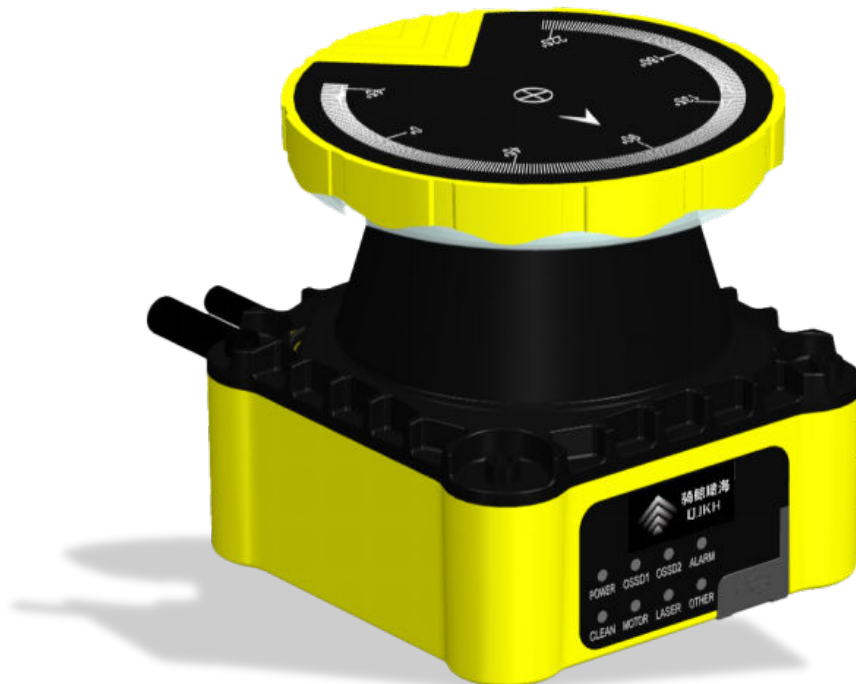




骑鲸瞰海
QJKH

SH27-03D Safety Laser Scanner Product Specification



CCH Technology & Intelligence Co., Ltd

Product Introduction

The SH series safety laser scanner is a high-performance single line lidar based on the direct time of flight (dTOF) ranging principle; Compliant with high-level safety requirements of Type 3 (IEC 61496), SIL2 (IEC 61508), Cat. 3 (ISO 13849-1), PL d (ISO 13849-1).

This product establishes a definable protection area through an invisible laser beam, which is used to protect hazardous areas and achieve protection of work hazardous points, passages, or material rack hazardous areas; Especially suitable for various application scenarios such as safe navigation and obstacle avoidance, regional security monitoring, etc.

Technical Parameters

Table 1 Technical Parameters Table

Detection Parameters	
Maximum Protection Radius	3 m @ 1.8% reflectivity
Detection Radius	25 m @ 70% reflectivity
Alarm Zone Radius	10 m
Measurement Range (Limit Value)	40m
Scanning Angle	276°
Angular Resolution	0.1°
Refresh Frequency	30 Hz
Tolerance Zone (TZ = Tolerance Range of Safety Laser Radar)	65 mm
Minimum Detectable Object (Object Resolution (Detection Capability))	70 mm @ Maximum Radius of Protection Zone
Electrical and Mechanical Parameters	
Operating Voltage	DC 24 V $\pm$ 20%
Power-on Startup Time	Typical value 10 s
Refresh Frequency	30 Hz
Power Consumption	< 5 W (no load)
Configuration Interface	Type-C + Ethernet
Safety Output (OSSD)	PNP output (ON state: max IOUT = 100 mA, VOUT $\geq$ VCC-2 V; OFF state: IOUT < 1 mA, VOUT < 2 V), over current protection, capacitive

	load $\leq 1\mu\text{F}$. ON state when no object in protection zone; OFF state when object detected or fault occurs
Auxiliary Output	PNP output, max IOUT = 100 mA, VOUT $\geq$ VCC-2 V; OFF state: IOUT < 1 mA, VOUT < 2 V), over current protection
Overall Dimensions	80 mm $\times$ 80 mm $\times$ 79.5 mm
Weight (including end cap cable)	420 g
Housing Color	Yellow
Ambient Temperature	Operating: -10 °C – 50 °C (no frost or condensation)
	Storage: -40 °C – 70 °C
Ambient Humidity	Operating: 35% RH – 95% RH
	Storage: 35% RH – 95% RH
Light Interference Immunity (Incandescent Lamp)	3000 lux
Shock Resistance	Acceleration 10 g Pulse duration: 16 ms Collision count: three axes, 1000 $\pm$ 10 times per axis
	5M1 (IEC TR 60721-4-5) 50 m/s ² ; 11 ms
Vibration Resistance	Frequency 10 Hz – 55 Hz Amplitude: 0.35 $\pm$ 0.05 mm Sweep count: three axes, 20 times per axis
	5M1 (IEC TR 60721-4-5) Sine: 1.5 mm, 2–9 Hz Random: 0.3 m ² /s ³ , 10–200 Hz
Protection Rating	IP65
Safety Standards	Type 3 (IEC 61496-3:2018)
	SIL 2 (IEC 61508:2010)
	Cat. 3 (ISO 13849-1:2023)
	PL d (ISO 13849-1:2023)
Electromagnetic Compatibility (EMC)	EN IEC 61326-1:2021
	EN 61000-4-2:2009
	EN 61000-4-3:2020
	EN 61000-4-4:2012
	EN 61000-4-6:2014
	EN 61000-4-8:2010
Configurable Functions	

Zone Configuration	Users can configure the SH zone into the desired shape via the configuration software
Response time	$t_R = n \times (m+1)$ • t_R = Response time • n = Set scanning period • m = Set number of scans The scanning period is determined by the motor speed, default is 30 Hz, corresponding to a scanning period of (1000/30) ms = 33.4 ms. Users can configure the response time by setting the number of scans. The setting range is 100 ms–567 ms, corresponding to 2–16 scans.
Zone Group Switching	Configure INPUT1–INPUT8 and General IO1–General IO4 to achieve static input switching of 64 monitoring instances and 64 zone groups; dynamic input switching of 256 monitoring instances and 64 zone groups

Working Principle and Protection Zone Configuration

The SH type safety laser radar is an electro-sensitive protective equipment (ESPE), based on the laser ranging principle, achieving two-dimensional area protection through rotational scanning; It uses invisible laser beams to establish a protection zone, mainly for protecting hazardous areas, ensuring protection of hazard points, access, and hazardous areas. Users can configure the number and shape of protection zones through the configuration software.

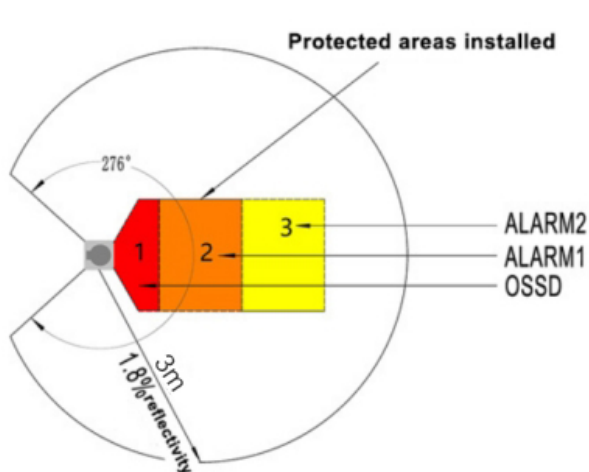


Figure 1 Protection Zone+Warning Zone mode

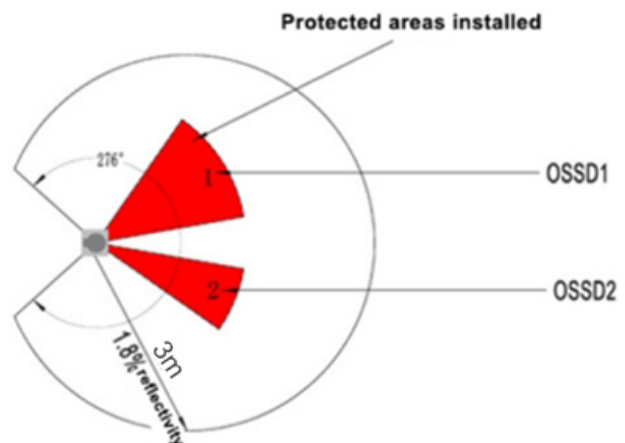


Figure 2 Dual Protection Zone mode

Symbol	Meaning	Symbol	Meaning
OSSD	Protection Zone	OSSD1	Protection Zone 1

ALARM1	Warning Zone 1	OSSD2	Protection Zone 2
ALARM2	Warning Zone 2	/	/

Appearance Information



Figure 3 Indicator Lights

Table 2 Appearance Information Description

No.	Component Name	Description
1	Contamination Indicator	The top of the window contains a total of nine Indicator Lights
2	Optical Window	The SH detection beam is emitted outward through the optical window, with a detection angle of 276°
3	Indicator Label	Indicator Label contains eight Indicator Lights
4	Type-C Interface	The radar connects to the computer via the configuration cable through this interface
5	Nameplate	Indicates the technical parameters related to the SH

Table 3 Indicator Light Status

Indicator Symbol	Indicator Definition	Status	Description
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POWER	Power Indicator	Green	Green light on after SH power-on successful
		Off	SH power-on failed
OSSD1	Safety Output 1 Indicator	Green	No object detected in Protection Zone 1, OSSD1 outputs ON state
		Red	Object detected in Protection Zone 1, OSSD1 outputs OFF state
OSSD2	Safety Output 2 Indicator	Green	Dual Protection Zone mode: no object detected in Protection Zone 2, OSSD2 outputs ON state
		Red	Dual Protection Zone mode: object detected in Protection Zone 2, OSSD2 outputs OFF state
		Off	Protection Zone + Warning Zone mode: off
ALARM	Warning Output Indicator	Green	Protection Zone + Warning Zone mode: no object detected in Warning Zone
		Red	Protection Zone + Warning Zone mode: object detected in Warning Zone
		Off	Undefined ALARM output: off
CLEAN	Optical Window Status Indicator	Green	Optical window is clean
		Red	Optical Window severely contaminated, cleaning required
MOTOR	Motor Status Indicator	Green	Radar motor is in normal working condition
		Red	Radar motor malfunction
LASER	Laser Measurement Status Indicator	Green	Radar laser measurement is in normal working condition
		Red	Radar laser measurement malfunction
OTHER	Other Status Indicator	Green	Radar is in normal working condition
		Red	Radar has other operational faults

Note: In the process of power on, power light stays on, all other indicator lights including contamination indicator enter a flowing light pattern, indicating that the device is starting up, which is a normal state. When the flowing light stops, the starting up completed.

I/O Interfaces

SH power/output interface is M12-17-pin male connector, cable length 0.3 m. Network connection interface is M12-4-pin female connector, cable length 0.3 m.

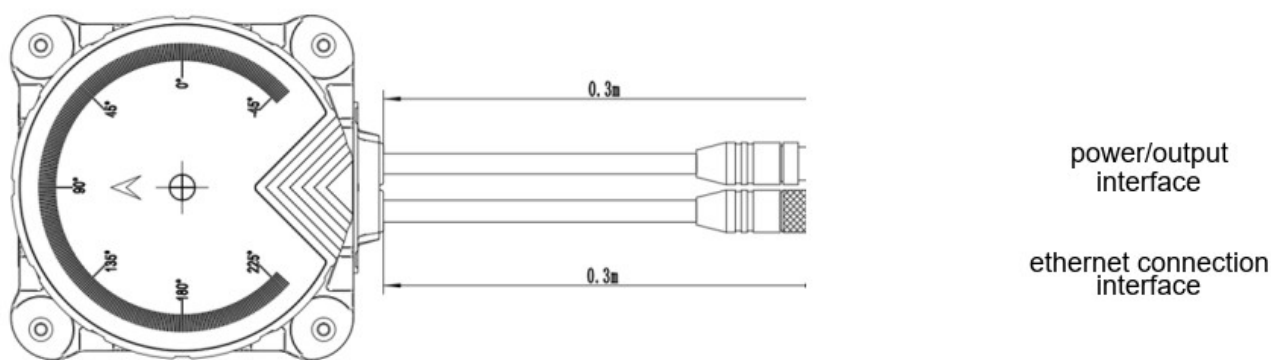


Figure 4 SH Connection Cables

The standard cable length for the power/control interface extension cable is 1 m. Wire core colors and corresponding interface assignments are shown in the table.

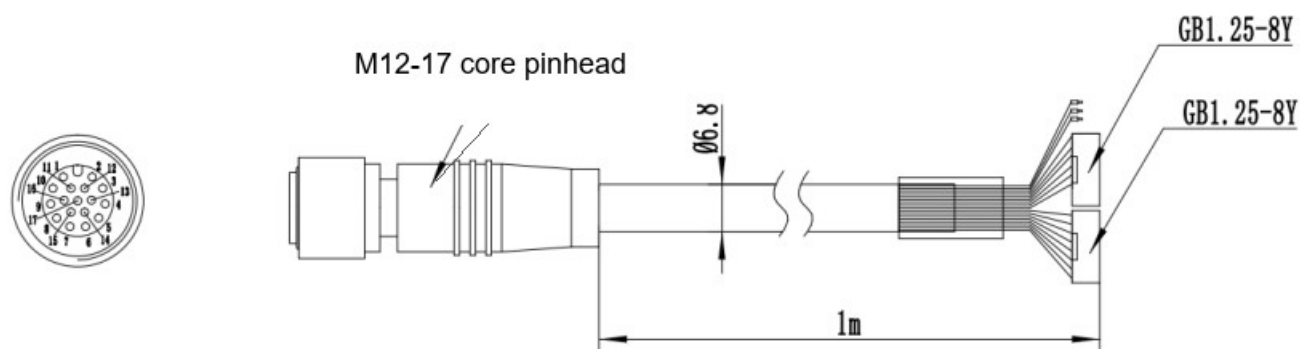


Figure 5 Power Interface extension cable

Table 4 Cable color signal correspondence table

Pin	Wire Color	Signal Definition	Function
1	Brown	24 V	Operating Voltage (+24 V DC)
2	Blue	0 V	Operating Voltage (0 V DC)
3	White	OSSD1.A	First pair of OSSD, OSSD1.A
4	Green	OSSD1.B	First pair of OSSD, OSSD1.B
5	Pink	General I/O 1	Configurable: Static control input: B1 General output: Warning Output 1 / Warning Output 2
6	Yellow	General I/O 2	Configurable: Static control input: A1 General output: Warning Output 1 / Warning Output 2 / Second pair of OSSD, OSSD2.A

7	Black	General I/O 3	Configurable: Static control input: A2 General output: Warning Output 1 / Warning Output 2 / Second pair of OSSD, OSSD2.B
8	Grey	General I/O 4	Configurable: Static control input: B2 General output: Warning Output 1 / Warning Output 2
9	Red	Input 1	Configurable: Static control input: C1 Dynamic control input: Encoder 1a (0°)
10	Purple	Input 2	Configurable: Static control input: C2 Dynamic control input: Encoder 1b (90°)
11	Grey-Pink	Input 3	Configurable: Static control input: D1 Dynamic control input: Encoder 2a (0°)
12	Red-Blue	Input 4	Configurable: Static control input: D2 Dynamic control input: Encoder 2b (90°)
13	White-Green	Input 5	Configurable: Static control input: E1 Dynamic control input: Encoder 3a (0°)
14	Brown-Green	Input 6	Configurable: Static control input: E2 Dynamic control input: Encoder 3b (90°)
15	White-Yellow	Input 7	Configurable: Static control input: F1 Dynamic control input: Encoder 4a (0°)
16	Yellow-Brown	Input 8	Configurable: Static control input: F2 Dynamic control input: Encoder 4b (90°)
17	White-Grey	/	/

The network interface extension cable is a 4-core industrial network connection cable, with an M12-4-pin male connector on one end and an RJ45 connector on the other end. The standard cable length is 1m.

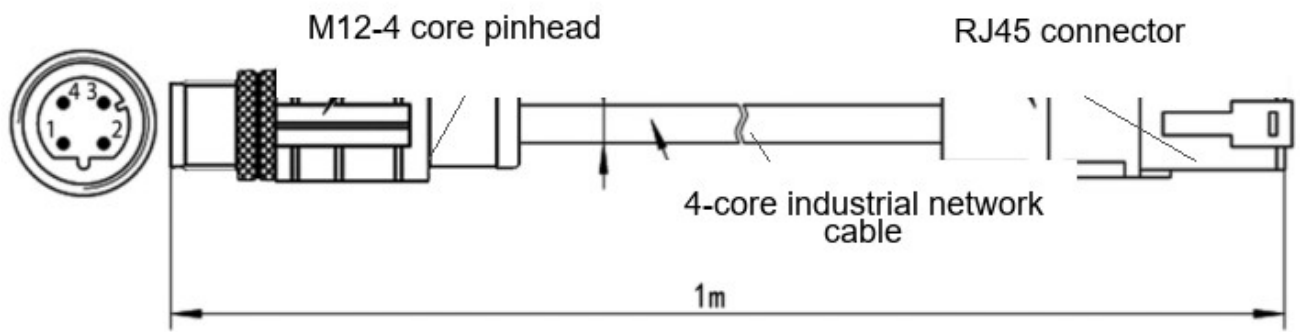


Figure 6 Network interface extension cable

Mechanical Dimensions

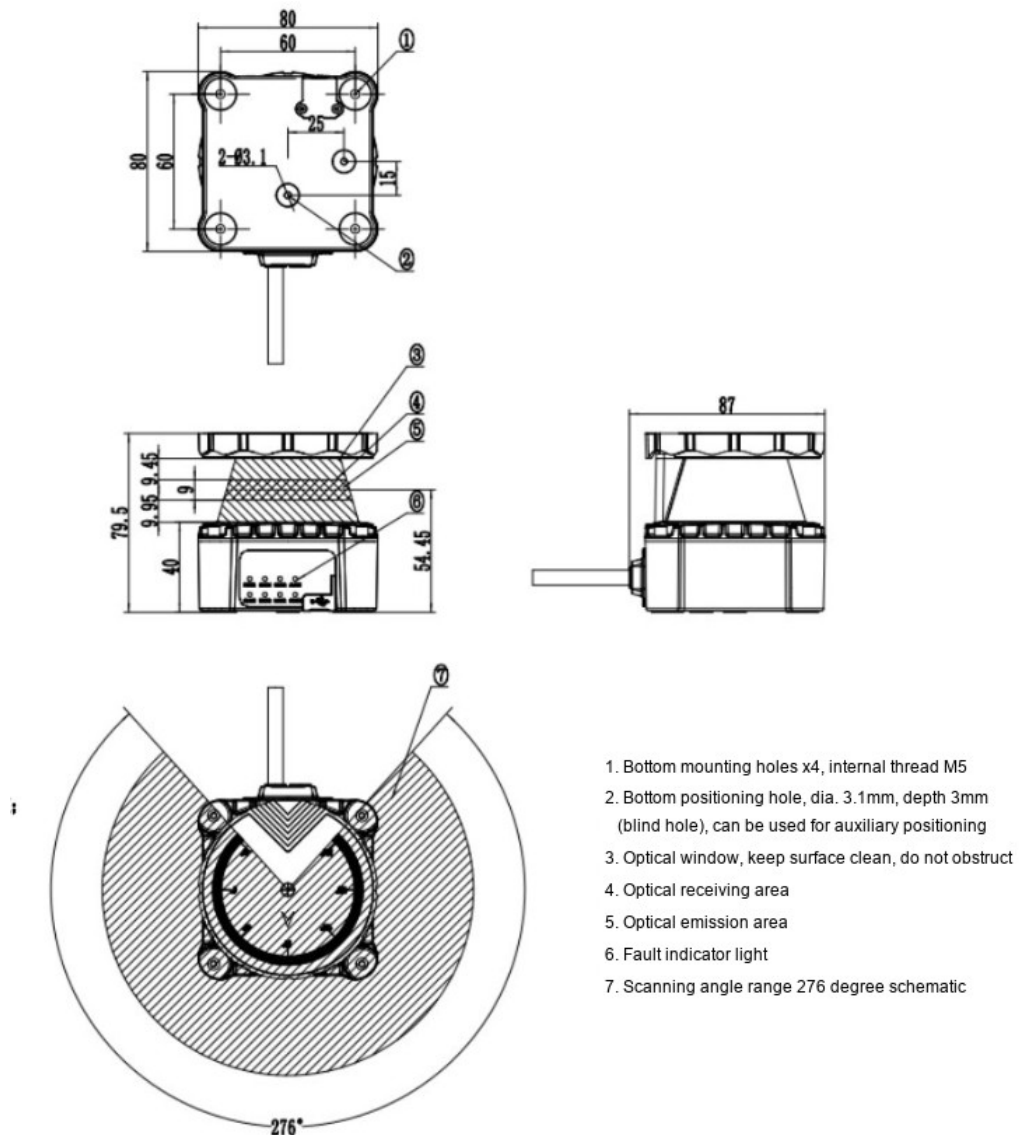


Figure 7 Overall Dimensions Figure



Figure 8 Scanning range Schematic Figure

Communication Protocol

Table 5 Data Format Overview Table

Data Format Description	Overview	
<pre>struct cmd_frame { uint8_t start_code[4]; uint16_t length; uint8_t check_sum; uint8_t cmd_type; uint8_t data[]; }__attribute__((packed));</pre>	1. Uses UDP communication protocol; 2. Port No. 2112 3. Distance data and echo intensity data use little-endian format; 4. Except for distance data and echo intensity data, big-endian format is used uniformly;	
Name	Bytes	Description
start_code	4	Sensor start code 0xFE 0x5A 0xA5 0x55
length	2	Data length following the length field, high byte first, low byte last
check_sum	1	1-byte checksum, XOR of all data from cmd_type to the end of the frame
cmd_type	1	Command Type 0x01: Get real-time radar data

data[M]	M	Command data, detailed data format under each command type, can be empty
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The SH safety lidar defaults angular resolution is 0.1 degree. After receiving the real-time data acquisition command, the radar periodically sends distance and echo intensity data.

Angular resolution is 0.1 degree: within the -48° to $228^{\circ} = 276^{\circ}$ range, a total of $276/0.1 + 1 = 2761$ sample points are collected. Each sample point data occupies 4 bytes of storage (distance data 2 bytes, echo intensity 2 bytes, distance data unit 1 mm). The total sample point data occupies $2761*2$ (distance data) + $2761*2$ (echo intensity data) = 11044 bytes, plus 512 bytes of device information field, totaling 11556 bytes, which exceeds the UDP transmission length (1472), so it is actively divided into 9 packets at the application layer (4 distance data packets, 4 echo intensity data packets, 1 additional information field packet).

Table 6 PC Real-time Data Command Table

PC Real-time Data Acquisition Command				
Type	start_code[4]	length	check_sum	cmd_type
Get Real-time Data	0xFE 0x5A 0xA5 0x55	0x00 0x02	0x01	0x01

Table 7 Radar Real-time Data Response Table (excluding sensor data)

Radar Real-time Data Response (excluding sensor data)					
Lidar real-time data	start_code[4]	length	check_sum	cmd_type	sensor data
frame_num_1	0xFE 0x5A 0xA5 0x55	0xxx 0xxx	0xXX	0x01	...
frame_num_2	0xFE 0x5A 0xA5 0x55	0xxx 0xxx	0xXX	0x01	...
...	...	...	...	...	...
frame_num_N-2	0xFE 0x5A 0xA5 0x55	0xxx 0xxx	0xXX	0x01	...
frame_num_N-1	0xFE 0x5A 0xA5 0x55	0xxx 0xxx	0xXX	0x01	...
frame_num_N	0xFE 0x5A 0xA5 0x55	0xxx 0xxx	0xXX	0x01	...

Continued from previous table - sensor data section

Table 8 sensor data Table

sensor data section

total_index	sub_pkg_num	sub_index	sub_data_type	data_len	data
0xxx 0xxx	0x09	0x00	0x01	0xxx 0xxx	0xxx 0xxx ... 0xxx 0xxx
Same as above	0x09	0x01	0x01	0xxx 0xxx	0xxx 0xxx ... 0xxx 0xxx
...	...	...	...	0xxx 0xxx	0xxx 0xxx ... 0xxx 0xxx
Same as above	0x09	0x06	0x02	0xxx 0xxx	0xxx 0xxx ... 0xxx 0xxx
Same as above	0x09	0x07	0x02	0xxx 0xxx	0xxx 0xxx ... 0xxx 0xxx
Same as above	0x09	0x08	0x03	0xxx 0xxx	add_info[512]

Table 9 sensor data Data Format

About sensor data format description
total_index:
Length is 2 bytes, used to record the total packet sequence number, incrementing sequentially, range 0-65535, high byte first, low byte last
sub_pkg_num:
Length is 1 byte, used to record the number of sub-packets contained under the total packet sequence number
sub_index:
Length is 1 byte, used to record the sub-packet sequence number under the total packet number. Sub-packets are merged into one complete frame of radar data
sub_data_type:
Length is 1 byte, used to record the data type 0x01: Distance data; 0x02: Echo data; 0x03: Additional information;
data_len:
Length is 2 bytes, used to record the number of bytes of sampling point data or additional information bytes following this field, high byte first, low byte last;
data[]:
Variable length, used to record radar sampling distance data or echo intensity data or additional information field. Distance data and echo data are distinguished by the data type field. Each distance data occupies 2 bytes, low byte first, high byte last; each echo data occupies 2 bytes, low byte first, high byte last.

For additional information, see the table below:

Table 10 Additional Information Data Table

Additional Information Data 512 byte			
Name	Field No.	Field Length (BYTE)	Description
dev_type	0–39	40	Device Type
dev_sn	40–71	32	Device SN
Angular Resolution	72–75	4	(1000) -- 0.01 degrees high byte first, low byte last
Number of Sampling Points	76–77	2	high byte first, low byte last indicating the scanning of 276degrees total number of sampling points in range
Software Version	78–81	4	4 bytes edition information
Hardware Version	82–85	4	4 bytes edition information
System Working Status	86	1	0x00: Normal working state Others: Fault state 0x01: Storage fault 0x02: Measurement fault 0x03: Motor fault 0x04: Self-test fault
Angular Resolution Multiplier	87–90	4	Angular Resolution Multiplier (corresponding to the angular resolution above): 100000
Scan Time scan_time	91–94	4	4 bytes, full-circle time (in 0.1 μ s units) high byte first, low byte last
Reserved	95–96	2	Reserved
Sampling Point Time sample_time	97–100	4	4-byte timestamp (in 1 ms units) high byte first, low byte last
Reserved	101–511	xx	Reserved