Specification

Product Name: 24GHz Large-space presence sensor（RS485 version）

Product Model: MSA203D 485

Product Version: V1.2

Versions	Release Date	Record	Publishing
V1.0	2024.06.30	Initial release	Jacky
V1.1	2024.09.29	Add 0x31 protocol	Jacky
V1.2	2024.09.29	Add MH18 remote manual	Jacky

【Product Description】

MSA203D 485 is a 24GHz radar sensor based on Merrytek patented orthogonal antenna. Its antenna has high gain and wide detection range. Combined with Merrytek's unique software algorithm and FMCW modulation,it can accurately detect micro movements brought by human in almost all indoor spaces and provide fast and accurate front-end sensing input for smart home, smart hotel, smart office and other scenes.

【Product Feature】

- Exclusive Merrytek Lifebeing Presence Detection
- FMCW modulation technology applied to detect micro movement brought by breathing
- Germany RF technology applied for 5-year gurantee assurance
- Accurate Presence/Absence Output
- Daylight Sensor Available
- RS485 signal output
- 24Ghz ISM Band Millimeter Wave Radar technology
- Major/Minor/Micro Motion detection diameter: 6-8m Max
- Major/Minor/Micro Motion detection range are highly coincide
- Round radiation. Effectively managing a whole space by a single sensor
- Absence switch to Presence within 0.5S
- Presence switch to Absence no less than 15S
- Flush mounting and Surface mounting installation available
- Sensor parameter adjustable by remote or RS485 protocol
- Sensing function based on millimeter wave radar technology
- Low RF power output. No harm to human health
- Not affected by temperature, humidity, noise, airflow, dust, light and other environments

【Product dimension】

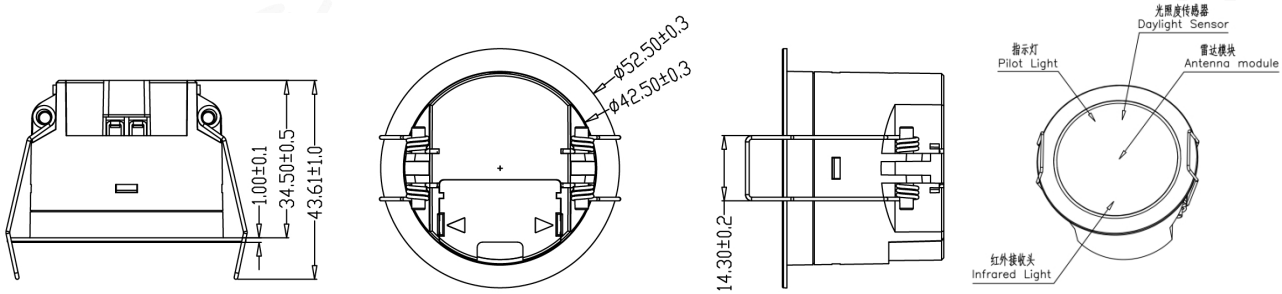
- Dimension: ϕ52.5x34mm
- Terminal: 4pin terminal

【Parameter】

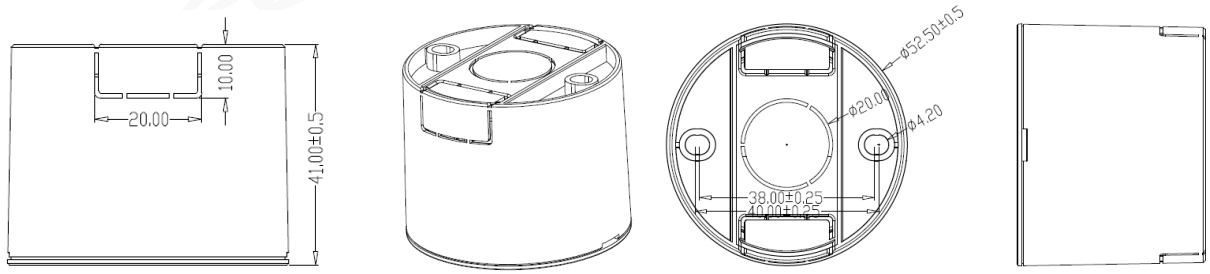
Input/Output	Input voltage	12-24V DC
	Rated voltage	12/24V DC
	Working Current	@12Vdc：50mA max @24Vdc：30mA max
	Working Power	≤1W @24V DC
	Output signal	RS485
Sensor Parameter	Radar frequency	24GHz -24.25GHz，ISM band
	Transmitting Power	5mW Max.
	Detection Area	0-4m
	Hold Time	3s-7200s remark: presence detection available only when hold time ≥15s
	Daylight difference value	10-100lux
	Daylight sensor measure range	0-1200Lux（based on 3m height installation）
	100% detection range radius	major/minor/micor movement（3m height installation）: 3.5±0.5m（based on 41㎡ open area test and might change due to different space）
	Remote control	Available
	Mounting height	2.5-4.0m typical value:3m
	Detecting Angle	120°
Application Environment	Drill hole	Φ45mm
	Working Temperature	0℃...+50℃
	Storage Temperature	-25℃~+80℃ Humidity:≤85% (non-condensation)
Certificate Standard	Certificate	FCC/RED
	Environmental Requirement	Compliant to RoHS
	IP Rating	IP20
	Guarantee	5 year（only for product quality problem）
Note: "N/A" means not available.		

【Dimension and Function diagram】

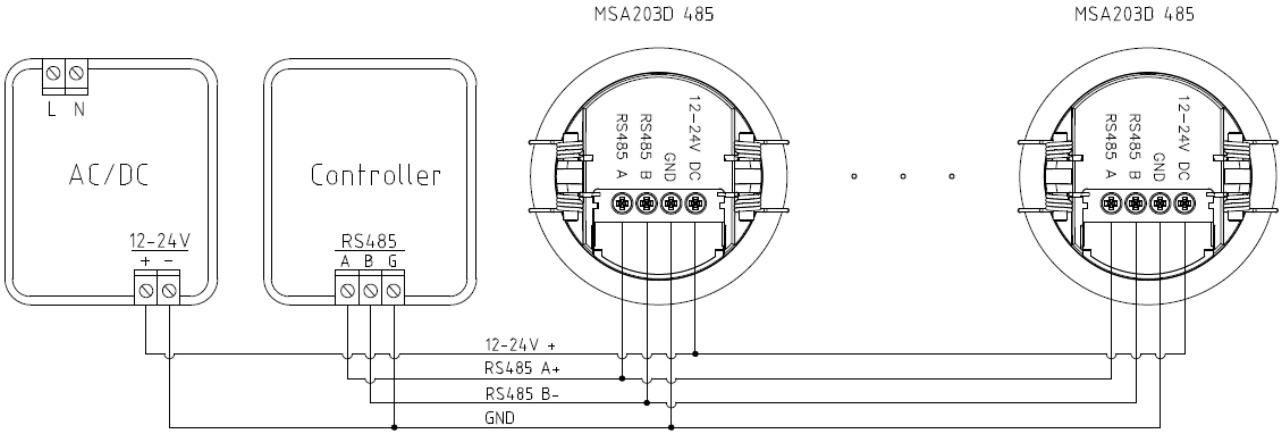
Recessed mounting



Surface mounting



【Wiring instruction】



Wiring layout suggestion：

1. Hand-in-hand wiring is highly recommended,yet star-topology or tree-topology is strongly deprecated
2. RS485 layout wire length shall not longer than 300m and 12pc sensor is the max quantity layout in one circuit
3. 4-pin shield wire or class 6 network wire is highly recommended for layout
4. Our sensor don't have terminal resistance,if there's impedance matching problem in RS485 bus, we recommend connect 2pc 120Ω resistance in the terminal

【Initialization】

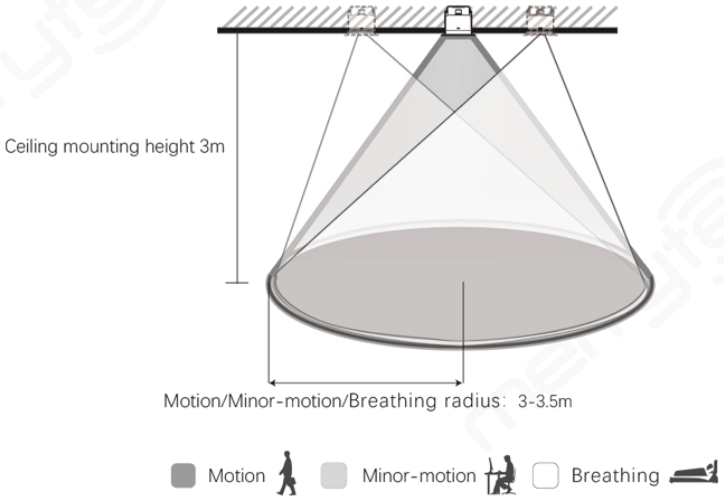
When powered on,sensor indicator will turn off after flashing for 10S and will enter a 20S detection cycle,if there's presence detected,then sensor will enter hold time calculating,if absence detected,then sensor relay will disconnect.During initialization,sensor will not detect moving signal and you can use our MH10 remote or RS485 protocol to adjust detection area、hold time and daylight sensor etc parameter.

【Factory setting】

Detection Area :4m	Hold Time:30s
Indicator light:open	Sensitivity:medium sensitivity

【Detection radiation】

MSA203D 485 is highly recommended ceiling flush mounting and its detection radiation is as below shows:



【Detection Signal】

The product detects human moving, minor moving, and presence signals, and realizes the detection of human-existing/no-human in non-sleep state. The following is a description of the moving, minor moving and presence signals:

- **Major movement:** detect the human significant moving (walking) in the detection area.
- **Minor movement:** detect the human slight moving in the detection area, such as leaning forward, leaning forwarder and back, swinging limbs, shaking head, typing, playing with mobile phones and so on.
- **Micro movement:** detect human abdominal and thoracic expansion behaviors caused by breathing, but not detect moving signal and minor moving signal.

Major movement

Minor movement

Micro movement

【RS485 protocol】

Baud rate	9600
Data bit	8
Stop bit	1
DATA0	Frame header
DATA1	ID high bit
DATA2	ID low bit
DATA3	Data length
DATA4	Function
DATA5/DATA6/DATA7	Value
DATA8	Check code
Communication data type	HEX TX/RX
Data communication requirement	Each data command interval shall>150ms

Example	Header	ID high bit	ID low bit	length	function	value	Check code
	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6
	51	FF	FF	06	05	64	BE

Check code: 51+FF+FF+06+05+64= 2BE take last 2 bit:BE

Example	Header	ID high bit	ID low bit	length	function	value			Check code
	DATA0	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7	DATA8
	51	FF	FF	08	07	09	27	C0	4E

Check code: 51+FF+FF+08+07+09+27+C0=34E take last 2 bit: 4E

Merrytek radar presence sensor protocol introduction:

Command	Function	Description	Data range	w/r	Default value
0x00	Read command value	Read command value		w	
0x03	Presence/absence report	Presence/absence value	1-2	w/r	01
0x05	Detection area setting	Detection area	0-100	w/r	100%
0x06	Sensitivity setting	set the sensor sensitivity	0-1 -2	w/r	1
0x07	Blocking time	Blocking time	0-FFFFFF	w	0
0x08	Indicator activation	LED Indicator	0-1	w/r	01
0x09	Daylight value report	Light sensor	0-1200lux	r	
0x0A	Daylight difference value setting	When daylight difference hit this value,daylight value will update	10-100	w/r	10Lux
0x0D	Hold time setting	Hold Time	3-7200	w/r	30s
0x17	Update firmware version	Firmware version	0.0.0-100.0.0	r	Current firmware
0x18	Setting device ID	Device ID	0x0000-0xFFFF	w/r	0xFFFF
0x20	Setting daylight compensation	Daylight Level Compensation	0x01-0x64	w/r	0x0a
0x21	Edit device ID	Edit ID	0-1	w	0x00
0x22	Report or Reading mode	Report or Reading mode switch	0-1	w/r	01
0x23	Status flip	status filp	1	w	1
0x25	Daylight threshold function	Daylight sensor	0-1200lux，65535	w/r	65535
0x26	Sensor function activation	Motion detection enable or disable	0-1	w/r	0

0x28	Presence detection activation	Presence detection enable or disable	0-1	w/r	1
0x29	Environment adapting	Turn on/off this function	0-5	w	0
0x30	Recover factory setting	Reset factory setting parameter	1	w	
0x31	Single mode	Single mode	0-1	w/r	0

Command value introduction

Command	When you're using reading data mode,you shall take below data format as reference					
Example / Function	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Format (DATA4)	Function (DATA5)	CRC (DATA6)
Inquire presence/absence status	0x51	0xFFFF	0x06	0x00	0x03	data0+...+data5
Inquire detection area	0x51	0xFFFF	0x06	0x00	0x05	data0+...+data5
Inquire sensitivity	0x51	0xFFFF	0x06	0x00	0x06	data0+...+data5
Inquire indicator status	0x51	0xFFFF	0x06	0x00	0x08	data0+...+data5
Inquire daylight value	0x51	0xFFFF	0x06	0x00	0x09	data0+...+data5
Inquire daylight difference value	0x51	0xFFFF	0x06	0x00	0x0A	data0+...+data5
Inquire hold time	0x51	0xFFFF	0x06	0x00	0x0D	data0+...+data5
Inquire firmware version	0x51	0xFFFF	0x06	0x00	0x17	data0+...+data5
Inquire device ID	0x51	0xFFFF	0x06	0x00	0x18	data0+...+data5
Inquire daylight compensation value	0x51	0xFFFF	0x06	0x00	0x20	data0+...+data5
Inquire data report or reading mode	0x51	0xFFFF	0x06	0x00	0x22	data0+...+data5
Inquire daylight value	0x51	0xFFFF	0x06	0x00	0x25	data0+...+data5
Inquire sensor activation status	0x51	0xFFFF	0x06	0x00	0x26	data0+...+data5
Inquire presence detection activation status	0x51	0xFFFF	0x06	0x00	0x28	data0+...+data5

1.	Presence/absence report: our radar will report if it's presence or absence within detection area					
Data Example / Function	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Absence	0x51	0xFFFF	0x06	0x03	0x01	data0+...+data5
Presence	0x51	0xFFFF	0x06	0x03	0x02	data0+...+data5

Presence/absence report:

Our radar will report presence/absence data ONLY when radar sees presence switch to absence or absence switch

to presence,if current status doesn't change,our radar with not report same presence/absence information

2.	Detection area setting：this function mainly used to adjust detection area based on When setting 89~100 value,radius detection area is 4m, When setting 77~88 value,radius detection area is 3.5m, When setting 65~76 value,radius detection area is 3m, When setting 53~64 value,radius detection area is 2.5m， When setting 41~52 value,radius detection area is 2.0m, When setting 29~40 value,radius detection area is 1.5m， When setting 17~28 value,radius detection area is 1m, When setting 1~16 value,radius detection area is 0.5m， When setting 0 value,radius detection area is 0m,					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Min:0%	0x51	0xFFFF	0x06	0x05	0x00	data0+...+data5
Max:100%	0x51	0xFFFF	0x06	0x05	0x64	data0+...+data5

3.	Sensitivity setting: there's high/medium/low sensitivity to choose					
Data example / Function	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
High sensitivity	0x51	0xFFFF	0x06	0x06	0x01	data0+...+data5
Low sensitivity	0x51	0xFFFF	0x06	0x06	0x00	data0+...+data5
Medium sensitivity	0x51	0xFFFF	0x06	0x06	0x02	data0+...+data5

4.	Blocking time: it's used to block sensor detection function within certain time					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5-DATA7)	CRC (DATA8)
0ms	0x51	0xFFFF	0x08	0x07	0x000000	data0+...+data7
1h	0x51	0xFFFF	0x08	0x07	0x36EE80	data0+...+data7

5.	Indicator activation: it's used to turn on/off indicator					
Data example / Function	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Disable	0x51	0xFFFF	0x06	0x08	0x00	data0+...+data5
Enable	0x51	0xFFFF	0x06	0x08	0x01	data0+...+data5

6.	Daylight value report: current daylight value will update only when daylight difference value is meet					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5-DATA6)	CRC (DATA7)
Min：0Lux	0x51	0xFFFF	0x07	0x09	0x0000	data0+...+data6
Max：1200Lux	0x51	0xFFFF	0x07	0x09	0x04B0	data0+...+data6

7.	Daylight difference: it means how much daylight changed from last second to current					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Min：10Lux	0x51	0xFFFF	0x06	0x0A	0x0A	data0+...+data5
Max：100Lux	0x51	0xFFFF	0x06	0x0A	0x64	data0+...+data5

8.	Hold time: it refers to the time period radar switch from presence to absence after people leaves detection area					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5-DATA6)	CRC (DATA7)
Min：3s	0x51	0xFFFF	0x07	0x0D	0x0003	data0+...+data6
Max：7200s	0x51	0xFFFF	0x07	0x0D	0x1C20	data0+...+data6

9.	Firmware version:it can inquiry radar's firmware version					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5-DATA6)	CRC (DATA7)
Min:v0.0.0	0x51	0xFFFF	0x07	0x17	0x0000	data0+...+data6
Max:v100.0.0	0x51	0xFFFF	0x07	0x17	0x2710	data0+...+data6

10.	Setting device ID: it can set device ID to distinguish from others					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5-DATA6)	CRC (DATA7)
Min:0x0000	0x51	0xFFFF	0x07	0x18	0x0000	data0+...+data6
Max:0xFFFF	0x51	0xFFFF	0x07	0x18	0xFFFF	data0+...+data6

1) When our sensor is powered and self-inspection finished(ie 20s after sensor powered),you can short press the pairing button,there'll be 51 FF FF 06 21 01 77 displayed and our indicator flashing,it means you can start set the sensor's ID,when succeed,the indicator will stop flashing(if you want finish ID setting soon after the indicator flashing,you can repeat short press the pairing button)

2) Each sensor's default ID is 0xFFFF

3) 0x0000 is broadcast address,it can receive all device's information

4) You can long press the pairing button>3s to recover factory setting fastly

5) Device factory setting parameter:100% sensitivity,;10s hold time;indicator open

6) Important tips: there can only be one sensor under ID setting in an RS485 bus,or there might be communication error

11.	Daylight compensation:it's used to compensate operating environment's daylight tolerance:0A is 1 times,64 is 10 times					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Min:0x01	0x51	0xFFFF	0x06	0x20	0x01	data0+...+data5
Max:0x64	0x51	0xFFFF	0x06	0x20	0x64	data0+...+data5

12.	ID edit activation: it refers if the device can edit					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Disable	0x51	0xFFFF	0x06	0x21	0x00	data0+...+data5
Enable	0x51	0xFFFF	0x06	0x21	0x01	data0+...+data5

13.	Report or Reading mode switch. 00 is reading mode 01 is report mode					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Disable	0x51	0xFFFF	0x06	0x22	0x00	data0+...+data5
Enable	0x51	0xFFFF	0x06	0x22	0x01	data0+...+data5

14.	Status flip: it's used to fastly switch presence to absence or from absence to presence					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Enable	0x51	0xFFFF	0x06	0x23	0x01	data0+...+data5

15.	Daylight threshold value : when you set a certain value as daylight threshold,if environment daylight is higher than this value and sensor is absence status,then sensor will not report presence when people enter detection area.If you set 0xFFFF command,then daylight threshold will disable,and daylight will report its actual lux value					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5-DATA6)	CRC (DATA7)
Min：0Lux	0x51	0xFFFF	0x07	0x25	0x0000	data0+...+data6
Max：1200Lux	0x51	0xFFFF	0x07	0x25	0x04B0	data0+...+data6
65535(it means daylight threshold disabled)	0x51	0xFFFF	0X07	0X25	0xFFFF	data0+...+data6

16.	If you enable sensor,then it can detect all movement signal,if disable,it'll block detect all movement signal,when you enable sensor from disable status,then there'll be 10s freezing time,and after that sensor can work normally					
Data example / Function	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Enable	0x51	0xFFFF	0x06	0x26	0x01	data0+...+data5
Disable	0x51	0xFFFF	0x06	0x26	0x00	data0+...+data5

17.	If you enable sensor,then it can detect all movement signal,if disable,it can only detect major movement signal and ignore minor and micro signal					
Data example / Function	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Enable	0x51	0xFFFF	0x06	0x28	0x01	data0+...+data5
Disable	0x51	0xFFFF	0x06	0x28	0x00	data0+...+data5

18.	When you set our sensor enter environment adapting mode,it'll automatically learn interference and will filter it,once sensor enter this mode,it'll take 6 minute					
Data example / Function	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Default state	0x51	0xFFFF	0x06	0x29	0x00	data0+...+data5
Minor adapting	0x51	0xFFFF	0x06	0x29	0x01	data0+...+data5
Medium adapting	0x51	0xFFFF	0x06	0x29	0x02	data0+...+data5
Deep adapting	0x51	0xFFFF	0x06	0x29	0x03	data0+...+data5
Adapting completer	0x51	0xFFFF	0x06	0x29	0x04	data0+...+data5
Adapting interrupted	0x51	0xFFFF	0x06	0x29	0x05	data0+...+data5

19.	Once activate this function,all sensor parameter will back to factory setting					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Enable	0x51	0xFFFF	0x06	0x30	0x01	data0+...+data5

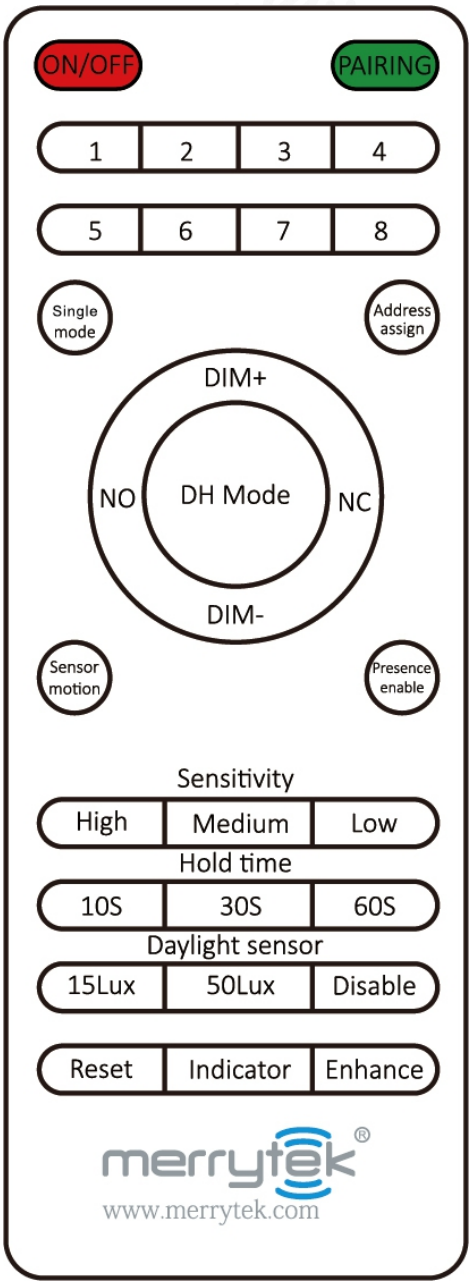
20.	Single mode: If you enable this mode,sensor will report absence after 15s when people leave detection area regardless of the hole time you preset,but this mode is only available when there's single person within detection area					
Data example / Data value	HEAD (DATA0)	ID (DATA1-DATA2)	LEN (DATA3)	Function (DATA4)	Value (DATA5)	CRC (DATA6)
Enable	0x51	0xFFFF	0x06	0x31	0x01	data0+...+data5
Disable	0x51	0xFFFF	0x06	0x31	0x00	data0+...+data5

Remark:

1. If you set wrong command,it'll report 51XXXX06FF02XX
2. If above command setting not succeed,there'll no data report

【Remote manual】

MH18 remote



ON/OFF: disable sense function

Short press to set Detection range:
1=0.5m,2=1m,3=1.5m,4=2m,5=2.5m,6=3m,7=3.5m,8=4m

Single mode: long press>3s to enter single mode

Address assign: long press>3s to enter sensor ID(from 1 to 65535) edit,and short press address assign button to confirm your set ID

Sensor motion: enable sense function

Presence enable:short press enable presence detection,long press disable presence detection

Sensitivity：short press to switch high/medium/low sensitivity

Hold time: short press to switch 10s/30s/60s hold time

Daylight sensor threshold: short press to switch 15lux/50lux/disable

Reset: all parameter back as factory setting

Indicator:short press to open indicator,long press to close indicator

Enhance:short press to enter self-learning mode,long press>3s to log off self-learning mode

【Disclaimer】

Due to the complexity of product technology and differences in application environment, it is difficult to guarantee a completely accurate or complete description, so this specification is only for user reference.

We will reserve the right to make changes to the product specifications without notifying the user, and do not make any commitments and guarantees in the legal sense.At the same time, our company encourages users to supplement or modify the contents of our specifications after using our products.