3 and C0 can output the coordinate information of T0.

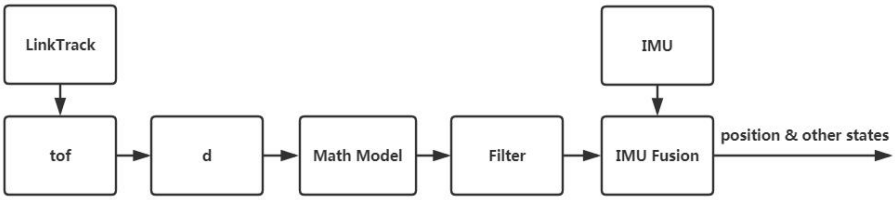


Fig. 8. LinkTrack TAG Positioning Algorithm Framework

Furthermore, if the data (here is DT data) is sent to T0 (through the communication interface), T0 will automatically send the DT data to the ANCHOR and the CONSOLE within the signal range, so that both A0~A3 and C0 can output the DT data of T0. And vice versa, when the DT data is sent to the ANCHOR and the CONSOLE (through the communication interface), the tag automatically outputs the DT data corresponding to the ANCHOR and the CONSOLE.

When there are multiple tags in the system, according to a certain mechanism, all tags can work at the same time without interrupting each other. Each tag outputs its own positioning information independently, as well as the DT data transmitted from each ANCHOR and CONSOLE； each ANCHOR and CONSOLE output the location information of all tags within the signal range, as well as the DT data transmitted from each tag.

The functions and output data of each role are described in Table 3.

Table 3: LP Mode Role Overview

Role	Installation	Description	Output

CONSOLE	No special requirements	**Monitoring:** Monitor the working status of all TAG and ANCHOR within the signal range, such as the location information of all TAG. **Data transmission:** Receive the data sent by the TAG and ANCHOR end users within the signal range； send the data to TAG and ANCHOR within the signal range. **Control:** Set nodes in the system wirelessly, one-key calibration, one-key air upgrade.	Role and ID. Local Time. Supply Voltage. The quantity of all tags in the signal range and their Role, ID, Positioning Coordinates. DT data of TAG.
ANCHOR	Installed at a fixed reference point generally.	**Positioning:** As the reference position of the TAG positioning solution. **Monitoring:** Monitor the working status of all TAG and ANCHOR within the signal range, such as the location information of all TAG. **Data transmission:** Receive the data sent by the CONSOLE and TAG end users within the signal range； send the data to CONSOLE and TAG within the signal range. **Control:** Set nodes in the system wirelessly, one-key calibration, one-key air upgrade.	
TAG	Generally installed on the carrier to be located	**Positioning:** Its own coordinate position is calculated by measuring the distance information to each ANCHOR, and then output through the communication interface. **Data transmission:** Receive the data sent by the CONSOLE and ANCHOR end users within the signal range； send the data to CONSOLE and ANCHOR within the signal range.	Role and ID. Local Time. System Time. Supply Voltage. The quantity of all ANCHOR in the signal range and their Role, ID, distance, signal strength. its own positioning coordinates and accuracy estimation factor (effective for simple positioning scenes). Triaxial angular rate and acceleration. Euler Angle and Quaternion. DT data of ANCHOR and CONSOLE.

1.5.2 DR Mode

DR MODE is a distributed ranging mode, in which there is only one role of NODE. All NODE can measure the distance with other nodes within the signal range, and can communicate with them, and the time of all nodes in the system can be output synchronously. The naming rules are as follows:

Node Naming Rules： In general, if the ID of a NODE is i, it is abbreviated as Ni, for example, the NODE whose ID is 0 is abbreviated as N0.

The schematic diagram of the work is shown in Fig. 9:

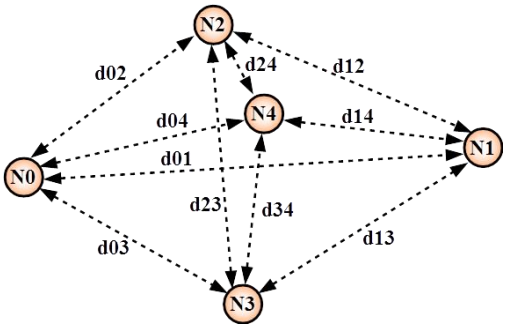


Fig. 9. DR MODE Schematic Diagram

The figure shows 5 nodes N0~N4. The working mechanism is as follows:

N0 measures the TOF (time of flight) to 5 nodes of N1~N4 respectively, multiplies the speed of light to obtain the distances d01, d02,.., d04 from N0 to each node, and then outputs all distances and their corresponding ID (through the communication interface). Similarly, N1 can obtain five distances to N0, N2, N3 and N4, which are d10, d12, d13, and d14, respectively, and then output. The measuring principles of N2, N3 and N4 are the same as before.

Furthermore, if data (here is the DT data) is sent to N0 through the communication interface, N0 will automatically broadcast the DT data to all nodes in the signal range, and N1~N4 will parse the wireless data message from N0 after receiving it, and then automatically output the DT data of N0. Similarly, if N1 receives the DT data (from the communication interface), it will automatically broadcast, so that N0, N2, N3, N4 automatically output the DT data of N1. The principle of N2, N3 and N4 data transmission is the same as before.

The descriptions of each role are described in Table 4:

Table 4: DR MODE Role Overview

Role	Installation	Description	Output
NODE|	It is generally installed on the carrier whose distance is to be measured.	● **Distance measurement：** The distance information to other NODE is measured and then output through the communication interface. ● **Data transmission：** Receives data sent by other NODE end users within the signal range； transmits data to other NODE within the signal range.	● role and id ● Network synchronization timestamp ● Power supply voltage ● The number of other nodes in the signal range and their role, id, distance, signal strength. ● DT data of other nodes

1.5.3 DT Mode

DT mode is data transmission mode, in which there are two roles: MASTER and SLAVE. Wireless data transmission with high speed and low delay can be realized. According to the different usage scenarios, there are three modes:

DT_MODE0： Intelligent communication mode. It can realize one-to-many broadcast and one-to-one two-way communication； the MASTER input is protocol frame data, and the MASTER output and slave input and output are transparent transmission data.

DT_MODE1 ： Two-way communication mode. It can realize one-to-one two-way communication, and the input and output of the MASTER and slave are all transparent data.

DT_MODE2 ： Broadcast communication mode. It can realize one-to-many broadcast communication, and the input and output of the MASTER and slave are all transparent data.

The naming rules are as follows：

MASTER Naming rules： Generally, there is only one MASTER, abbreviated as M.

SLAVE Naming rules： In general, if the ID of a SLAVE is I, it is abbreviated as Si,. For example, a SLAVE whose ID is 0 is abbreviated as S0. In particular, under DT_MODE1 and DT_MODE2, SLAVE does not need to distinguish between ID, and abbreviated as S.

The working diagram is shown in Fig. 10, where the left figure is DT_MODE0, the middle figure is DT_MODE1, and the right figure is DT_MODE2. The working principle is as follows:

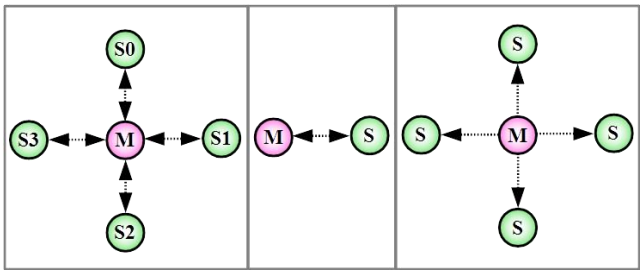


Fig. 10. DT MODE Schematic Diagram

DT_MODE0 Working Mechanism： The data transmission type is determined by sending specific protocol frame data to the MASTER M through the communication interface, and the DT data length and data are also embedded in the protocol frame. When the data transmission type is broadcast communication type: all the data transmission contents in the protocol frame sent to M will be sent to all slave computers S0~S3, and then the DT data will be output transparently through the communication interface. When it is a two-way communication type: the DT data embedded in the protocol frame sent to M will be sent to the designated slave's ID, such as S2, then S2 outputs the data transparently through the communication interface, and if the DT data is sent to S2 through the communication interface (transparent input), then M will output the DT data transparently from S2 through the communication interface.

DT_MODE1 Working Mechanism： If the DT data is sent to the MASTER M through the communication interface (transparent input), the slave S will transparently output the DT data from M through the communication interface. If the DT data is sent to the slave S through the communication interface (transparent input), the MASTER M will transparently output the DT data from S through the communication interface.

DT_MODE2 Working Mechanism： If the DT data is sent to the MASTER M through the communication interface (transparent input), the slave S will transparently output the DT data from M through the communication interface.

The description of each role is described in Table 5.

Table 5: DT MODE Role Overview

Role	Installation	Description
MASTER	No special requirements	● **Data transmission：** Data transfer with SLAVE.
SLAVE	No special requirements	● **Data transmission：** Data transfer with MASTER.

2 Typical Specifications

Table 6: Typical Specifications

Parameters	LTS	LTP	LTSS	LTPS	Note
Antenna Type	Integrated	External	Integrated	Integrated	The standard antenna of LTP is a rod antenna.
Product Weight：g	12	33.3	2.9	3.9	Including shell, antenna.
Antenna Weight：g	*	8.72	*	*	*
Product Size：mm	43*31*10	60.3*29*9	32*27*7	39*27*7	Length * Width * Height, where the LTP size does not include an external antenna.
Antenna Size：mm	*	85.5* ϕ 9.3	*	*	*
Main Color	Black				Does not include interface seat, mounting hole, font screen printing and other colors.
Shell Material	ABS	Aluminium alloy	*	*	*
Communication Interface	UART				The TTL signal line is 3.3 V electrical level.
	USB		*	*	The USB interface is the same data source as UART.
	2*CAN		*	*	There are 2 CAN interfaces with exactly the same electrical connection. Not yet open.
Typical Positioning Accuracy	1-D：10cm@ Precision，5cm@ Standard deviation				The data are obtained based on the experiment in chapter 4, in which the three-dimensional positioning accuracy refers to the Z axis, and the X and Y axes are consistent with the two-dimensional positioning accuracy.
	2-D：10cm@ Precision，5cm@R99				*
	3-D：30cm@ Precision，15cm@ Standard deviation				*
Gyroscope	Mean square error noise：0.1°/S		*	*	The IMU parameters are the precision described in the sensor data manual.
	Range of a survey instrument：±2000°/S				*
Accelerometer	Noise： 300μg				*
	Range of a survey instrument：±16g				*
Euler Angle Accuracy：°	Roll, pitch：1				Standard deviation； Euler angle accuracy is the static rough measurement accuracy, dynamic accuracy is not measured, only as a reference.
	Yaw: there is drift				
Working Temperature：℃	[-20,85]				This data is obtained from the rough test of the actual scenario, and the actual use should be based on the specific use environment.
Power Supply	[3.6,5.5]	[4.7,5.2]	[3.6,5.5]		All communication interface power supplies

Voltage：V					are electrically connected, it should be noted that if the power supply interface is USB, it is necessary to use 5V voltage power supply to ensure the normal operation of the USB interface.
Power Consumption：W	1.0	1.35	0.7	0.8	The parameter configuration is consistent with the test in section 4.1.
Number of Channels	6				A configurable channel refers to a channel in which the product can work properly, but only part of the channel can give full play to its performance (such as distance).
Number of Optimal Channels	3	1	3	1	
Communication Distance：m	80	500	80	350	Measured in an open environment.
Maximum Transmit Power：dBm	-30	0	-30	0	The data are obtained based on the experiment in section 4.1.
Transmitting Gain：dB	[0,33.5]				Adjustable.
Frequency Band：MHz	[3244.8,6998.9]				*
Bandwidth：MHz	499.2, 1081.6, 1331.2				Different channels may correspond to different bandwidths.
Cold Start Time：S	1				The time from power on to normal operation.

3 Setting and Function

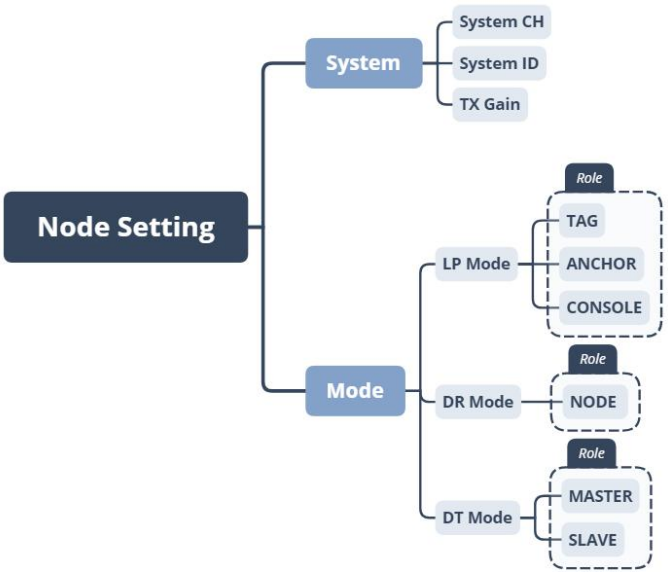


Fig. 11. LT Configuration Overview

Fig. 11 shows an overview of the LT configuration, including the relevant parameter configurations for System and Mode.

3.1 System Parameters

The System in the document refers to a LinkTrack system that runs independently, and the System Parameters of the same System are required to be the same.

System Parameters is composed of System CH, System ID and TX Gain, and its main functions are:

1. Meet the allowable frequency bands and transmission power specifications of different countries and regions.

2. Meet the requirements of multiple systems working at the same time.

3. Adapt to more use environment.

3.1.1 System CH

System CH is formed by the combination of radio frequency channel and coding. LinkTrack supports 6 RF channels and 2 coding modes, thus 12 combination modes can be obtained, **the nodes of the same set of System are required to be configured with the same System CH**.

The configuration of each System CH is shown in Table 7.

Table 7. System CH Detailed Information

System CH	Centre Frequency (MHz)	Band (MHz)	Bandwidth (MHz)	Encoder Mode
0	3494.4	[3244.8,3744]	499.2	Encoder Mode0
1	3494.4	[3244.8,3744]	499.2	Encoder Mode1
2	3993.6	[3744,4243.2]	499.2	Encoder Mode0
3	3993.6	[3744,4243.2]	499.2	Encoder Mode1
4	4492.8	[4243.2,4742.4]	499.2	Encoder Mode0
5	4492.8	[4243.2,4742.4]	499.2	Encoder Mode1
6	3993.6	[3328,4659.2]	1331.2	Encoder Mode0
7	3993.6	[3328,4659.2]	1331.2	Encoder Mode1
8	6489.6	[6240,6739.2]	499.2	Encoder Mode0
9	6489.6	[6240,6739.2]	499.2	Encoder Mode1
10	6489.6	[5980.3,6998.9]	1081.6	Encoder Mode0
11	6489.6	[5980.3,6998.9]	1081.6	Encoder Mode1

The recommended System CH for LTS and LTP is described in Table 8. Here, level 1 priority refers to that under this System CH, the indicators such as communication packet loss rate and distance range are the best, followed by level 2 and level 3.

Table 8. The Corresponding Table for the Product and System CH

Product	Level 1 priority	Level 2 priority	Level 3 priority
LTS	2,3,4,5,8,9	-	other
LTP	2,3	-	other

3.1.2 System ID

System ID is a variable that is set to distinguish different System identities. **Nodes in the same set of System are required to be configured with the same System ID.**

3.1.3 TX Gain

The adjustable range of TX Gain is [0, 33.5] dB. By adjusting TX Gain, the maximum increment of transmission power can be up to 33.5dB. In general, the larger TX Gain is, the farther the communication distance is. **It is generally required that the nodes of the same set of System are configured with the same TX Gain.**

3.2 Mode Parameters

The LinkTrack system supports running in three modes, namely LP Mode, DR Mode and DT Mode.

3.2.1 LP Mode

LP Mode is divided into six different modes. The parameters are shown in Table 9.

Table 9. LP Mode Parameter Table

Mode		Role	Parameters				
			Capacity	UpdateRate (Hz)	DT MaxLength, DT NoCache MaxLength (Byte)	DT Rate (Bps)	Delay (ms)
LP	LP_MODE0	TAG	40	1,2,5,10,25,50	128, 20	1000	< 20
		ANCHOR	8		128, 20	1000	
		CONSOLE	1		1000, 224	11200	
	LP_MODE1	TAG	40	1,2,5,10,20	128, 20	400	< 50
		ANCHOR	30		128, 20	400	
		CONSOLE	1		1000, 224	4480	
	LP_MODE2	Coming soon !					
	LP_MODE3						
	LP_MODE4	TAG	40	1,2,5,10	128, 20	200	< 100
		ANCHOR	120		128, 20	200	
		CONSOLE	1		1000, 224	2240	
	LP_MODE5	TAG	4	1,2,5,10,25,50, 100,200	128, 20	4000	< 5
		ANCHOR	4		128, 20	4000	
		CONSOLE	0	*	*	*	*
	LP_MODE6	TAG	16	1,2,5,10,25,50, 100	128, 20	2000	< 10
		ANCHOR	6		128, 20	2000	
		CONSOLE	1		1000, 88	8800	

Mode：Pattern. In order to meet the requirements of Role capacity, refresh frequency and latency in different scenarios as much as possible, LP Mode supports the configuration of five different modes, LP_MODE0, 1, 4, 5, 6.

Role：The role. There are three roles that can be configured under LP Mode: TAG, ANCHOR and CONSOLE, of which LP_MODE5 does not support the CONSOLE role.

Capacity：Capacity. Maximum capacity of each Role working simultaneously in LP Mode. For example, LP_MODE0 supports up to 40 TAGs (T0~T39), 8 ANCHORs (A0~A7), and 1 CONSOLE (C0) working simultaneously.

UpdateRate：The update frequency represents the output frequency of the positioning data frame, and its size does not affect the parameters such as Capacity, DT Rate, Delay, etc. after the LP Mode is determined. In particular, for ANCHOR and CONSOLE, when there is no TAG working in the system, the positioning frame will be automatically output at 1Hz frequency, and when TAG works, the set UpdateRate output will be automatically restored. In this paper, UpdateRate Max is defined as the highest option for UpdateRate, which represents the fastest update frequency of positioning output frames and number of transmitted frames. For example, under LP_MODE0, the

UpdateRate Max of each Role is 50Hz, and when the UpdateRate of the TAG is set to 25Hz, the positioning output frame of the TAG will output one frame every other 40ms.If there is DT data from other ANCHOR and CONSOLE, the fastest update frequency of data transmission output frame is the same as that of UpdateRate Max, i.e., 50Hz, in the case of no cache.

DT MaxLength： The maximum length of data transmitted in a single frame. If the DT data of a single frame exceeds the DT MaxLength, the excess part will be discarded and will not be sent. For example, under LP_MODE0, the length of data sent to TAG and ANCHOR in a single time cannot exceed 128bytes, and the length of data sent to CONSOLE in a single time cannot exceed 1000 bytes. For another example, if the data transmission data sent to TAG in a single time is 150 bytes, the DT data received by ANCHOR and CONSOLE is the first 128 bytes.

DT NoCache MaxLength： The maximum length of data transmission in a single frame without cache. For example, under LP_MODE0, the DT NoCache MaxLength of TAG and ANCHOR is 20 bytes and the CONSOLE is 200 bytes. For another example, under LP_MODE0, if the length of data transmitted to TAG at 50Hz is 15 bytes, then ANCHOR and CONSOLE will output the DT data sent from TAG at 50Hz.

DT Rate： Data transmission rate, which represents the amount of bandwidth that each Role sends to other Role. After the LP Mode is determined, the DT Rate is not affected by the actual number of nodes and the frequency of data updates. Its calculation formula is

DT Rate = UpdateRate Max * DT NoCache MaxLength

For example, under LP_MODE0, the UpdateRate Max of TAG and ANCHOR is 50Hz, and the MaxLength of DT NoCache is 20 Bytes, so the DT Rate is 1000B/S. The UpdateRate Max of the CONSOLE is 50Hz, and the MaxLength of the DT NoCache is 200 Bytes, so the DT Rate is 1000B/S. For another example, under LP_MODE0, up to 1000 bytes of data can be sent to TAG per second. When ANCHOR and CONSOLE are received within the signal range, they will be sent automatically through the communication interface.

Delay： Delay, which represents the delay value of the positioning output frame and the digital output frame. The size of the Delay is determined by UpdateRate Max and its calculation formula is :

Delay = 1 / UpdateRate Max

For example, under LP_MODE5, the UpdateRate Max of TAG, ANCHOR and CONSOLE are all 200Hz and the delay is 5ms, that is, the positioning delay of TAG is 5ms (no filter is turned on, that is, Filter Factor is 0). If the DT data is sent to ANCHOR at this time (the data length does not exceed DT NoCache MaxLength), then TAG outputs the DT data from ANCHOR, and the delay is 5ms.

If the phenomenon of data caching occurs, the delay will increase, and the formula is as follows:

Delay = (1 / UpdateRate Max) * ((DT Length / DT NoCache MaxLength) + 1)

Where "/" represents rounding calculation. For example, under LP_MODE0, if the length of the data sent to ANCHOR is 50 bytes, its length is 2.5 times that of DT NoCache MaxLength, and the cache

phenomenon occurs, the TAG side outputs the DT data from ANCHOR with a delay of 60ms.

3.2.2 DR Mode

The DR Mode parameters are shown in Table 10.

Table 10. DR Mode Parameter Table

Mode	Role	DR_MODE0				
		Capacity	UpdateRate (Hz)	DT MaxLength， DT NoCache MaxLength (Byte)	DT Rate (Kbps)	Delay (ms)
DR_MODE0	NODE	5	1,2,5,10,25,50,100,200	4096, 100	156.25	< 5
		10	1,2,5,10,25,50,100	4096, 100	78.125	< 10
		20	1,2,5,10,25,50	4096, 70	27.34375	< 20
		50	1,2,5,10,20	4096, 100	7.8125	< 100

Mode： Mode. DR Mode supports only one Mode configured as DR_MODE0. In order to meet the Role capacity, refresh frequency, latency, and other requirements of different scenarios, DR_MODE0 supports configuring a variety of different capacities.

Role： Role. There is only one role of NODE in DR Mode.

Capacity： Capacity. Maximum capacity of each Role working simultaneously in DR Mode. For example, under DR_MODE0, four Capacity configurations of 5, 10, 20 and 50 are supported. When Capacity is 50, DR_MODE0 supports up to 50 nodes (N0~N49) working simultaneously.

UpdateRate： The update frequency represents the output frequency of the positioning data frame. After the Capacity of the DR Mode is determined, its size does not affect the parameters such as DT Rate, Delay, etc. In this paper, UpdateRate Max is defined as the highest option for UpdateRate, which represents the fastest update frequency of positioning output frames and number of transmitted frames. For example, when the Capacity of DR_MODE0 is 20, the UpdateRate Max is 50Hz. When the UpdateRate of NODE is set to 25Hz, the positioning output frame of NODE will output one frame every 40ms. If there is DT data from other NODE, the fastest update frequency of the data transmission output frame is the same as that of UpdateRate Max, that is, 50Hz.

DT MaxLength： The maximum length of DT data in a single frame. If the DT data of a single frame exceeds the DT MaxLength, the excess part will be discarded and will not be sent. For example, when DR_MODE0's Capacity is 10, the NODE's DT MaxLength is 4096 bytes, meaning that the length of data sent to the NODE at a single time cannot exceed 4096 bytes. For another example, when DR_MODE0's Capacity is 10, if the data transmitted to the NODE in a single time is 4321 bytes, the data received by other nodes is the first 4096 bytes.

DT NoCache MaxLength： The maximum length of DT data in a single frame without cache. For example, if the Capacity of DR_MODE0 is 10, the DT NoCache MaxLength of NODE is 100 bytes. If the length of the DT data sent to NODE at 100Hz frequency is 88 bytes, other nodes will output the DT data sent by the NODE at 100Hz.

DT Rate： Data transmission rate, which represents the amount of bandwidth that each Role sends to other Role. After the Capacity of DR Mode is determined, DT Rate is not affected by the actual number of NODE work and UpdateRate. Its calculation formula is

DT Rate = UpdateRate Max * DT NoCache MaxLength

For example, when the Capacity of DR_MODE0 is 5 and the UpdateRate Max of NODE is 200Hz, the DT NoCache MaxLength is 100Bytes, then DT Rate is (200*100)*8/1024=156.25Kbps. For another example, when DR_MODE0's Capacity is 10, up to 78.125kb of data can be sent to the NODE every second. When other nodes in the signal range receive it, they will automatically send it through the communication interface.

Delay： Delay, which represents the delay value of the positioning output frame and the digital output frame. The size of Delay is determined by UpdateRate Max, and its calculation formula is

Delay = 1 / UpdateRate Max

For example, when the Capacity of DR_MODE0 is 10, the UpdateRate Max of the NODE is all 100Hz, and the Delay is all 10ms, that is, the positioning Delay of the NODE is 10ms. If the DT data is sent to the NODE at this point (the data length does not exceed the DT NoCache MaxLength), the delay of other NODE output from the NODE data is 10ms. If the phenomenon of DT data caching occurs, the delay will increase, and the formula is as follows:

Delay = (1 / UpdateRate Max) * ((DT Length / DT NoCache MaxLength) + 1)

Where, "/" stands for integer calculation. For example, when the Capacity of DR_MODE0 is 10, if the length of the DT data to the NODE is 350 bytes, the length is 3.5 times of the MaxLength of DT NoCache. If the cache phenomenon occurs, the delay of the DT data from this NODE output from other NODE end is 40ms.

3.2.3 DT Mode

DT Mode is divided into three different modes, as shown in Table 11, Table 12 Table 13.

Table 11. DT_MODE0 Parameters

Role	Capacity	DT Rate (Mbps)	DT MaxLength, DT NoCache MaxLength (Byte)	TX Period Min & Delay (ms)
MASTER	1	3.0	1000,1000	<2，MASTER and SLAVE only have one transmission data. <4，When both MASTER and SLAVE transfer data.
SLAVE	255	1.5	1000,1000	

Table 12. DT_MODE1 Parameters

Role	Capacity	DT Rate (Mbps)	DT MaxLength, DT NoCache MaxLength (Byte)	TX Period Min & Delay (ms)
MASTER	1	3.0	1000,1000	<2，MASTER and SLAVE only have one transmission data. <4，When both MASTER and SLAVE transfer data.
SLAVE	1	1.5	1000,1000	

Table 13. DT_MODE2 Parameters

Role	Capacity	DT Rate (Mbps)	DT MaxLength, DT NoCache MaxLength (Byte)	TX Period Min & Delay(ms)
MASTER	1	3.0	1000,1000	<0.5
SLAVE	INF	*	*	*

Mode： Mode. In order to meet the requirements of logarithmic bandwidth and communication mechanism in different scenarios as much as possible, DT Mode supports three modes: DT_MODE0, 1 and 2.

Role： Role. DT Mode supports configuration of both MASTER and SLAVE roles.

Capacity： Capacity. Maximum capacity of each Role working simultaneously in DT Mode. For example, under DT_MODE0, the capacity of MASTER is 1 and the capacity of SLAVE is 255, that is, DT_MODE0 supports at most 1 MASTER and 255 slaves (S0~S254) working at the same time.

DT Rate： Data transmission rate, which represents the amount of bandwidth that each Role sends to other Role. For example, under DT_MODE0, when MASTER is in broadcast state, the data transmission rate is 3Mbps； when MASTER is in two-way communication state, the data transmission rate for MASTER and SLAVE is 1.5Mbps.

DT MaxLength： The maximum length of DT data in a single frame. If the DT data length of a single frame exceeds the DT MaxLength, the excess part will be discarded and will not be sent. For example, in DT_MODE2, the DT MaxLength of MASTER is 1000 bytes, that is, the length of DT data sent to MASTER in single time cannot exceed 1000 bytes. If the DT data sent to MASTER in single time is 1024 bytes, then the DT data received by other NODE is the first 1000 bytes.

DT NoCache MaxLength： The maximum length of DT data in a single frame without cache. Under DT Mode, DT MaxLength is equal to DT NoCache MaxLength, so there is no caching mechanism.

TX Period Min： Minimum transmission cycle. It represents the interval between two frames of digital data sent to the Node. For example, under DT_MODE0, when MASTER is in broadcast state, the time interval for sending two consecutive data frames to MASTER is recommended to be more than 2ms； when MASTER is in two-way communication state, the time interval for sending two consecutive data frames to MASTER or SLAVE is recommended to be greater than 4ms.

Delay： The delay represents the delay value of the data transmission output frame, which is consistent with the TX Period Min.

3.3 Baudrate

All MODE are related to this. The Baudrate refers to UART and USB. The CAN communication interface is not open for the time being.

Table 14: Baudrate Parameter List

Baudrate	Note
115200,230400,460800,921600,1000000,1200000, 1500000,2000000,3000000	The baudrate can be set to the corresponding parameter in the list. Due to the limited bandwidth of low baud rate data transmission, the baud rate setting is recommended to be greater than or equal to 921600 in practical use, so that the performance of the product can be released as much as possible.

3.4 Indicator Light

All patterns are related to this. The communication interface refers to the UART or USB on the node. Support setting to turn the indication function on or off.

Table 15: Indicator Light Meaning

Description	Status
In the normal operation mode of LP, DR and DT.	For every frame of data sent out by the communication interface, the green light reverses the state. Every time a frame of data is sent to the communication interface, the blue light reverses the state. If no new transceiver status change is detected within 1 second, the relevant color light goes off automatically.
Directly connected nodes in wireless firmware update.	
Directly connected nodes in wireless setup mode.	
Directly connected ANCHOR or CONSOLE in coordinate measurement.	
Directly connected nodes in firmware update.	The blue and green lights flash at a high frequency at the same time with a flip state of 0.05 seconds.
Non-directly connected nodes in wireless firmware update.	The blue and green lights flash at a high frequency at the same time with a flip state of 0.1 seconds.
Non-directly connected nodes in wireless setup mode.	The blue light flashes in a flipped state for 1 second, and the green light always goes out.
TAG in coordinate measurement.	
Non-directly connected ANCHOR in coordinate measurement.	The blue and green lights flash rapidly at the same time with a flip state of 0.5 seconds.
The node is not powered on.	Blue and green lights are always off.
Indicator off	

3.5 RSSI

LP and DR Mode are related to this item, and DT Mode is independent of this. The node can

output the received first-path signal strength indicator FP RSSI and the total received signal strength indicator RX RSSI, with a resolution of 0.5dB. Where FP RSSI represents the signal strength indication first received by the node, RX RSSI represents all signal strength indicators received by the node. The difference between FP RSSI and RX RSSI can be used as a reference for judging line-of-sight and non-line-of-sight.

3.6 Math Model

The TAG of LP Mode is related to this item, while other Role, DR and DT Mode are not related to this item. For different applications, TAG has three typical Math Models built in the positioning algorithm, as shown in Table 16.

Table 16: Math Model Description Table

Math Model	Description
MATH_MODEL0	The TAG doesn't calculate position, but only outputs other valid information, such as distance, signal strength and so on.
MATH_MODEL1	It is suitable for 8 ANCHOR scenarios, and it needs to distinguish between the scenarios where the TAG is above or below the ANCHOR's Plane. When 3-D positioning, 8 ANCHOR need to be erected as rectangles (that is, the ANCHOR must have height difference)； when only 4 ANCHOR (A0~A3) are used, the positioning effect of X and Y is equivalent to that of MATH_MODEL2, and the Z coordinate output is invalid.
MATH_MODEL2	It is suitable for multi-area ANCHOR cascade scenarios (it should be noted that the firmware does not open the coordinate solution model for multi-area ANCHOR cascade scenarios (that is, more than 4 ANCHOR), that is, the output location frame has only the original distance and no coordinate data.). Under this mathematical model, the Z coordinate information of the TAG can not tell whether it is below or above the plane. If the third dimension positioning information is needed, it is generally recommended that the positioning TAG move on one side of the ANCHOR plane, and when the TAG is close to the ANCHOR plane, the Z-coordinate output accuracy will gradually decrease or even misunderstood, and output invalid values.

3.7 Filter Factor

The TAG of LP Mode is related to this item, while other Role, DR and DT Mode are not related to this item. For the position output of the positioning TAG, there is a Kalman state estimator inside the node, which can achieve the smoothing effect by filtering the coordinates calculated by the TAG. The Filter Factor of TAG represents the degree of filtering: the higher the value, the better the smoothing effect, but the greater the positioning data output delay； the smaller the value, the weaker the smoothing effect, but the smaller the positioning data output delay； when the value is 0, it means no filtering is performed, and the location data output from the tag is the original positioning data.

3.8 Function Key

All MODE are related to this. Function Key, not open yet.

3.9 Voltage Monitoring

LP and DR Mode are related to this, and DT Mode is independent of this. Through the power supply supplied by the communication interface, the node can monitor the power supply voltage through the internal voltage monitor and send it out through the communication protocol frame.

3.10 One-key Calibration

LP Mode is related to this item, while DR and DT Mode are not related to this item. Under LP Mode, after sending calibration command by connecting any CONSOLE or ANCHOR, the coordinates of ANCHOR can be calibrated and the relative position of ANCHOR can be determined. The current firmware only supports the calibration of 4 ANCHOR (A0~A3) in the same plane, and more ANCHOR need to be calibrated manually.

3.11 Wireless Setting

LP and DR Mode are related to this, and DT Mode is independent of this. Under LP Mode, all nodes in the network can be queried, read and written parameters, restart and other functions can be realized by connecting any CONSOLE or ANCHOR.

3.12 Firmware Update

All Mode are related to this item. Upgrade after loading the firmware by connecting to the Node.

3.13 One-key Wireless Update

LP and DR Mode are related to this, and DT Mode is independent of this. Under LP Mode, it can upgrade all Node in the network with one click after loading firmware by connecting any CONSOLE or ANCHOR. Under DR Mode, connect any NODE for one-key update.

4 Typical Performance

4.1 TX Power

4.1.1 Condition

Table 17. Setting of Key Parameters for Transmission Power Testing

Main Parameters	LinkTrack S	LinkTrack P
System CH	9	3
TX Gain (dB)	33.5	
Mode	DT_MODE0	
Role	MASTER	
Supply Voltage：V	5.0	

Under DT_MODE0, MASTER continuously transmits radio signals outward in a time period no more than 3ms, and captures the signal through a spectrometer (Agilent 8596E).

It should be noted that LTS is an integrated antenna, which is measured by aligning the radio frequency antenna of LTS with the receiving antenna of the spectrometer. LTP is an external antenna, which is measured by directly connecting the SMA radio frequency head to the spectrometer. Therefore, the actual transmission power of LTS should be larger, and the transmission power of LTP should be closer to the real value. It can be seen in Fig. 12 that the maximum transmission power of LTS at the central frequency is about -30 dBm. It can be seen in Fig. 13 that the maximum transmission power of the LTP at the central frequency is about 0 dBm.

4.1.2 Result

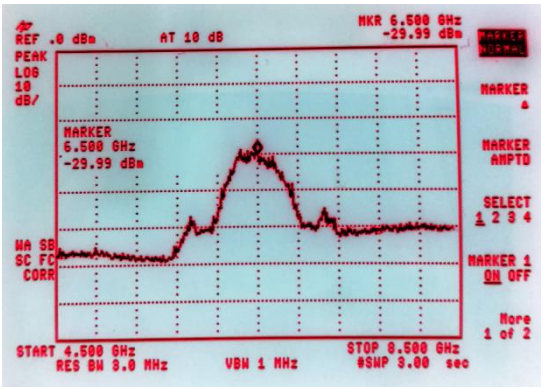


Fig. 12. LinkTrack S Emission Spectrum

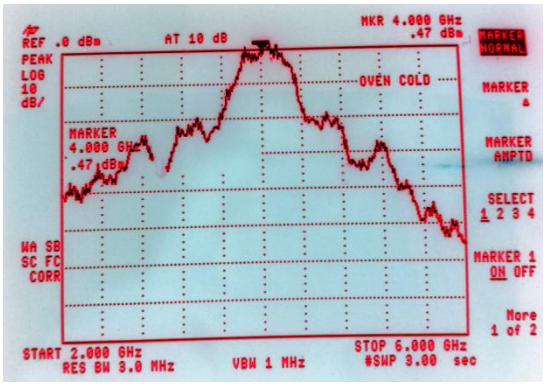


Fig. 13. LinkTrack P Emission Spectrum

4.2 Positioning

Through the actual measurement, there is little difference in the positioning performance between LTS and LTP, and the main difference is that the maximum modulable transmission power of LTP is larger than that of LTS. The document positioning performance indicators are all derived from LTS.

It is a challenging task to evaluate the positioning performance of LinkTrack, for example, its positioning performance is related to clock drift, antenna direction, tag position, ANCHOR layout and so on. Among them, the influence of ANCHOR layout on positioning accuracy can be obtained by theoretical calculation. This document has designed three experiments to analyze the positioning performance related to the three factors of clock drift, antenna direction, and tag position as much as possible, the units in the experiment are all m.

Due to the limited experimental conditions, the relevant indicators of positioning performance have not passed the comparative evaluation of Ground Truth.

4.2.1 Condition

In the test of positioning performance, the basic experimental conditions are shown in Table 18.

Table 18. Basic Conditions of Experiment

Name	Content	Note
Hardware	LTS	*
Temperature：℃	[10,40]	*
Location	Nooploop No. 2 Experimental Base (Shenzhen)	*
Time	201906	*
Environment	Outdoor open space	*
Working mode	LP_MODE0	*
TAG, ANCHOR power supply voltage：v	5	*
Number of TAG and ANCHOR ：	A0、A1、A2、A3、T0	*
ANCHOR Coordinates：m	(0,0,1.6),(0,7.3,1.6),(7.28,7.3,1.6),(7.28, 0,1.6)	Through the actual measurement of the ruler, installed on the tripod.
Update frequency of TAG and ANCHOR：Hz	50	*
System CH	9	*
TX Gain：dB	33.5	*
TAG MATH_MODEL	MATH_MODEL2	*
Whether the TAG is fused IMU	None	*
Whether the TAG is filtered or not	None	*

4.2.2 Static

Table 19. TAG Static Test Condition

Name	Content	Note
Brief introduction of experiment	Install the TAG on the tripod, which is mounted on the horizontal floor.	*

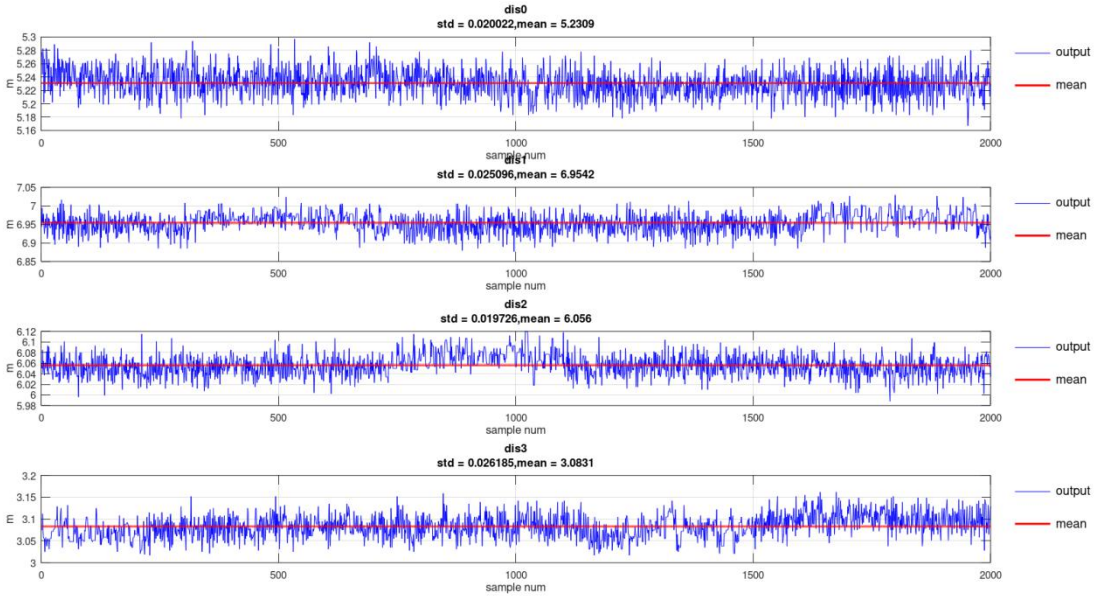


Fig. 14. Distance Wavefrom TAG to ANCHOR under Static Test

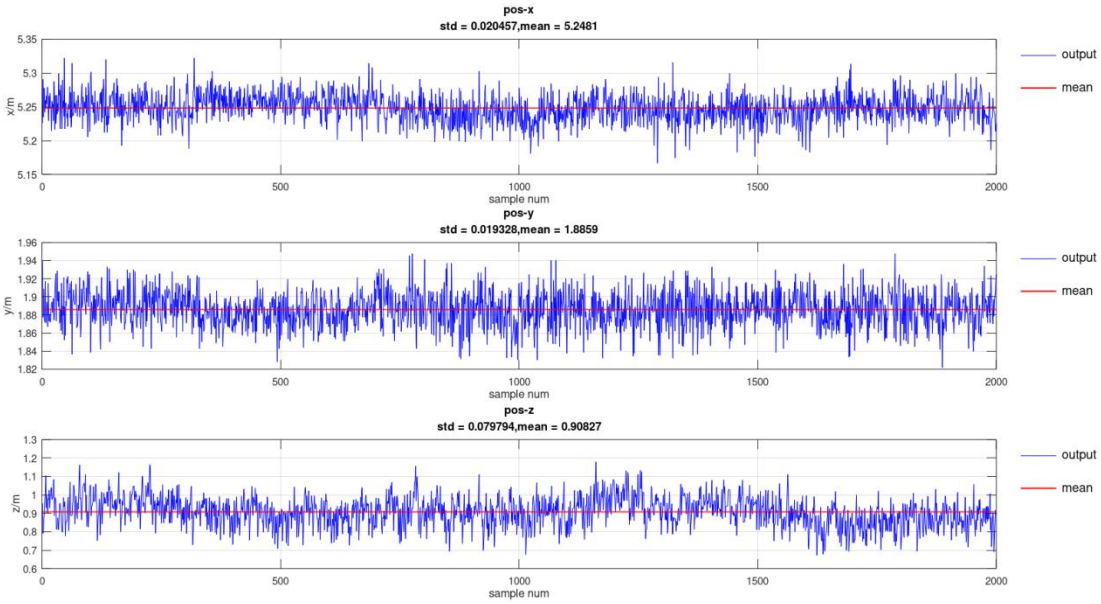


Fig. 15. TAG Coordinate Waveform under Static Test

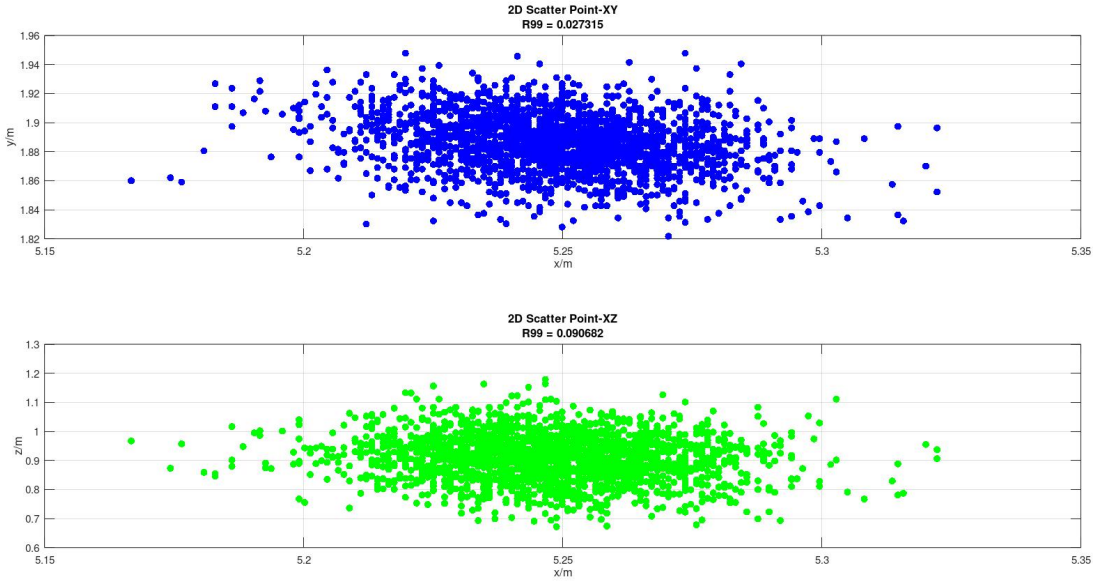


Fig. 16. Two-dimensional Coordinate Distribution Map of TAG under Static Test

4.2.3 Rotation

Table 20. TAG Rotation Test Condition

Name	Content	Note
Brief introduction of experiment	The TAG is installed on the rotating platform, and the rotating platform is statically installed on the horizontal ground.	*
Rotation rate：°/s	112.5	Test based on Nooploop Turntable 1.

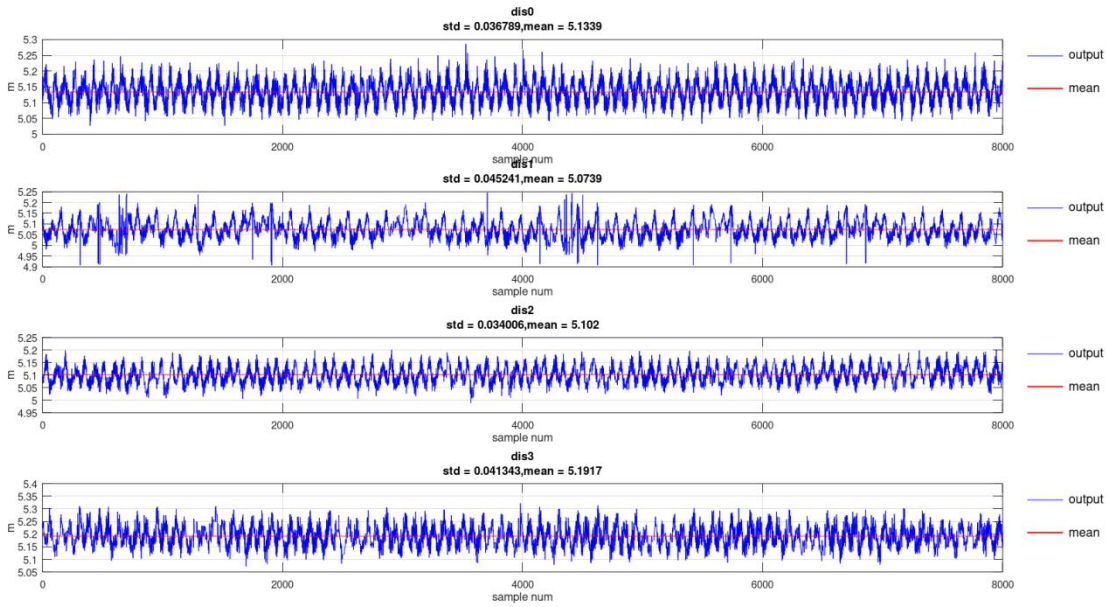


Fig. 17. Distance Waveform from TAG to ANCHOR under Rotation Test

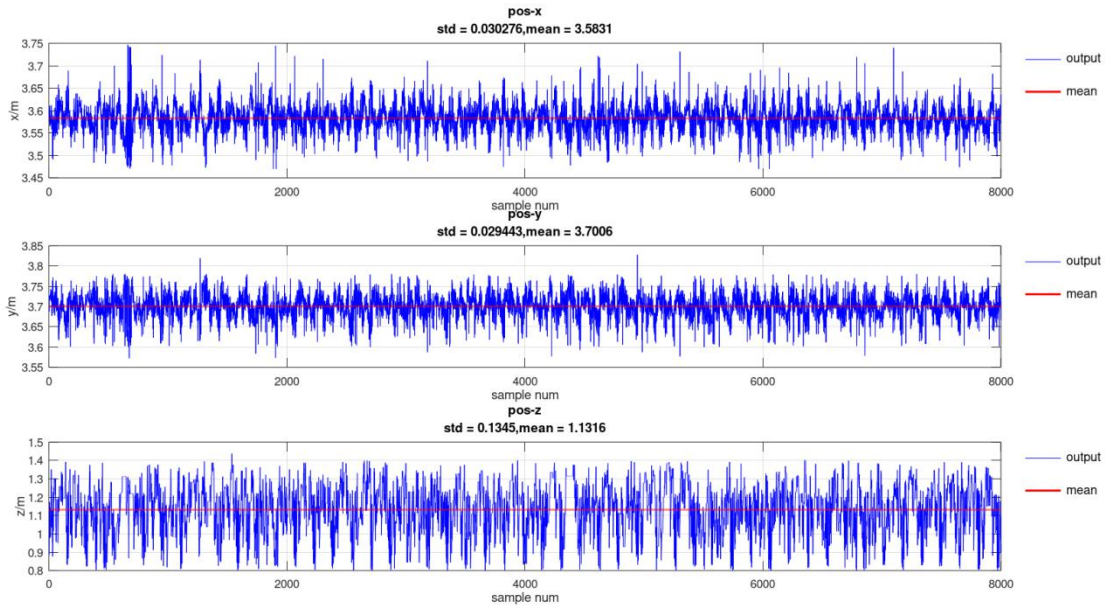


Fig. 18. TAG Coordinate Waveform under Rotation Test

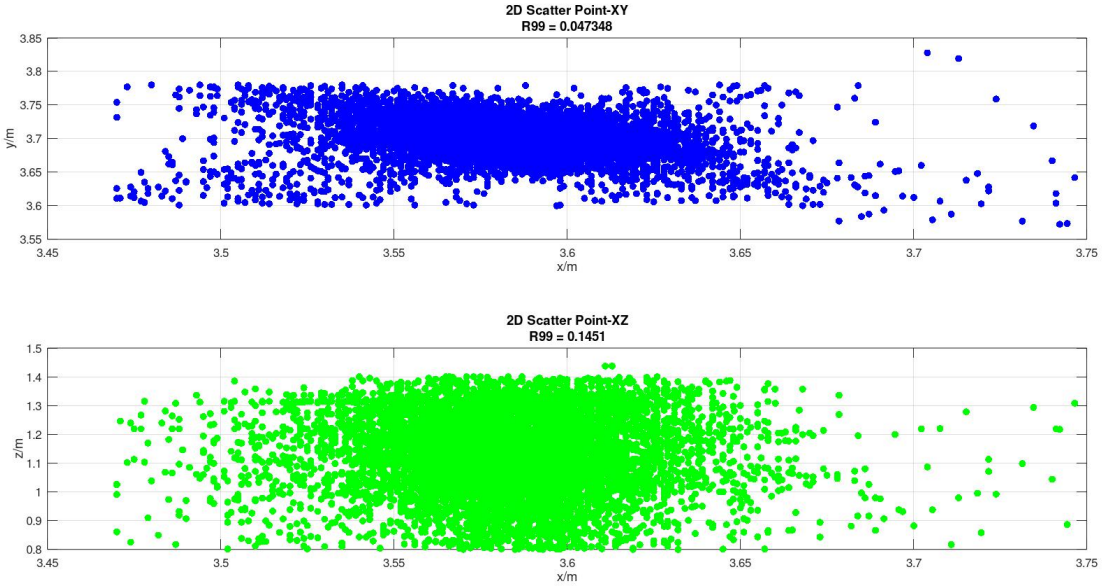


Fig. 19. Two-dimensional Coordinate Distribution Map of TAG under Rotation Test

4. 2. 4 Dynamics

Table 21. Test Conditions for TAG Dynamics

Name	Content	Note
Brief introduction of experiment	Install the tag on the carrier of the mobile car, and the mobile car moves about 3 laps in a fixed track.	*
Accuracy of track width：m	±0.03	*
Track size：m	The track dimensions are shown in Fig. 20.	*
TAG movement speed：m/s	1.4	Average speed

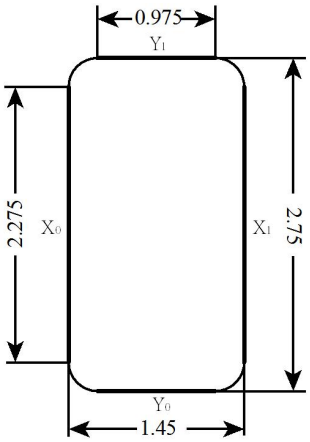


Fig. 20. Track Size Diagram of Dynamics Test, unit: m

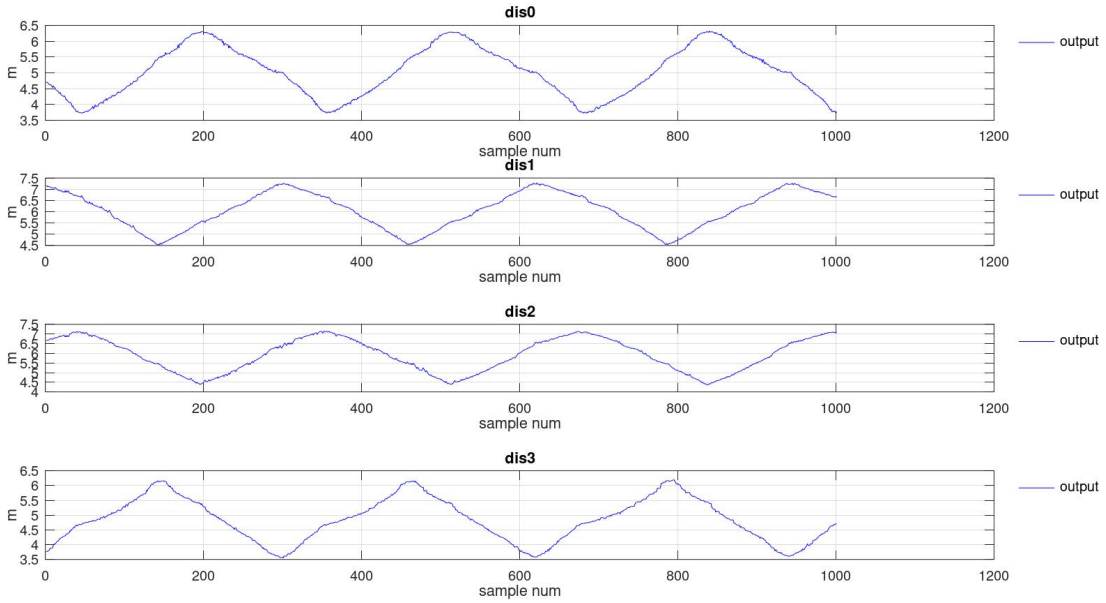


Fig. 21. Distance Waveform from TAG to ANCHOR under Dynamics Test

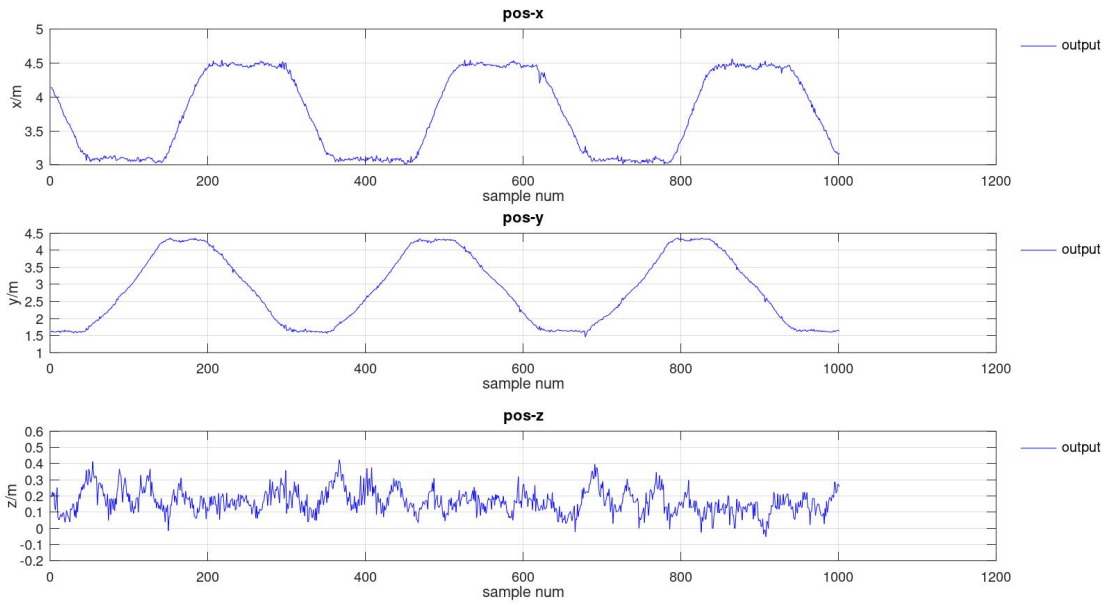


Fig. 22. TAG Coordinate Waveform under Dynamics Test

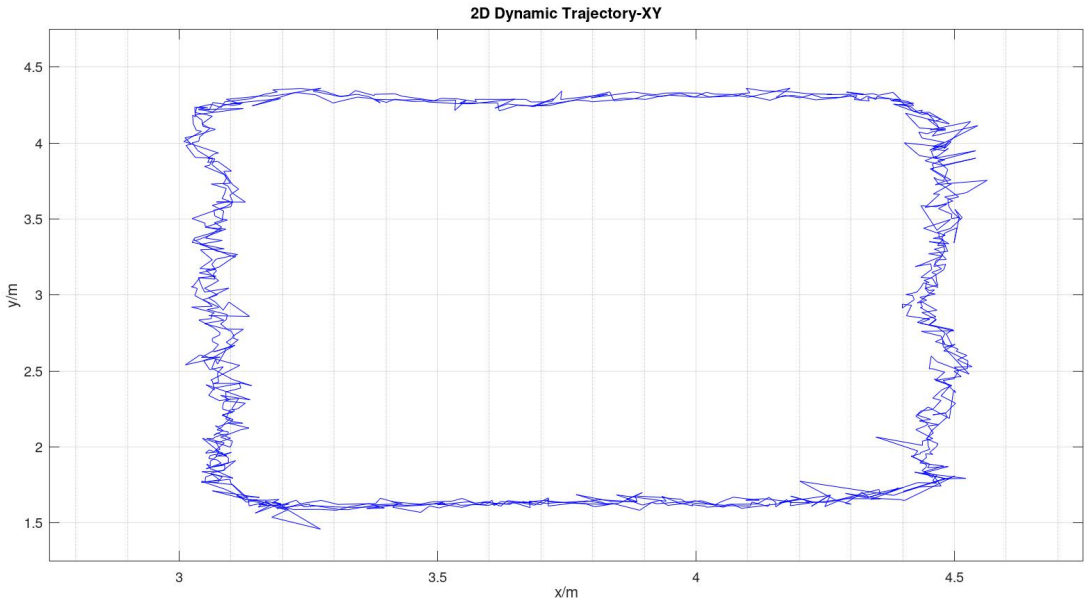


Fig. 23. TAG Track Waveform under Dynamics Test

Because there is no Ground Truth and timestamp tracking in the test, the scheme shown in Fig. 24 is used as the location performance evaluation index.

Table 22. Index Evaluation under Dynamics Test

Name	Content	Note
Xm0 Trajectory standard deviation：m	0.0247	Xm0, Xm1, Ym0 and Ym1 refer to the trajectories corresponding to X0, X1, Y0 and Y1 orbits and combine the trajectories passing through the same orbit into a group of data.
Xm1 Trajectory standard deviation：m	0.0275	
Ym0 Trajectory standard deviation：m	0.0207	
Ym1 Trajectory standard deviation：m	0.0303	
Xm1-Xm0 Average relative length：m	1.4	*

Ym1-Ym0 Average relative length：m	2.68	
Xm1-Xm0 Average relative length deviation：m	-0.05	The deviation here is the deviation relative to the orbit, that is: Xm1-Xm0 Average relative length deviation = (Xm1-Xm0) - (X1-X0), Ym1-Ym0 Average relative length deviation = (Ym1-Ym0) - (Y1-Y0).
Ym1-Ym0 Average relative length deviation：m	-0.07	

5 Protocol

LinkTrack supports NLink and third-party protocols. For more information on NLink, please refer to the NLink Protocol documentation. The protocol mentioned in the document refers to the communication protocol of UART and USB, while the CAN communication protocol is not open yet.

5.1 NLink Protocol

5.1.1 Principle

5.1.1.1 Composition

As shown in Table 23, Protocol consists of Frame Header, Function Mark, Data, Checksum, in which Frame Header and Function Mark are fixed values, Data is the newest variable transferred, and Checksum is the lowest byte after the Sum of Frame Header, Function Mark and Data.

Table 23. Protocol Composition

Frame Header	+	Function Mark	+	Data	+	Checksum

5.1.1.2 Endian

NLink follows the principle of Little-endian | small-end mode, that is, the low byte comes first and the high byte comes last.

5.1.1.3 Type

Fixed length protocol: a protocol with fixed length.

Variable length protocol: a protocol with variable length.

NLink protocol consists of fixed-length protocol and variable-length protocol, which can meet the needs of different scenarios.

5.1.2 Description

Table 24. Overview of NLink Protocol

Protocol	Abbreviation	Length Type	Description
NLINK_LINKTRACK_ANCHOR_FRAME0	ANCHOR_FRAME0	Fixed Length	The output includes the system time, all tag coordinates and their distance to the anchor, node id, supply voltage and other information.
NLINK_LINKTRACK_TAG_FRAME0	TAG_FRAME0	Fixed	The output includes system

		Length	time, tag coordinate and its precision indicator, distance to anchor, IMU raw data information, attitude information and so on.
NLINK_LINKTRACK_NODE_FRAME0	NODE_FRAME0	Variable Length	DT output protocol.
NLINK_LINKTRACK_NODE_FRAME1	NODE_FRAME1	Variable Length	The output includes the system time and all tag coordinates.
NLINK_LINKTRACK_NODE_FRAME2	NODE_FRAME2	Variable Length	The main output includes system time, tag coordinate and its precision indicator, distance to anchor, IMU raw data information, attitude information and so on.
NLINK_LINKTRACK_NODE_FRAME3	NODE_FRAME3	Variable Length	The main output includes information such as system time, distance and signal strength.
NLINK_LINKTRACK_USER_FRAME1	USER_FRAME1	Variable Length	Input frame of DT data, including remote node role, id and the data content to be sent.
NLINK_LINKTRACK_SETTING_FRAME0	SETTING_FRAME0	Fixed Length	LinkTrack setting protocol containing parameter setting and read such as anchor coordinates.

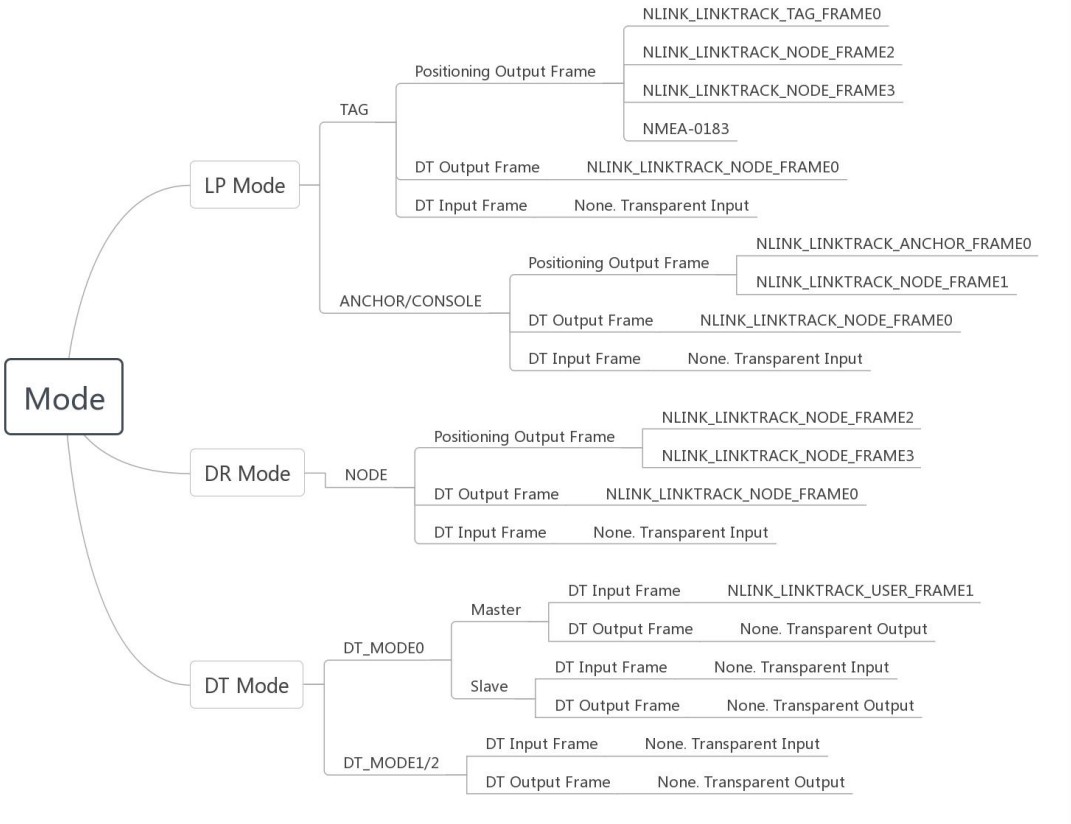


Fig. 25. Relationship Diagram of Mode, Role and Protocol

5.2 Third Party Protocol

5.2.1 NMEA-0183

The NMEA protocol is a set of communication protocols formulated by the National Marine Electronics Association (NMEA-The National Marine Electronics Association) to establish a unified RTCM (Maritime Radio Technology Committee) standard in different GPS (Global Positioning system) navigation equipment. According to the standard specification of NMEA-0183 protocol, GPS receiver transmits position, speed and other information to PC, Pad and other devices through serial port[1].

In LP Mode, the output protocol of TAG supports the standard specification of the NMEA-018.

6 Firmware

The format of the firmware version number officially released is va.b.c, and the format of the firmware version number tested is va.b.betad. LinkTrack product series can check for the latest firmware through NAssistant and upgrade firmware, and support both wired firmware upgrade and wireless firmware upgrade (OTA upgrade).

7 Software

NAssistant is the debugging software for LinkTrack. Its main functions are: Setting Debugging, Status Display, Functional Application, Firmware Upgrade.

Setting Debugging：It is used to Setting node-related parameters, such as frequency band, mode, baud rate, refresh frequency and so on.

Status Display： It is used to display the running status of each node in the system, such as one-dimensional waveform display of positioning coordinates, two-dimensional and three-dimensional trajectory display and so on.

Functional Application：It is used for application development, such as data import and export, motion trajectory storage, historical track playback and so on.

Firmware Upgrade： It is used to upgrade the firmware of the product and supports wired firmware update and wireless firmware upgrade.

8 Mechanical Specifications

8.1 Size

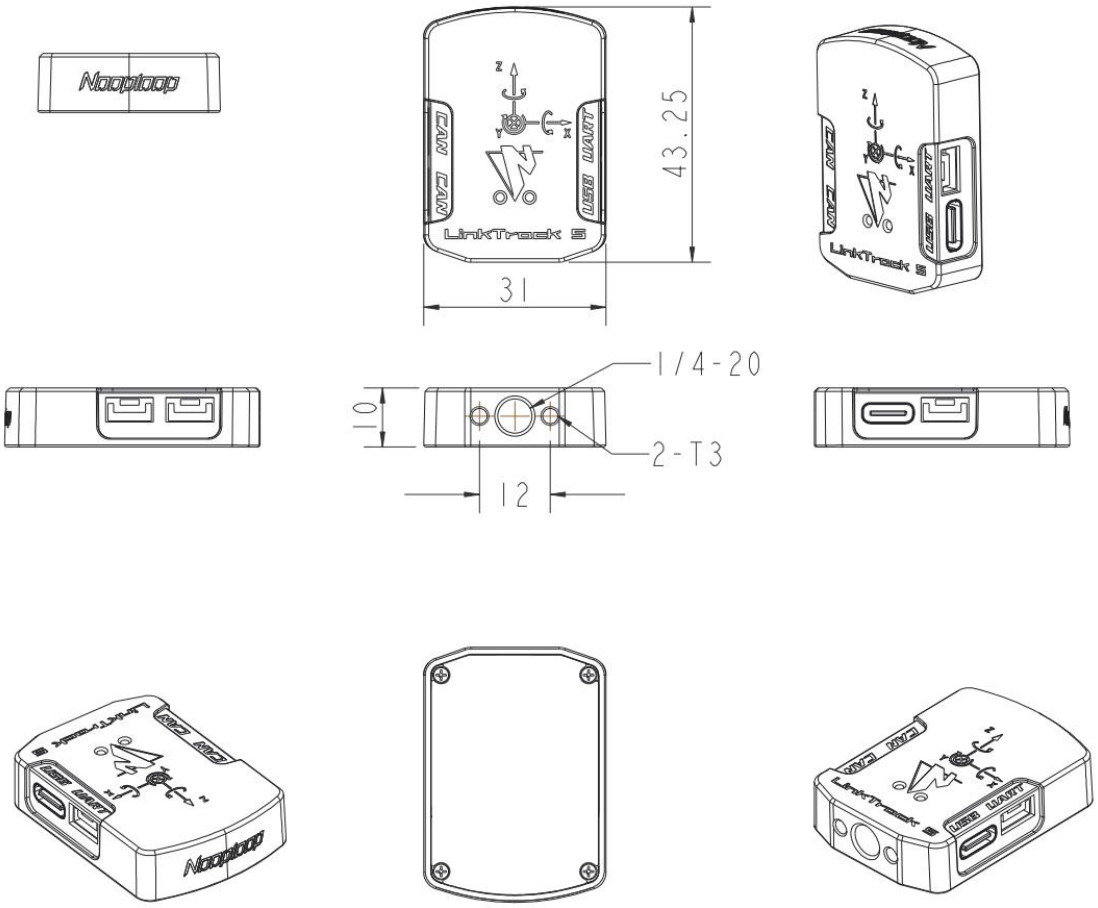


Fig. 26. LinkTrack S Dimension Drawing, unit: mm

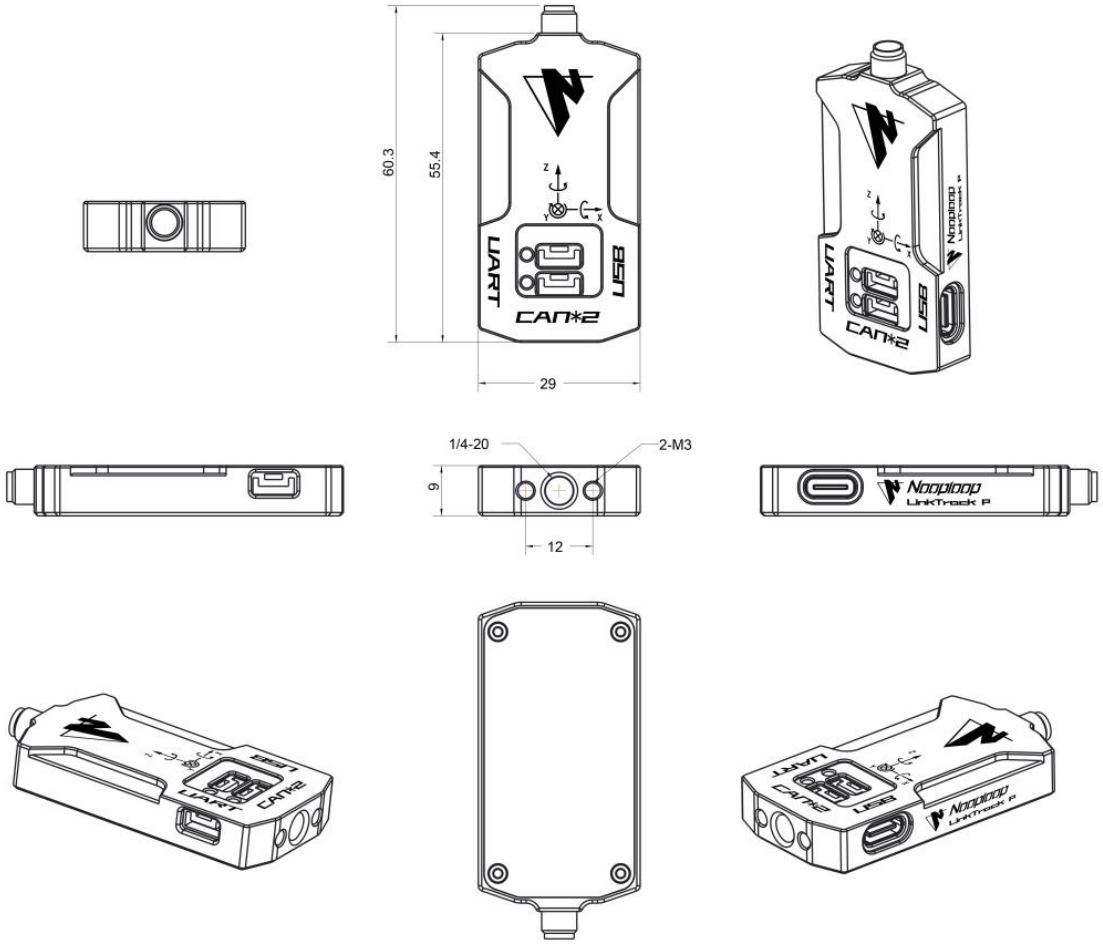


Fig. 27. LinkTrack P（No standard NAUWB01 antenna）Dimension Drawing, unit: mm

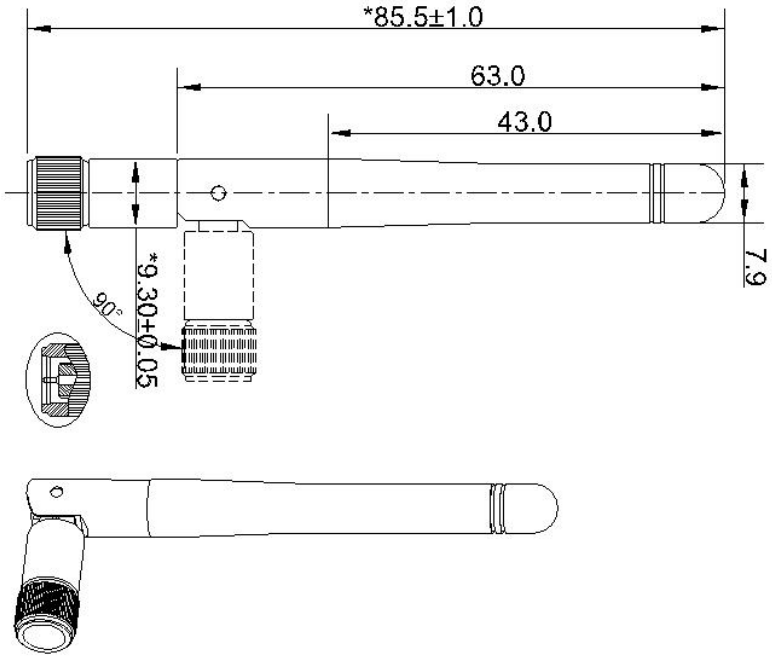


Fig. 28. NAUWB01 Antenna Dimension Drawing, unit: mm

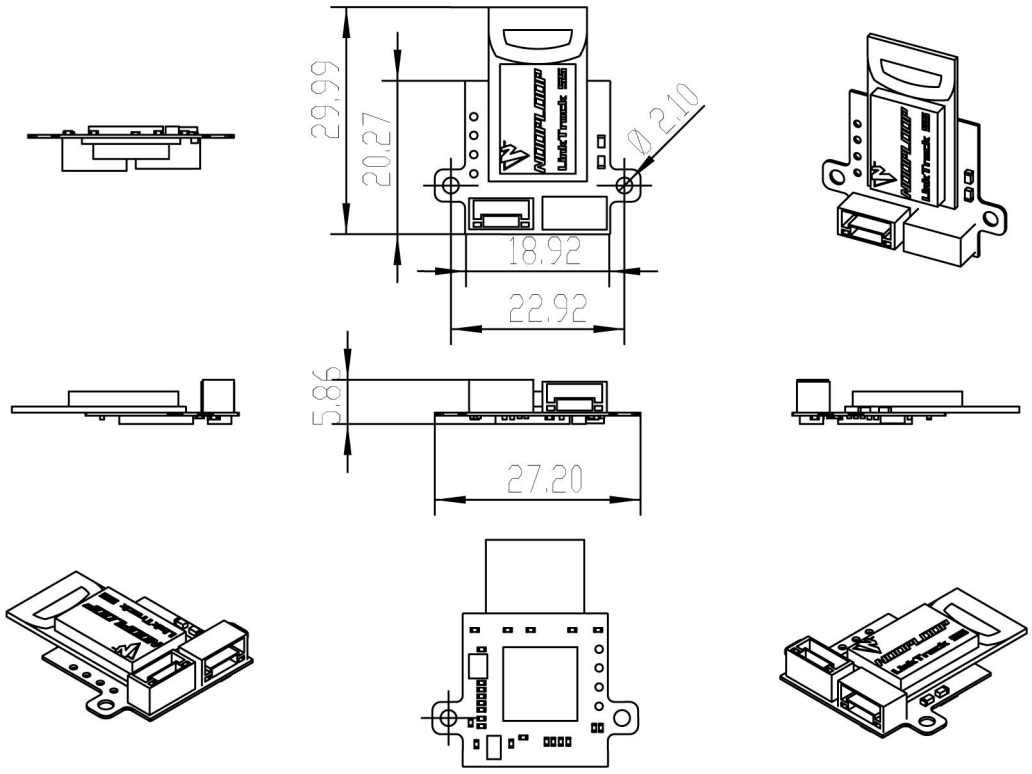


Fig. 29. LinkTrack SS Dimension Drawing, unit: mm

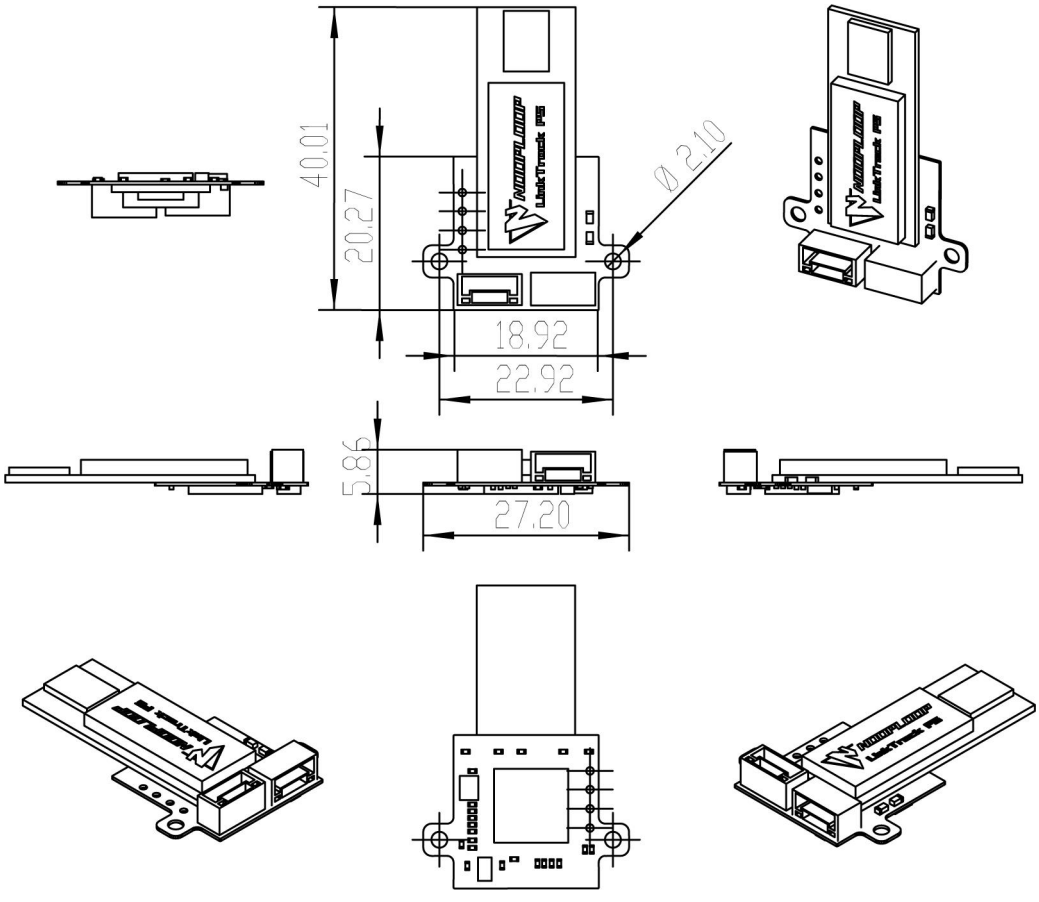


Fig. 30. LinkTrack PS Dimension Drawing, unit: mm

8.2 Figure

Note: the picture of the product does not represent the actual size. Please refer to Section 8.1 for the actual size.

Fig. 31. LinkTrack S Picture

Fig. 32. LinkTrack P Picture

Fig. 33. NAUWB01 Antenna Picture

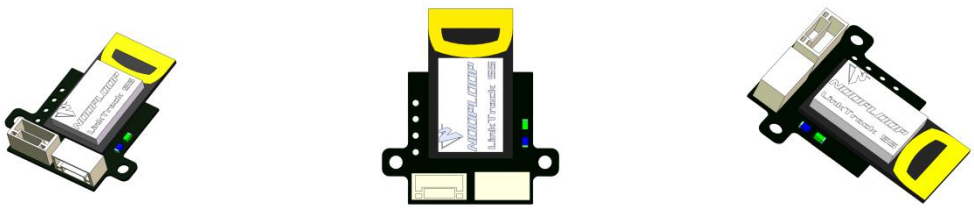


Fig. 34. LinkTrack SS Picture

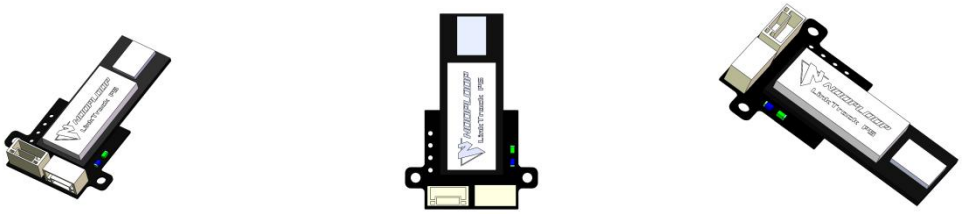


Fig. 35. LinkTrack PS Picture

9 Abbreviation and Acronyms

Table 25. Abbreviations and Acronyms

Abbreviation	Full Title
UWB	Ultra Wideband
PNT	Positioning, Navigation, Timing
PNTC	Positioning, Navigation, Timing, Communication
LP	Local Positioning
CP	Centralized Positioning
DP	Distributed Positioning
DR	Distributed Ranging
DT	Data Transmission
LPS	Local Positioning System
GPS	Global Positioning System
BDS	BeiDou Navigation Satellite System
GNSS	Global Navigation Satellite System

10 Reference

[1] https://baike.baidu.com/item/GPS%E5%8D%8F%E8%AE%AE/306564?_fr=aladdin

11 Update Log

Table 26. Update Log

Version	Date	Description
1.0	20190701	● Release the first edition of the manual.
1.1	20190715	● The corresponding table of the relationship between Product and System NUM is added. ● The description of Math Model under LP Mode is detailed. ● Modify the maximum communication distance of LTP to 500m. ● The control function description of CONSOLE and ANCHOR and the output content of Role are added. ● Added Filter Factor description. ● Some of the wrong characters have been corrected: buadrate-- > baudrate.
1.2	20190717	● Corrected the corresponding table of product and System NUM.
1.3	20190731	● Added RSSI introduction. ● Some of the wrong characters have been corrected
2.0	20200323	● Fully update the manual. ● Corrected update rate with DR_MODE0 capacity of 5. ● System NUM is changed to System CH.
2.1	20200508	● Introduction of LTSS and LTPS has been added.

12 Further Information

Company: Shenzhen Nooploop Technology Co., Ltd

Address: Room 113, 1st Floor, Building 5, Qianhai Shengang Youth DreamWorks, No. 35 Qianwan 1st Road, Qianhai-Hong Kong Cooperation Zone, Shenzhen

E-mail: marketing@nooploop.com

Website: www.nooploop.com