

# 6km eye-safe ranging module Product Manual V2.0

UBK-LRF0630S

<http://www.unbtek.com/>

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## Dear Users

Before starting to operate the ranging module, please read this manual carefully to ensure that you can use it correctly and obtain accurate measurement results, at the same time, ensure the safe use of the equipment and extend the service life of the equipment.

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Manual revision status:

Date	Edition	Reviser	content
2019.12	V1.0	Cliu	Prepare product manual
2020.03	V1.1	Blan	Modify product manual Added: 6.2.7.Set single/continue ranging frequence and single ranging number
2021.04	V2.0	Cliu	Modify product manual

## 1. Precautions for use

### 1.1. Safety mark

	<p><b>【Danger】</b> Pay attention to laser radiation. The safety category of this product is Class-1. Please do a good job in safety protection.</p>
	<p><b>【Warning】</b> Improper use will cause personal injury.</p>
	<p><b>【Notice】</b> If it is not used normally, it will cause damage to the ranging module.</p>
	<p><b>【Electric shock】</b> The working voltage of the ranging module is about DC9~15V, and the current is about 0.1~1A. Pay attention to the protection when operating the ranging module.</p>
	<p><b>【Electrostatic protection】</b> The device is very sensitive to static electricity, which will cause irreversible damage to the device. Operators should do well in electrostatic protection during operation.</p>
	<p><b>【Environmental humidity】</b> When transporting, storing and using this product, attention shall be paid to avoid humid environment. Working in humid environment such as condensation and frost will affect the ranging performance and may cause damage to the module.</p>

### 1.2. Precautions for use

(1) Do not disassemble the module and components. Improper operation will damage the ranging module and void the warranty.

(2) When integrating the ranging module in the system, please read the product manual carefully. The wrong voltage will cause permanent damage.

(3) When using, keep away from water and other liquids to avoid being polluted by dust or other pollutants.

(4) During transportation and storage, store the modules in the delivered packaging.

(5) Do not make any changes to the equipment, as this may cause potential hazards to operators and modules. It is forbidden to change any electronic, mechanical and optical components. Any modification to the equipment will void the warranty.

(6) This ranging module does not need special maintenance, but it is necessary to keep the optical glass surface (transmitting and receiving lens) free of deposits. To ensure unobstructed



measurement, use air blowing to remove dust. If dust or other deposits are difficult to remove, please contact the sales personnel.

(7) In a very strong light environment, the performance of ranging may be reduced when the object with low surface reflectivity is ranging.

(8) Ranging error may be increased by using glass, optical filter, plexiglass or other translucent materials.

(9) Rain, snow, fog, haze, dust and other weather conditions will affect the ranging performance.

(10) Avoid ranging under the condition of rapid temperature change, and the ranging performance will be affected.

(11) **It is necessary to avoid ranging strong reflection targets (such as glass, smooth metal surface, etc.),** which may cause permanent damage to the detection components.

(12) **It is necessary to avoid ranging the close range target within 30m,** which may cause permanent damage to the detection components.

(13) **In order to avoid the possibility of permanent damage to the detection module when multiple ranging modules work in opposite direction in close range.**

(14) **Avoid using high-energy laser source to direct the receiving antenna of the ranging module,** which may cause permanent damage to the detection module.

(15) **When installing and using the ranging module, the mirror cover should always cover the receiving antenna.** Otherwise, it may cause permanent damage to the detection component.

(16) Beyond the working conditions (including but not limited to working temperature, impact vibration magnitude, etc.), the use of the ranging module will cause damage to the ranging module and void the warranty.

(17) If there is any damage, please do not operate and contact customer service for further assistance.

## 2. Product Overview

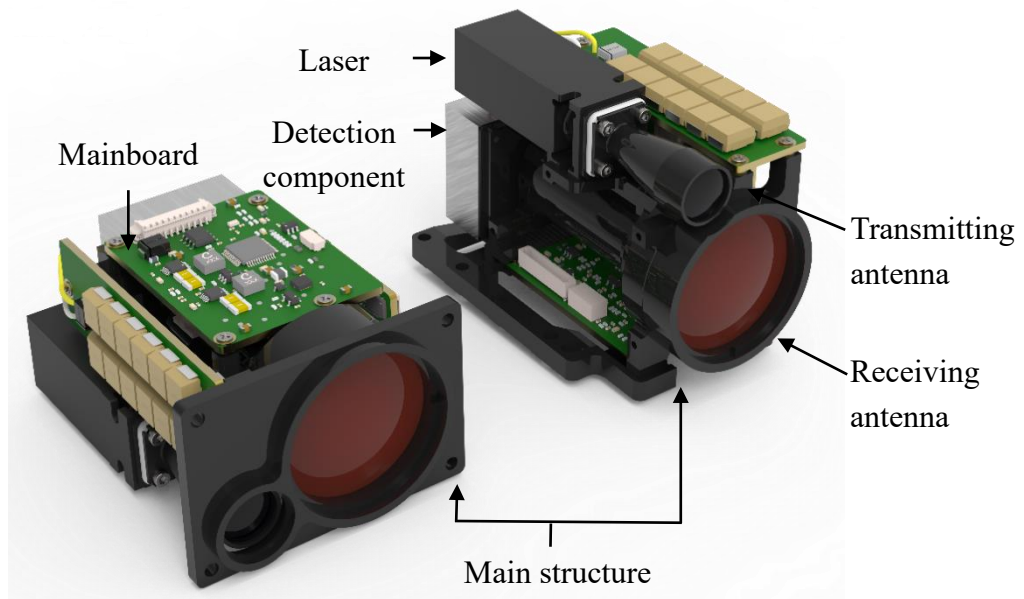
UBK-LRF0630S eye-safe ranging module is developed based on 1535nm erbium-glass laser independently developed by our company. It belongs to level I eye-safe product. The product adopts monopulse ranging, the maximum range is up to 6km. Support UART(TTL\_3.3V), RS232 and RS422 (Full duplex) electrical interface (One out of three), provide upper computer software, Specifies the set and communication protocol. The advantages are stable operation functions, small size and light weight.

## 3. Product composition

### 3.1. Main components

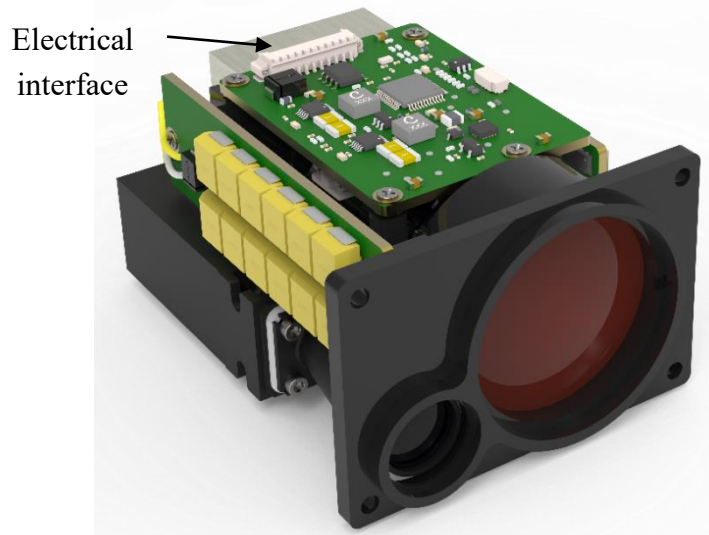
UBK-LRF0630S eye-safe ranging module is mainly composed of laser, transmitting antenna, receiving antenna, detection component, hardware circuit board, main structure, etc.

The hardware circuit board is composed of main control board, power board and operational amplifier board.



## 3.2. Interface component

- (1) Mechanical mounting surface, having four mounting hole.
- (2) Electrical interface, including DC9~15V supply interface, UART(TTL\_3.3V), RS232 and RS422 (Full duplex) communication interface (One out of three);



#### 4. Parameter

Number	Technical specifications	Parameter
1	Eye safety	Class1/1M
2	Wavelength	1535 ± 5 nm
3	Max range	≥7600m; Car target ≥6000m; Humanoid target ≥4000m; UAV target ≥2000 m <sup>1)</sup>
4	Mini range	50m
5	Accuracy	± 2m <sup>2)</sup>
6	Optical aperature	Φ 30mm
7	Divergence	≤0.35mrad
8	Receive FOV	1.88mrad
9	Dimention(L×W×H)	≤80×56×40mm/≤77×49×54mm (-D / -C)
10	Weight	≤135g/≤140g (-D / -C)
11	Frequency	1~10 Hz
12	Resolution	30m
13	Detection probability	≥98%
14	False alarm rate	≤1%
15	Multi-target detection	Up to 3 targets
16	Communication interface	UART(TTL_3.3V)/RS232/Full duplex RS422 (One out of three)
17	Supply	DC 9~15 V
18	Standby power consumption	≤60 mW <sup>3)</sup>
19	Start-up power consumption	≤12 W <sup>4)</sup>
20	Peak power consumption	≤18 W <sup>4)</sup>
21	Operation temperature	-40~+65 °C
22	Storage temperature	-55~+75 °C
23	Vibration	0.01~0.04 g <sup>2</sup> /Hz, 20~2000Hz
24	Mechanical Shock	75g, 6ms

Notes:

1) Car taget size 2.3 m × 2.3 m; Humanoid target size 0.5 m × 1.7 m; UAV target size 0.2 m × 0.3 m ; Reflectivity 30%, Conspicuity ≥10km;

2) ± 1m Accuracy is optional;

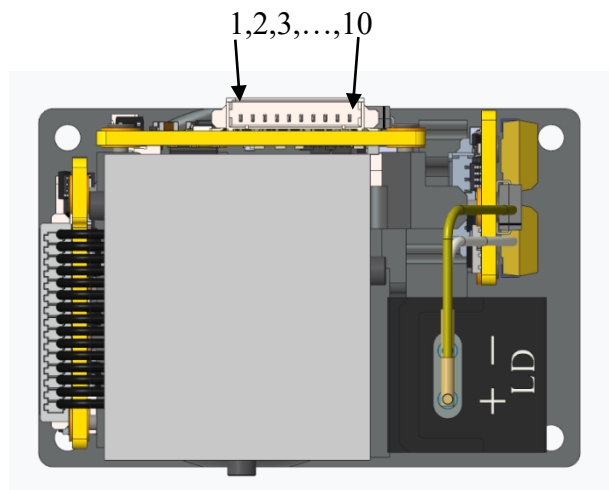
3) Standby power of RS232 is 90mW;

4) The duration of start-up power consumption is less than 200ms; The duration of peak power consumption is less than 30ms and the average power consumption is less than 5W;

## 5. User interface

### 5.1. Electrical interface

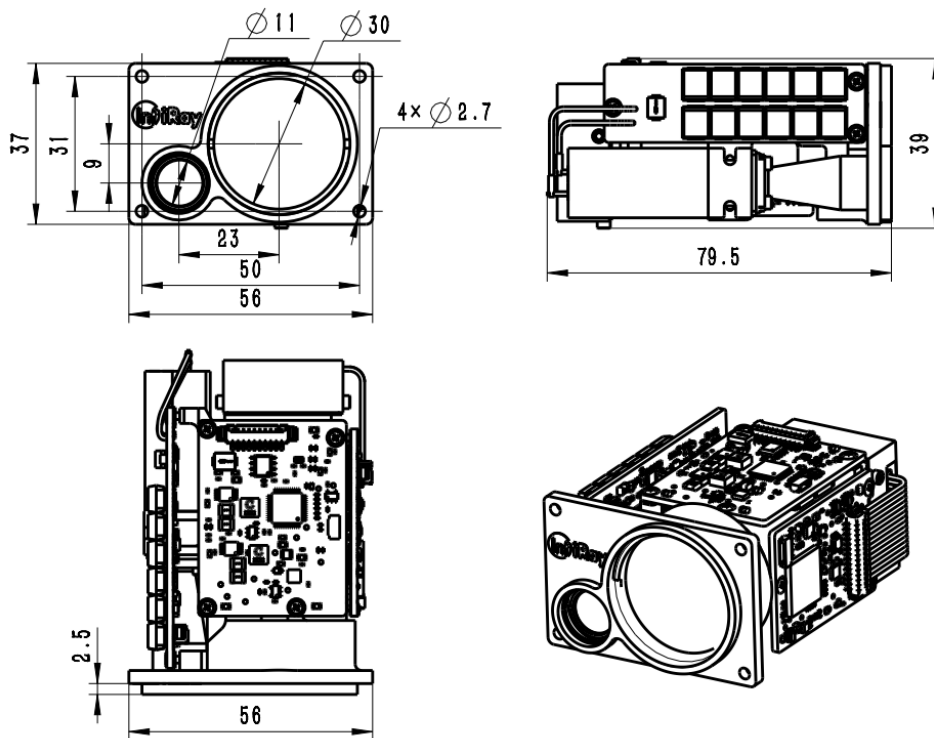
The connector model of electrical interface is CJT-A1251WR-S-10P, and the specific wiring definition is shown in the table below.



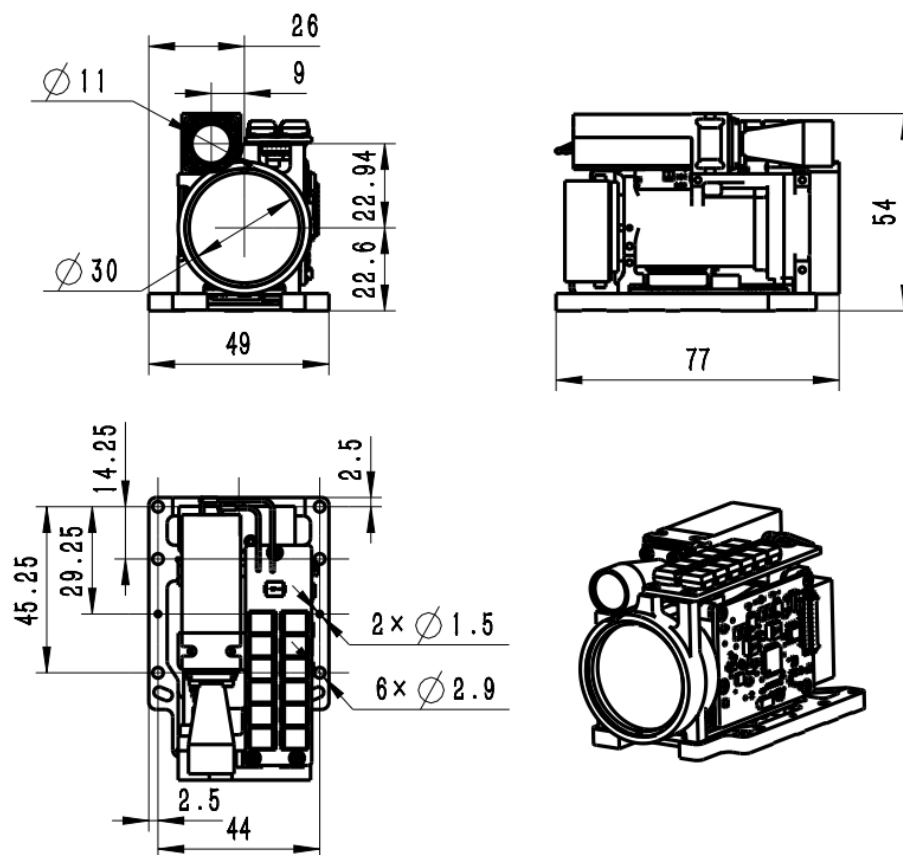
Pin	Definition	Description
1	GND	GND
2	RS422_RX_N	RS422 Receiver -
3	RS422_RX_P	RS422 Receiver +
4	RS422_TX_N	RS422 Transmitter -
5	RS422_TX_P	RS422 Transmitter +
6	GND	GND
7	RS232_RX	RS232 Receiver
8	RS232_TX	RS232 Transmitter
9	Power -	Power supply, GND
10	Power +	Power supply, 9~15V

### 5.2. Dimensions

The overall dimension of the ranging module and the user installation interface are shown in the figure below.



LRF0630S-D



LRF0630S-C



## 6. Serial port Communication protocol

### 6.1. Communication protocol description

#### 6.1.1. Communication speed and format

Format standard	115200(default)/57600/9600, n, 8, 1, the high bit of the multiple bytes data is sent first.
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#### 6.1.2. Data package format

Frame head		A data length	B data content	C checksum
0xEE	0x16	1byte	Unfixed	Unfixed
"C check" is to sum all the data in "B data content" and take the lower 8 bits. The number of bytes contained in "B data content" is the value of "A data length". "B data content" includes command data and response data				

#### 6.1.3. Device code

Device name	Device code
YFR-LRF0630S	0x03

#### 6.1.4. Command data format

Target device code	Command code	A certain length of additional data
1byte	1byte	Corresponding to "A data length"

#### 6.1.5. Response data format

Native device code	Response code	A certain length of additional data
1byte	1byte	Corresponding to "A data length"

#### 6.1.6. Operation process

The ranging module is in the low power consumption mode by default. It needs to send the low power wake-up instruction (0xa5) to it first and wait for the response information (as shown in the table below) before all the instructions in 6.2 below can be operated. After the ranging module wakes up, no command operation is received within 2 seconds, so it can automatically enter into low power consumption mode.

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02 (a data length)	0x03	0x07	Check_sum

After the ranging module executes the instructions in 6.2 below and returns the response information, it automatically enters into low power consumption mode.

## 6.2. Communication Protocol

### 6.2.1. Equipment Self-check

(1) Send to ranging module:

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02 (data length)	0x03	0x01	Check_sum

(2) Get from ranging module:

Byte	0	1	2	3	4	5	6	7	8	9
Describe	0xEE	0x16	0x06 (data length)	0x03	0x01	Status3	Status2	Status1	Status0	Check_sum
<p>Status3 reserved</p> <p>Status2 echo intensity 0x00 ~ 0xff</p> <p>Status1 bit0 -- FPGA system status; 1 normal 0 abnormal  bit1 -- laser light out state; 1 laser emission 0 laser don't emit light  bit2 -- main wave detection state; 1 with main wave 0 without main wave  bit3 -- echo detection status; 1 with echo 0 without echo  bit4 -- bias switch status; 1 bias on 0 bias off  bit5 -- bias output state; 1 bias normal 0 bias abnormal  bit6 -- temperature status; 1 temp normal 0 temp abnormal  bit7 -- laser PWM status; 1 laser PWM normal 0 laser PWM abnormal</p> <p>Status0 bit0 -- 5V6 power supply status; 1 normal 0 abnormal  bit1 -- 15V power supply status; 1 normal 0 abnormal</p>										

### 6.2.2. Single ranging

(1) Send to ranging module:

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02 (data length)	0x03	0x02	Check_sum

(2) Get from ranging module:

Byte	0	1	2	3	4	5	6	7	8	9
Describe	0xEE	0x16	0x06 (data length)	0x03	0x02	Status	Integer high 8 bits of distance	Integer low 8 bits of distance	Decimal of distance	Check_sum
<p>First/Last Target ranging:  Status: 0x00 – indicates that the ranging result is single target;  0x01 – including that another target before this target;</p>										

<p>0x02 – including that another target after this target;</p> <p>0x03 –reserved;</p> <p>0x04 – indicates that the ranging result is out of range(no target);</p> <p>0x05 –reserved;</p> <p>Muilt Target ranging:</p> <p>Status_bit3~0:</p> <p>0x0 – indicates that the ranging result is single target;</p> <p>0x1 – including that another target before this target;</p> <p>0x2 – including that another target after this target;</p> <p>0x3 – including that another two targets before and after this target;</p> <p>0x4 – indicates that the ranging result is out of range(no target);</p> <p>0x5 –reserved;</p> <p>Status_bit7~4:</p> <p>0x0~0xf – indicates that the current distance result number; Value range [0, n-1], number of targets <math>1 \leq n \leq 16</math>;</p>
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### 6.2.3. Set First/Last/Muilt Target

(1) Send to ranging module:

Byte	0	1	2	3	4	5	6
Describe	0xEE	0x16	0x03 (data length)	0x03	0x03	Target	Check_sum
<p>Target: 0x01 – Set First Target;</p> <p>0x02 – Set Last Target;</p> <p>0x03 – Set Muilt Target;</p>							

(2) Get from ranging module:

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02 (data length)	0x03	0x03	Check_sum

### 6.2.4. Continue ranging

(1) Send to ranging module:

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02 (data length)	0x03	0x04	Check_sum

(2) Get from ranging module:

By te	0	1	2	3	4	5	6	7	8	9
De scr ibe	0xEE	0x16	0x06 (data length)	0x03	0x04	Stat us	Integer high 8 bits of distance	Integer low 8 bits of distance	Decim al of distan ce	Check _sum
<p>First/Last Target ranging:</p> <p>Status: 0x00 – indicates that the ranging result is single target;</p>										

0x01 – including that another target before this target;
0x02 – including that another target after this target;
0x03 –reserved;
0x04 – indicates that the ranging result is out of range(no target);
0x05 –reserved;
Muilt Target ranging:
Status_bit3~0:
0x0 – indicates that the ranging result is single target;
0x1 – including that another target before this target;
0x2 – including that another target after this target;
0x3 – including that another two targets before and after this target;
0x4 – indicates that the ranging result is out of range(no target);
0x5 –reserved;
Status_bit7~4:
0x0~0xf – indicates that the current distance result number; Value range [0, n-1], number of targets $1 \leq n \leq 16$ ;

### 6.2.5. Stop ranging

(1) Send to ranging module:

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02 (data length)	0x03	0x05	Check_sum

(2) Get from ranging module:

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02 (data length)	0x03	0x05	Check_sum

### 6.2.6. Ranging abnormal

(1) Get from ranging module:

Byte	0	1	2	3	4	5	6	7	8	9
Describe	0xEE	0x16	0x06	0x03	0x06	Reserv ed	Reserv ed	Reserv ed	Statu s	Check _sum
Status1	bit0 -- FPGA system status;		1 normal			0 abnormal				
	bit1 -- laser light out state;		1 laser emission			0 laser don't emit light				
	bit2 -- main wave detection state;		1 with main wave			0 without main wave				
	bit3 -- echo detection status;		1 with echo			0 without echo				
	bit4 -- bias switch status;		1 bias on			0 bias off				
	bit5 -- bias output state;		1 bias normal			0 bias abnormal				
	bit6 -- temperature status;		1 temp normal			0 temp abnormal				
	bit7 -- laser PWM status;		1 laser PWM normal			0 aser PWM abnormal				
This instruction will be returned only when bit0 ~ 7 in status1 is abnormal.										

### 6.2.7. Set baud rate

(2) Send to ranging module:

Byte	0	1	2	3	4	5	6	7	8	9
Describe	0xEE	0x16	0x06	0x03	0xA0	BaudHigh24	BaudHigh16	BaudLow8	BaudLow0	Check_sum

(3) Get from ranging module:

Byte	0	1	2	3	4	5	6	7	8	9
Describe	0xEE	0x16	0x06	0x03	0xA0	BaudHigh24	BaudHigh16	BaudLow8	BaudLow0	Check_sum

### 6.2.8. Set single/continue ranging frequency and single ranging number

(1) Send to ranging module:

Byte	0	1	2	3	4	5	6	7
Describe	0xEE	0x16	0x04	0x03	0xA1	Freq	Num	Check_sum
Freq: 0x01~0x0A single/continue ranging frequency Num: 0x01~Freq single ranging number								

(2) Get from ranging module:

Byte	0	1	2	3	4	5
Describe	0xEE	0x16	0x02	0x03	0xA1	Check_sum

## 7. Examples of common communication instructions

### 7.1.1. Equipment Self-check

SEND: a5  
 RECV: ee 16 02 03 07 0a  
 SEND: ee 16 02 03 01 04  
 RECV: ee 16 06 03 01 ff 00 f7 ff f9

### 7.1.2. Single ranging

SEND: a5  
 RECV: ee 16 02 03 07 0a  
 SEND: ee 16 02 03 02 05  
 RECV: ee 16 06 03 02 04 00 00 00 09

### 7.1.3. Continue ranging

SEND: a5  
 RECV: ee 16 02 03 07 0a  
 SEND: ee 16 02 03 04 07  
 RECV: ee 16 06 03 04 04 00 00 00 0b  
 RECV: ee 16 06 03 04 04 00 00 00 0b



RECV: .....

#### **7.1.4. Stop ranging**

SEND: ee 16 02 03 05 08

RECV: ee 16 02 03 05 08

#### **7.1.5. Set First Target**

SEND: a5

RECV: ee 16 02 03 07 0a

SEND: ee 16 03 03 03 01 07

RECV: ee 16 02 03 03 06

#### **7.1.6. Set Last Target**

SEND: a5

RECV: ee 16 02 03 07 0a

SEND: ee 16 03 03 03 02 08

RECV: ee 16 02 03 03 06

#### **7.1.7. Set Mult Target**

SEND: a5

RECV: ee 16 02 03 07 0a

SEND: ee 16 03 03 03 03 09

RECV: ee 16 02 03 03 06

#### **7.1.8. Set single/continue ranging frequency of 1Hz and single ranging once**

SEND: a5

RECV: ee 16 02 03 07 0a

SEND: ee 16 04 03 a1 01 01 a6

RECV: ee 16 02 03 a1 a4

#### **7.1.9. Set single/continue ranging frequency of 5Hz and single ranging 5 times**

SEND: a5

RECV: ee 16 02 03 07 0a

SEND: ee 16 04 03 a1 05 05 ae

RECV: ee 16 02 03 a1 a4

## 8. Product lists

Serial Number	Name	Amount
1	Ranging module	1 set
2	Connection wire	1 set
3	Product manual	1
4	Certificate of conformity	1
5	list of products	1