Technical Specification of KS114

Ver.: 1.04

Innovative technology originates from Dauxi Technologies

Revision Date	Contents	Prepared by	Revision	Note
Nov. 22, 2019	Parameter revision	L.Q.B.	1.00	Initial release.
Jun.3,2020	Beam angle added.	X.T.C	1.01	Page 5.
Nov.23,2020	Increase the content of reference assembly dimensions.	X.Y.C	1.02	Please refer to Page 23~24.
Dec.21,2020	Increase the ID and the protocol with verification.	X.Y.C	1.03	Please refer to Page 17
Sep.12,2021	The assembly size of the KS114 increases the control tolerance.	Y.M.G.	1.04	Please refer to Page 23.

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Contents

Abstract of KS114 functions:

- **IP65 waterproof (IP67 waterproof model KS204/KS214), split type receiver/distributor,** double-probe version for KS106/KS106A/KS136/KS136A;
- Mainboard and probe are encapsulated; output signal is digital distance signal, similar to KS103;
- Beam angle configured by software is horizontal 100° vertical 50° or horizontal 90° vertical 40°;
- Detection range: **1cm-3m (common range is 1cm-1.5m. The range 1cm-1.5m can be customized but it is not regular);** accuracy: **2cm**;
- **Default 485 interface** (Page 14 of the instruction); the ***I²C*** interface that is compatible with KS103 protocol can be customized; TTL interface can be customized;
- MODBUS RTU interface and CAN interface can be customized;
- A total of 20 modifiable ***I²C/TTL/485*** addresses within the range of 0xd0 ~ 0xfe (except for 0xf0,0xf2,0xf4,0xf6, 8-bit address);
- Enter uA level sleep mode automatically if I²C control command is not received within 5s; it can be awakened by host I²C command at any time;
- Industrial configuration adopted; work temperature (-30℃~+85℃);
- Working voltage **3-5.5V (5V power supply is recommended; 9-24V power voltage is optional, spot goods)**;
- Communication rate at I²C mode: 50~100kbit/s; default communication rate of serial port: 115,200bps, which may be changed by the user to 9,600bps.
- Auto acoustic recognition technology employed, improving the anti-interference performance;
- Environmentally-friendly and lead-free;
- Single/double switch output are customizable;
- Reliability: Reject ratio/50,000h is lower than 2ppm.

Electric performance parameters of KS114

Power supply voltage: 3-5.5V DC power supply **(5V power supply is recommended; 9-24 power supply voltage is optional, spot goods).**

Instantaneous max. current at startup: ***10mA@5.0V, typical***, lasting for 10s. Standby status will be entered after light flashing; current: <***5mA@5.0V, typical***. KS114 will enter the working status when effective control command is received; power consumption: ***15mA@5.0V*****, detected once every *10ms; 12mA@5.0V*****, detected once every 25ms; *10mA@5.0V*****, detected once every 100ms; *5mA@5.0V*****, detected once every 200ms;**

9-24V power supply voltage is optional; power consumption is lower than *20mA@12.0V.*

Introduction to beam angle

Beam angle for 0xb0 command constant horizontal 100±15° vertical 50±10° beam angle (the width of KS114 is 26.5mm and the dimension direction is the horizontal direction; the length of KS114 is 50.56mm and the dimension direction is the vertical direction), and the test obstacle is a 2cm rod. thing.

Beam angle for 0x05 command, 0x0a command, 0x0f command factory default is horizontal 90±15° vertical 40±10° (0x81 configuration). It can be configured as a horizontal 100±15° vertical 50±10° beam angle in 0x80 mode, or a horizontal 85±15° vertical 35±10° beam angle in 0x82 mode.

Wiring Instructions

4 wires are drawn out from KS114 and the color is red, black, white and yellow in turns.

Connect the red wire to the positive pole of **3-5.5V** power supply;

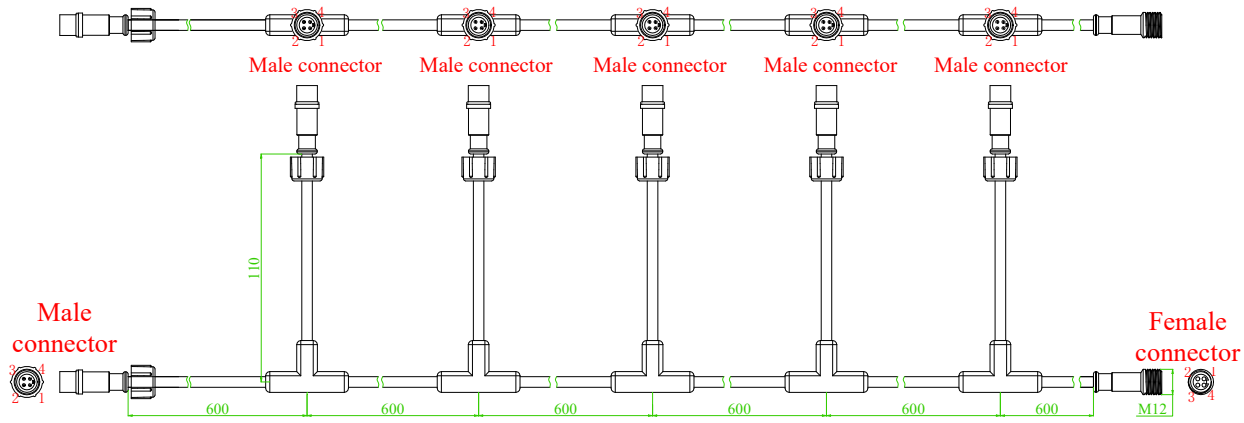
Connect the black wire to the negative pole of power supply or GND;

Connect the white wire to SCL under I2C mode, or RXD under TTL mode, or 485B under 485 mode.

Connect the yellow wire to SDA under SDA or TTL mode or 485A under TXD or 485 mode;

The working mode of KS114 is set in factory before delivery and nonmodifiable. So, the user should indicate whether require KS114-I2C, KS114-TTL, KS114-485 or KS114-MODBUS RTU prior to procurement. The KS114-485 interface is the default configuration.

Bus installation is recommended when there are multiple KS114, so only one 4-core bus is required regardless of the quantity of KS114, as shown in picture below (6 sets of KS114 can be connected; the dimensional model in picture below: *LINE-3T-6-600-110-CNT*):



Rules and Notes of Coding

KS114-L15-C702-L2M-B4Y

Where,

KS114: Model;

L15: Length of extended wire of KS114 is 15±3cm;

C702: Black. C100: Optional white wire; C101: Optional silver wire; C107: Optional yellow wire; other colors of wires can be customized;

L2M: Small 4-core communication wire of KS114, the default length is 2m; the code will be L0.5M if length is 0.5m, for example;

B4Y: Code of terminal on small 4-core communication wire of KS114. Other terminals can be used or be omitted.

When purchased black KS114 has no communication wire, the code will be: **KS114-L15-C702**

When purchased KS114 has communication wire but no terminal, the code will be: **KS114-L15-C702-L2M**

Just add suffix "-12V" at the tail when purchasing the product with 9~24V power supply.

Example: **KS114-L15-C100-L2M-B4Y-12V**, it means white KS114 which supports 9-24V power supply.

Detection range chart (The detection range is the projection of cone section. The beam angle is the angle of inverted triangle shown in picture below)

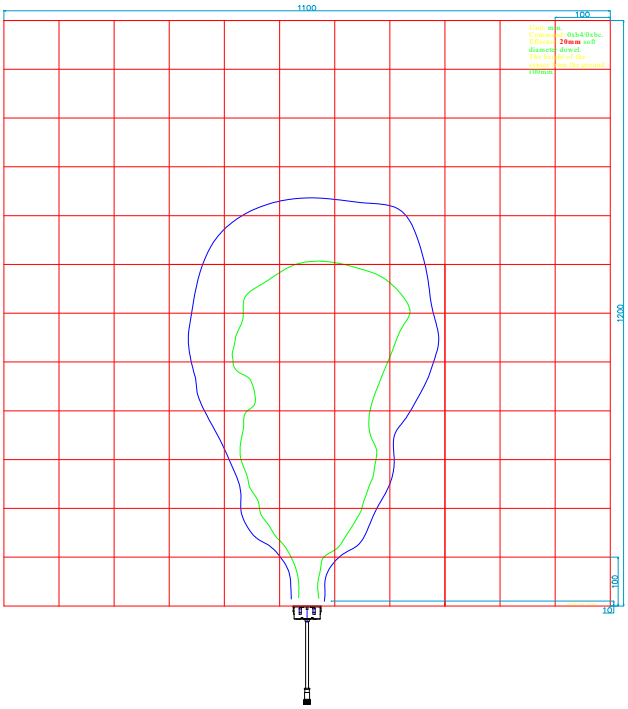


Fig. B1 (vertical beam angle, KS114 length 50.56mm dimension direction)

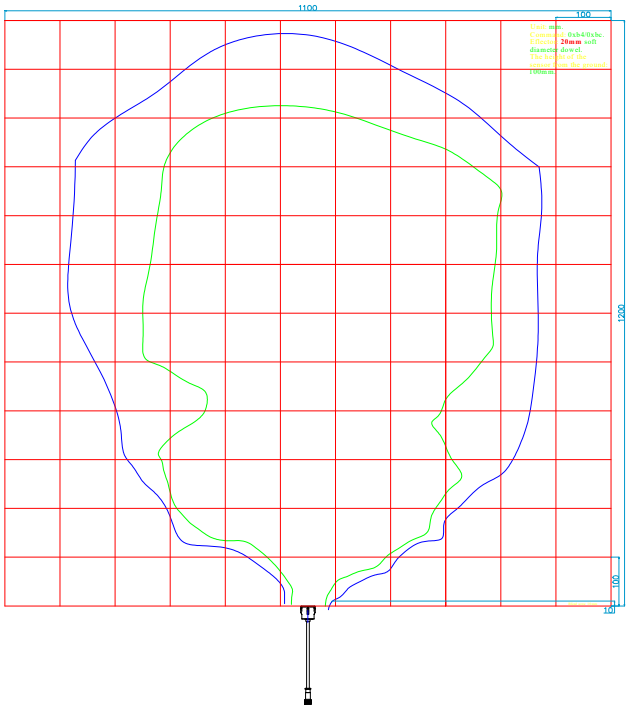


Fig. B2 (horizontal beam angle, KS114 width 26.5mm dimension direction)

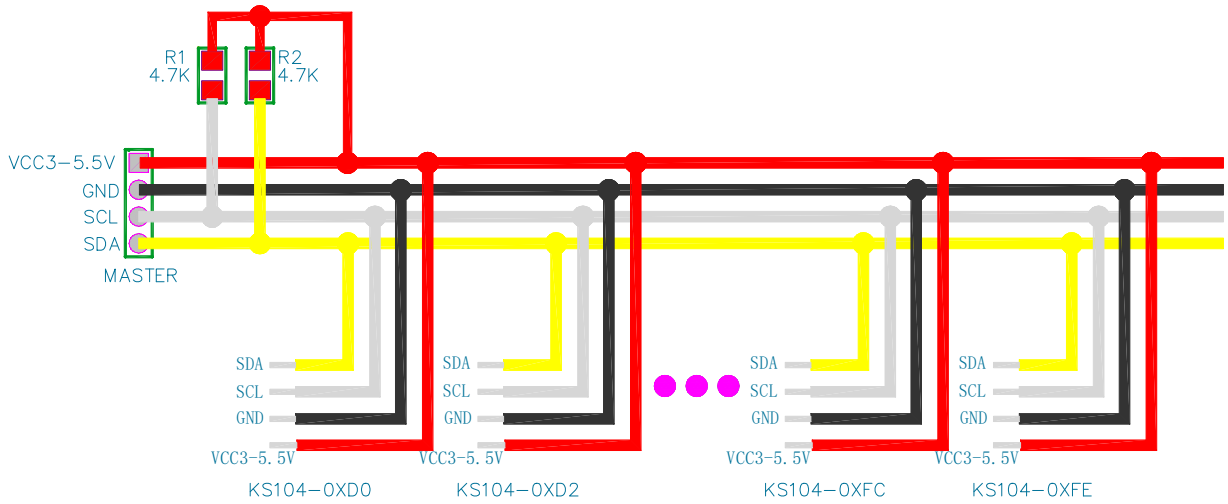
Condition / Drawing No.	Reflector Size	Material	Distance of Probe to Ground (Ground should be free from obstacle such as gap of ceramic tile and bulge)	Voltage	Beam angle direction	Noise Reduction Level	Beam angle(FOV)	Beam Angle
Fig. B1	Round bar with diameter of 20mm	PVC	100mm	5V	The vertical beam angle is the length of KS114 50.56mm dimension direction	0x71/0x7b by default	Blue 50±10°； Green40±10°	The blue line means the detection range of instruction 0xb0/0xb2/0xb4; the green line means the detection range when other instructions (0x05,0x0a,0x0f,0xb8,0xbc) are configured as 0x81; the instruction can be configured as 0x80 when other instructions need to be amplified from green to blue through beam angle.
Fig. B2					The beam angle in the horizontal direction is the width of KS114 26.5mm dimension direction		Blue100±15°； Green90±15°	

I²C Mode

KS114 wiring and instructions:

For SCL and SDA wire in client's host, one 4.7K (resistance: 1~10K) resistor needs to be connected to VCC (must be 5V) through the host, for the I2C communication wire SCL and SDA of KS114 has no pull-up resistor internally.

Wiring diagram is as shown in picture below: Connect the red wire to positive pole 3~5.5V of power supply, connect the black wire to the negative pole GND of power supply, connect the white wire to SCL and connect the yellow wire to SDA. **Note: Do not connect wires while they are alive, make sure wiring is finished before power-on! If hot-line work is required, first connect negative pole GND of power supply before connecting other wires.**



The recommended I²C communication rate of KS114 should not be higher than 100kbit/s.

The default address of KS114 is 0xe8; the user can modify any of the 20 addresses: 0xd0, 0xd2, 0xd4, 0xd6, 0xd8, 0xda, 0xdc, 0xde, 0xe0, 0xe2, 0xe4, 0xe6, 0xe8, 0xea, 0xec, 0xee, 0xf8, 0xfa, 0xfc, 0xfe. (1)

Note 1: The addresses above do not include 0xf0, 0xf2, 0xf4, or 0xf6 which are reserved as the 10-bit address of I²C slave. The 8-bit address should have right

shift by 1 bit for use, for only 7-bit I²C slave address is supported by the host device that controls the module. For example, the module's default address is 0xe8 and the corresponding 7-bit address is 0x74.

Modify time sequence of I2C address:

Address	2	**0x9a**	Delay 1ms	**Address**	2	**0x92**	Delay 1ms	**Address**	2	**0x9e**	Delay 1ms	**Address**	2	**New Address**	Delay 100ms

The I²C address should be modified in strict accordance with the times sequence; the delay time in time sequence is the shortest time. The 51 SCM hosts can be realized by calling the change_i2c_address (addr_old,addr_new) function as shown in Attachment 3.

Once the I²C address is modified, power on KS114 again and the LED will display the new address. It is forbidden to power off KS114 suddenly while modifying the **I²C** address of KS114. Do not put the address modification function in the while (1) circulation and make sure it is operated for a single time in program after power-on.

When I²C address is set differently, the two I²C buses on the host can be connected to 20 KS114 at the same time. Insufficient current power is not a concern, as other modules will enter the micro-watt level power consumption and sleep mode when one KS114 module is controlled by the host.

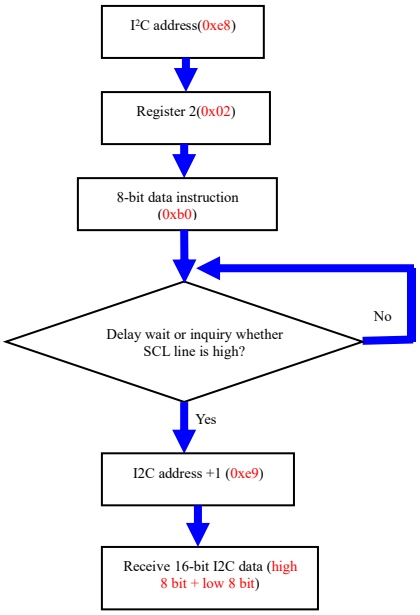
Work process of KS114:

Once KS114 is powered on, the system start self-check and when it is done, the red LED of tail extended wire of KS114 will have flickering display of 8-bit I²C address in binary mode, in which, quick flickering means "1", while slow flickering means "0". For example, when 0xea address is displayed, the binary number will be *0B*11101010, the green LED will flash twice quickly→ **flicker twice quickly**→ off → **flicker twice quickly**→ off → **flicker twice quickly**→ off →**flicker once quickly** → off → **flicker twice quickly** → off → **flicker once quickly** → off → **flicker twice quickly** → off → **flicker once slowly** → off. **(3)**

Note 3: Do not stare at the flickering LED at a close distance, but observe it from the corner of your eyes, as the flickering green light of LED may stimulate your eyes.

Once effective data instruction is received after startup of KS114, the LED will stop flickering immediately and enter the instruction detection mode.

KS114 has communication with the host through I²C interface and it will make response to I²C control instruction of host automatically. The instruction is an 8-bit data and the instruction transmission process is:



Intelligent identification at end of detection

This function is shielded in KS114.

Detection instruction

Once the detection instruction is sent, KS114 will enter the corresponding detection mode based on the detection instruction, and the host needs to wait for a certain period before inquiring the detection results through I²C bus; otherwise, the 0xff value will be acquired if query of I²C bus is too early. Note: The format for **detection instruction** of each frame is:

I²C Address	Register 2	8-bit data

All **I²C control** instructions are summarized as follows:

Register	Instruction	Range of Return Value (Decimal)	Range of Return Value (Hexadecimal)	Remarks
0		1~254	0x01~0xff	Mark of program version and manufacturer. Please refer to example function in Attachment 3; return value =read_byte(0xe8,0);
1		1~252	0x01~0xfc	Mark of manufacturing date. The higher 8 bits of 16-bit data are manufacturing year, while the lower 8 bits are manufacturing month. The mark will be 1 if it is manufactured in 2011, or 2 if manufactured in 2012…F if manufactured in 2025, 0 if manufactured in 2026, or 1 if manufactured in 2027. Month: The mark is 1 if it is manufactured in January, and the rest can be analogized in the same manner; the mark is A if it is manufactured in October, or C if manufactured in December. Refer to example function in Attachment 3, return value =read_byte(0xe8,1);
2	**0x05**	**1-2817us**	**0x01-0xb01us**	**The default effective detection range is 1cm-50cm. The returned us value is divided by 58 to acquire the cm distance. This is a high-speed instruction and its execution period is not over 9ms.**
2	**0x0a**	**1-3840us**	**0x01-0xf00us**	**The default effective detection range is 1cm-70cm. The returned us value is divided by 58 to acquire the cm distance. This is a high-speed instruction and its execution period is not over 9ms.**
2	**0x0f**	**1-6273us**	**0x01-0x1881us**	**The default effective detection range is 1cm-110cm. The returned us value is divided by 58 to acquire the cm distance. This is a high-speed instruction and its execution period is not over 9ms.**
2	**0xb0**	**30-5657mm**	**0x1e-0x1619mm**	**The default effective detection range is 1cm-5m. It returns mm value. The execution period of this instruction is not over 33ms.**
2	**0xb1**	**0-255**	**0-0xff**	**Send one wave only, no other function. The returned value is the value of Register 2 and 3.**
2	**0xb2**	**1-32639us**	**0x01-0x7f7f μs**	**The effective detection range is 1cm-5m. It returns us value.**
2	**0xb3**	**1-32639us**	**0x01-0x7f7f μs**	**Receive echo only; the effective detection range is 1cm-5.6m, be used along with 0xb1 instruction. It applies to correlation distance measurement between 2 sets of KS114.**
2	**0xb4**	**30-5657mm**	**0x1e-0x1619mm**	**The default effective detection range is 1cm-5m. It returns mm value.**
2	**0xb8**	**30-5657mm**	**0x1e-0x1619mm**	**The default effective detection range is 1cm-5m. It returns mm value.**
2	**0xba**	**1-32639us**	**0x01-0x7f7f μs**	**The effective detection range is 1cm-3m. It returns us value.**
2	**0xbc**	**30-5657mm**	**0x1e-0x1619mm**	**The effective detection range is 1cm-5m. It returns us value.**
2	0x70	None	None	Stage 1 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to battery power supply
2	0x71	None	None	Stage 2 noise reduction. All instructions will work on Stage 1 noise reduction. Factory default setting, applies to battery power supply
2	0x72	None	None	Stage 3 noise reduction. All instructions will work on Stage 1 noise reduction.

				Applies to USB power supply.
2	0x73	None	None	Stage 4 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to long-distance USB power supply.
2	0x74	None	None	Stage 5 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to power supply of switching power supply.
2	0x75	None	None	Stage 6 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to power supply of switching power supply.
2	0x77	None	None	Configure the communication baud rate of serial port as 9600bps
2	0x78	None	None	Configure the communication baud rate of serial port as 57600bps
2	0x79	None	None	Configure the communication baud rate of serial port as 115200bps, factory defect setting
2	0x7a	None	None	Configuration instruction of beam angle
2	0x7b	None	None	Factory default setting. Applies to configuration of dead zone.
2	0x7c	None	None	Configuration instruction of beam angle
2	0x7d	None	None	Configuration instruction of beam angle
2	0x7e	None	None	Configuration instruction of beam angle
2	0x80	None	None	**Configure beam angle of instruction 0x05, 0x0a and 0x0f as horizontal 100° and vertical 50°**
2	0x81	None	None	**Configure beam angle of instruction 0x05, 0x0a and 0x0f as horizontal 90° and vertical 40°**
2	0x82	None	None	**Configure beam angle of instruction 0x05, 0x0a and 0x0f as horizontal 80° and vertical 35°**
2	0x8A	None	None	Configure protocol of serial port, refer to section of serial port
2	0x8B	None	None	Configure protocol of serial port, refer to section of serial port
2	0x8F	None	None	Configure protocol of serial port, refer to section of serial port
2	0x95	None	None	Configure the 2nd time sequence of parameter 0x70-0x8f
2	0x98	None	None	Configure the 3rd time sequence of parameter 0x70-0x8f
2	0x9c	None	None	Configure the 1st time sequence of parameter 0x70-0x8f
2	0x92	None	None	Modify the 2nd time sequence of address
2	0x9a	None	None	Modify the 1st time sequence of address
2	0x9e	None	None	Modify the 3rd time sequence of address
2	0xc4	None	None	Wait for 5s sleep
2	0xc5	None	None	Wait for 1s sleep
2		0~255	0~0xff	While reading the data, Register 3 has combined use with Register 2, Register 2 returns the higher 8 bits of 16-bit data detection results, while Register 3 returns the lower 8 bits of 16-bit data. Make sure the ***address*** + ***Register 2*** + ***detection instruction*** is sent before inquiring the return value of register. Refer to example function of Attachment 3, return value =read_byte(0xe8,2);
3		0~255	0~0xff	While reading the data, Register 3 has combined use with Register 2, Register 2 returns the higher 8 bits of 16-bit data detection results, while Register 3 returns the lower 8 bits of 16-bit data. Make sure the ***address*** + ***Register 2*** + ***detection instruction*** is sent before inquiring the return value of register. Refer to example function of Attachment 3, return value =read_byte(0xe8,3);
4			0x77~0x79	The communication baud rate 0x77~0x79 of serial port is stored by the register for further query. 0x77 corresponds to the baud rate of 9600bps; 0x78 corresponds to the baud rate of 57600bps, while 0x79 corresponds to the baud rate of 115200bps. Refer to example function of Attachment 3, return value =read_byte(0xe8,4);
5			0xd0~0xfe	20 I^2C or serial port addresses are stored in the register,

				excluding 0xf0, 0xf2, 0xf4 and 0xf6 for further query. Refer to example function of Attachment 3, return value =read_byte(0xe8,5);
6			0x70~0x75	Noise reduction level 0x70~0x75 is stored in the register for query. The default value is 0x71. Refer to example function of Attachment 3, return value =read_byte(0xe8,6);
7			0x7a~0x7e	Dead zone configuration is stored in the register. The default value is 0x7b. Refer to example function of Attachment 3, return value =read_byte(0xe8,7);
8			0xe0	Reserved for further upgrade
			0xe1	Reserved for further upgrade
			0xe2	Reserved for further upgrade
			0xe3	Reserved for further upgrade
9			0x6a	Initialization in process
			0x69	Initialization completion mark. Refer to example function of Attachment 3, return value =read_byte(0xe8,9);
10		0~255	0~0xff	Higher 8 bits of initialization temperature, not opened Refer to example function of Attachment 3, return value =read_byte(0xe8,10);
11		0~255	0~0xff	Lower 8 bits of initialization temperature, not opened Refer to example function of Attachment 3, return value =read_byte(0xe8,11);
12		0~255	0~0xff	Higher 8 bits of current ambient sound velocity, not opened Refer to example function of Attachment 3, return value =read_byte(0xe8,12);
13		0~255	0~0xff	Lower 8 bits of current ambient sound velocity, unit: mm/100ms, not opened Refer to example function of Attachment 3, return value = read_byte(0xe8,13);
15~36				Reserved for upgrade

Table 1

Distance detection

For details about parameters and control instructions, please refer to Table 1 above.

After passing the time sequence of "I²C address + register 2 + distance detection instruction", delay or the corresponding time specified in the table above, use the read function to read the value of Register 2 and 3, to acquire the 16-bit distance data. The returned mm distance is converted according to the current ambient temperature; the returned us value refers to the time used from transmission of ultrasonic wave to the reflection when meeting obstacles.

Power supply noise reduction instruction (0x70,0x71,0x72,0x73,0x74,0x75), baud rate instruction (0x77/0x78/0x79) and beam angle configuration instruction (0x7a-0x7e/0x80/0x81/0x82)

It is recommended to supply power with battery for KS114 by default. The measured distance may have unstable fluctuation when power supply with big noise is adopted. The user can configure the clutter suppression function of KS114 distance measurement module by sending the instruction of 0x70,0x71,0x72,0x73,0x74,0x75. 0x70 is at test level; the Instruction **0x71** can configure the module as Stage 1 noise reduction, which applies to power supply by battery. It is also the **factory defect setting**. The Instruction 0x72 can configure the module as Stage 2 noise reduction, which applies to the scenarios with certain high-frequency noise such as USB power supply. The Instruction 0x73 can configure the module as Stage 3 noise reduction, which applies to scenarios with long-distance USB power supply. The Instruction 0x74 can configure the module as Stage 4 noise reduction, which applies to the scenarios of power supply of switching power supplies. The Instruction 0x75 can configure the module as Stage 5 noise reduction, and this level is not recommended if there are no special requirements.

The user can send Instruction 0x7a, 0x7b, 0x7c, 0x7d and 0x7e to configure the beam angle, and the beam angle decreases along with the increase of this value. **The factory default setting is 0x7b**. Refer to Table 1.

It can be configured simply by sending the following instruction time sequence to this module: "I²C address + Register 2 + 0x9c; I²C address + Register 2 + 0x95; I²C address + Register 2 + 0x98; I²C address + Register 2 +

0x70/0x71/0x72/0x73/0x74/0x75/0x7a/0x7b/0x7c/0x7d/0x7e/0x80/0x81/0x82"; when it is sent, it will have delay for at least 2s to finish auto configuration of system, and it will rework according to the configuration.

Taking the program of Attachment 3 as example, configure the module as Stage 2 noise reduction and the configuration code is as follows:

config_0x71_0x7d(0xe8,0x72); //If I²C address is 0xe8

delayms(2000);

Configure the module as the max. beam angle and the configuration code is as follows:

config_0x71_0x7d(0xe8,0x7a); //If I²C address 为 0xe8

delayms(2000);

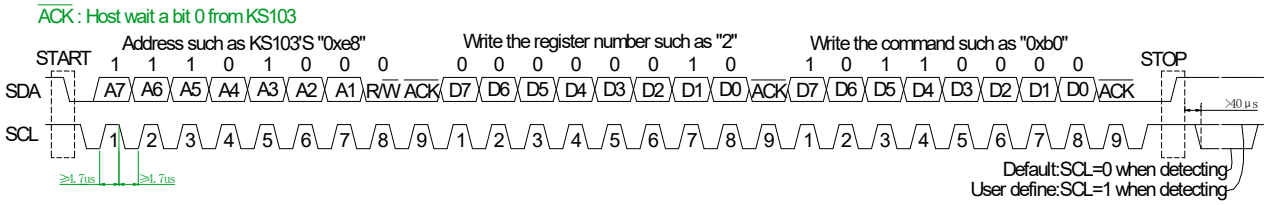
Please put the configuration code into the initialization function of program, i.e., before the while(1) circulation, in order to protect the module. When effective configuration instruction is received by KS114, the LED lamp will be normally on for 5s, which means configuration succeeds.

When KS114 is powered on again, it will run based on the new configuration permanently and no further configuration is required.

Sequence chart

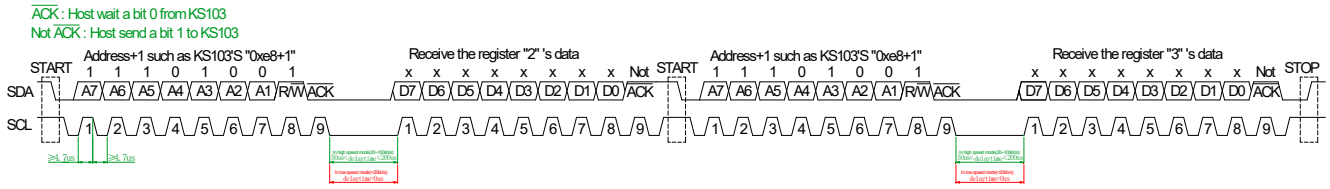
Sequence chart 1: Send the detection instruction in the format of (Such as register 2):

I²C address	Register 2	8-bit data instruction



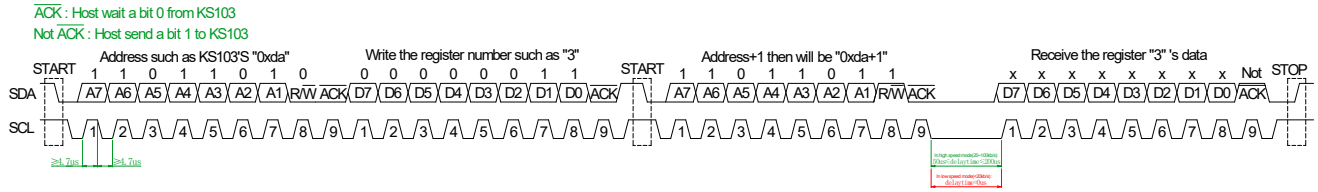
Sequence chart 2: Once the sequence chart 1 is executed, it will receive the 16-bit data after increase of SCL or the delay of 100ms; the higher bit data will be received before the lower bit data and instruction format is:

I²C address + 1	Read Register 2	I²C address + 1	Read Register 3



Sequence chart 3: Once the sequence chart 1 is executed, it will receive the data from Register x after increase of SCL or the delay of 100ms (Register 3 is used in this example) and read the instruction of any register (Such as Register 3) as follows: **(5)**

I²C address	Register 3	I²C address + 1	Read Register 3



Note 5: When the instruction of reading any register is adopted, make sure to send the detection instruction of Register 2 firstly before reading Register 2 or 3. Note: All detection instructions are stored in Register 2. The instruction of *sending detection instruction* before *reading time sequence of any register* (read Register 2 + 3) is adopted in the example. When "I²C address +1" is written to KS114, do not receive the 8bit data immediately at the I²C communication rate of 20~100kb/s; instead, wait for the effective response of ACK low level, or wait for the delay of at least 50us(delaytime) before receiving the data from the register. If one delay of at least 50us (delaytime) is added between the written "I²C address +1" and "Read Register 2/3", reliable communication with KS114

can be maintained even if I²C communication rate is increased. The delay of at least 50us (delaytime) mentioned above can be omitted when I²C communication rate is lower than 20kb/s. Besides, the recommended interval is over 1ms for the detection distance below 10cm; otherwise, the previous ultrasonic wave can be received in the next detection. In short, **there are two key points to establish I²C communication successfully:** Firstly, the delay of both high and low level should not be lower than 4.7us; secondly, when the green LED has fast flickering when effective detection data from host are received, but the return value is incorrect, the delay not less than 50us should be added in the host to acquire the correct data. Please follow the regulations of sequence chart 1~3.

Set sleep wait time

The default wait time is 5s in sleep mode, and it will enter sleep mode automatically when detection instruction is not received within 5s. Besides, 1s mode is available for user. Send data instruction 0xc5 through I²C bus to enter 1s sleep mode, or send 0xc4 to recover 5s sleep mode.

It can be configured simply by sending the following instruction sequence to this module: "I²C address + Register 2 +0xc4/0xc5"; when it is sent, please wait for 2s delay at least to finish configuration of system automatically, and start working according to the new configuration.

Taking the program of Attachment 3 as example, the configuration code is as follows:

```
write_byte(0xe8,2,0xc4);
delayms(2000);
```

Once the sleep wait period is set, KS114 will save it automatically and start work according to the new configuration. Once KS114 is powered on again, it will run based on the new configuration.

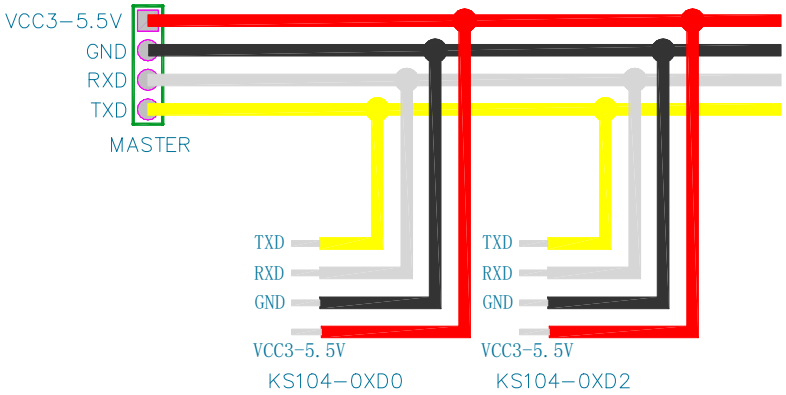
TTL Serial Port & 485 Serial Port Mode

The baud rate at serial port mode of KS114 is 115200bps; it has 1 start bit, 8 data bits, 1 stop bit, no parity bit and TTL level. The baud rate 115200bps can be modified into other baud rates such as 9600.

Wiring at TTL & 485# Serial Port Mode

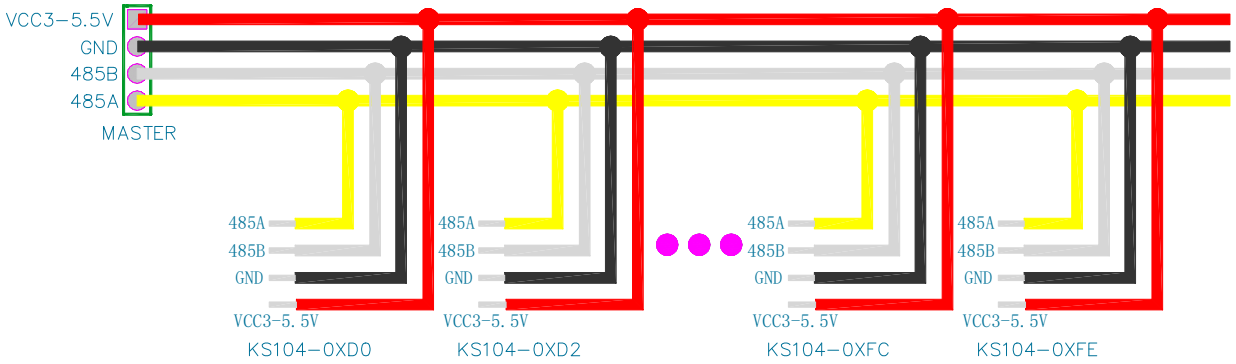
Wiring at TTL serial port mode: Connect the red wire to positive pole 3~5.5V of power supply, black wire to the negative pole GND of power supply, white wire to RXD and yellow wire to TXD. The TTL serial port here is not a 232# serial port; TTL level can be connected to TXD/RXD of SCM directly, but it cannot be connected to 232# serial port directly (otherwise the module will be burnt), until the TTL level is converted into 232# level by a MAX232 level.

The specific wiring at TTL serial port mode is as follows **(at most two ports can be wired)**:



Wiring of signal wire at 485# serial port mode: Connect the red wire to positive pole 3~5.5V of power supply, black wire to negative pole GND of power supply, white wire to 485B and connect the yellow wire to 485A.

The wiring at 485# serial port mode is as follows **(at most 20 serial ports can be connected):**



The default address of KS114 is 0xe8; the user can modify any of the 20 addresses: ： 0xd0, 0xd2, 0xd4, 0xd6, 0xd8, 0xda, 0xdc, 0xde, 0xe0, 0xe2, 0xe4, 0xe6, 0xe8, 0xea, 0xec, 0xee, 0xf8, 0xfa, 0xfc, 0xfe. **(8)**

Note (8): The addresses above do not include 0xf0, 0xf2, 0xf4,0xf6 and they are consistent with address of I^2C version. Besides, it is recommended to have 1 set of KS114 on the bus of TTL serial port when TTL serial port mode is adopted, for TTL serial port protocol specifies one-to-one arrangement, or it should **not exceed 2 sets at most**. **At most 20 sets of KS114 can be connected to the bus of 485# serial port** when 485# serial port mode is adopted.

485# serial port and TTL serial port have different wiring but completely consistent control codes; the description of “serial port” equals to “485# serial port or TTL serial port”.

Modify time sequence of serial port address:

Address	2	**0x9a**	Delay 1ms	**Address**	2	**0x92**	Delay 1ms	**Address**	2	**0x9e**	Delay 1ms	**Address**	2	**New address**	Delay 100ms

The serial port address should be modified in strict accordance with time sequence; the delay of time sequence is the min. time.

Once modification is done, the LED will be normally on; power on KS114 again and the LED will display the new address. It is forbidden to power off KS114 suddenly while modifying the address of KS114. Do not put the address modification function in the while (1) circulation and make sure it is operated for single time in program after power-on.

Once the serial port address is set differently, a total of 20 KS114 (in 485# mode) or 2 KS114 (in TTL mode) can be connected to two serial port wires of host. Other modules will not be affected when one KS114 module is controlled by the host.

Work process of KS114:

When KS114 is powered on and started, the system will enter self-check firstly and it requires about 1,200ms. In the self-check process, KS114 will check if all probes are inserted normally and all configurations are correct. If a fault is detected, it will report the position of probe fault automatically. Once initialization is done, KS114 will send the following hexadecimal code to the upper computer through the serial port:

69 a9 79 e8 71 7b e3 69 00 00 87 55 81 00 00 00 00 00 0a 4b 53 31 30 34 5f 64 61 75 78 69 2e 63 6f 6d 0a 43 6f 70 79 20 52 69 67 68 74 3a 44 61 75 78 69 2e 49 6e 63 20 32 30 31 39 0a 56 65 72 2e 31 2e 30 2e 31 30 0a 53 65 74 20 62 79 20 58 2e 51 2e 4f 6e 20 4e 6f 76 2e 36 2c 32 30 31 39 0a 00 01

The codes are as follows:

0x69: Program version, stored in Register 0;

0xa9: Mark of manufacturing date, stored in Register 1;

0x79: Communication baud rate of serial port, stored in Register 4;

0xe8: I2C or serial port address, stored in Register 5;

0x71: Noise reduction level, stored in Register 6;

0x7b: Factory default setting for configuring dead zone. Stored in Register 7;

0xe3: Error code, stored in Register 8;

0x68: Initialization completion mark, stored in Register 9; its value is 0x69 when initialization starts;

For detailed introduction of hexadecimal value, please refer to Table 2 below. The next return value is 0x0A and this is line change mark. The next return value should be converted into character format for observation, and the return information includes website of manufacturing parent company.

The register list is as follows; serial port fails to be quired.

Register	Instruction	Range of Return Value (Decimal)	Range of Return Value (Hexadecimal)	Remarks
0		1~254	0x01~0xff	Mark of program version and manufacturer
1		1~252	0x01~0xfc	Mark of manufacturing date. The higher 8 bits of 16-bit data are manufacturing year, while the lower 8 bits are manufacturing month. The mark will be 1 if it is manufactured in 2011, or 2 if manufactured in 2012…F if manufactured in 2025, 0 if manufactured in 2026, or 1 if manufactured in 2027. Month: The mark is 1 if it is manufactured in January, and the rest can be analogized in the same manner; the mark is A if it is manufactured in October, or C if manufactured in December.
4			0x77~0x79	The communication baud rate 0x77~0x79 of serial port is stored by the register for further query. 0x77 corresponds to the baud rate of 9600bps; 0x78 corresponds to the baud rate of 57600bps, while 0x79 corresponds to the baud rate of 115200bps.
5			0xd0~0xfe	20 I^2C or serial port addresses are stored in the register, excluding 0xf0, 0xf2, 0xf4 and 0xf6 for further query.
6			0x70~0x75	Noise reduction level 0x70~0x75 is stored in the register for query. The default value is 0x71.
7			0x7a~0x7e	Dead zone configuration is stored in the register. The default value is 0x7b.
8			0xe0	Reserved for further upgrade
			0xe1	Reserved for further upgrade
			0xe2	Reserved for further upgrade
			0xe3	Reserved for further upgrade
9			0x6a	Initialization in process
			0x69	Initialization completion mark.
10		0~255	0~0xff	Higher 8 bits of initialization temperature
11		0~255	0~0xff	Lower 8 bits of initialization temperature
12		0~255	0~0xff	Higher 8 bits of current ambient sound velocity
13		0~255	0~0xff	Lower 8 bits of current ambient sound velocity, unit: mm/100ms

Table 2

Once self-check is done, the LED will have flickering display of 8-bit serial port address in binary mode as shown in Fig .13; in which, in which, quick flickering means "1", while slow flickering means "0". For example, when 0xea address, the binary number will be *0B*11101010, the green LED will flash twice quickly→ **flicker twice quickly**→ off → **flicker twice quickly**→ off → **flicker twice quickly**→ off →**flicker once quickly** → off → **flicker twice quickly** → off → **flicker once quickly** → off → **flicker twice quickly** → off → **flicker once slowly** → off. (9)

Note (9): Do not stare at the flickering LED at close distance, but observe it from the corner of your eyes, for the flickering green light of LED may stimulate your eyes.

Once effective data instruction is received after startup of KS114, the LED will stop flickering immediately and enter the instruction detection mode.

When KS114 has communication with the host through serial port interface, it will have response to the host's control instruction automatically. The instruction is an 8-bit data; the instruction sending and detection result receiving process is:

Serial port address (send 0xe8 to KS114) → Register (send 0x02 to KS114) → Detection instruction (send 0xb0 to KS114) → Receiver higher 8 bits of detection data of KS114 through serial port → Receive lower 8 bits of detection data of KS114

The communication protocol above can be modified; in which, it will return "higher 8 bits + lower 8 bits" when 0x8F is configured as the default protocol, return "0xA5 +higher 8 bits + lower 8 bits + Xor check value of the 3 bytes above" when 0x8A is configured; return "current address + higher 8 bits +lower 8 bits +three bytes above and lower 8 bits" when 0x8B is configured.

It can be configured easily by sending instruction time sequence to this module: "Serial port address + Register 2 + 0x9c; serial port address + Register 2 + 0x95; serial port address + Register 2 + 0x98; serial port address + Register 2 + 0x8A/0x8B/0x8F"; once the instruction is sent, please wait for delay of 2s at least to make the system finish configuration automatically, and it will start work based on the new configuration.

When KS114 is working in serial port mode, only Register 0x02 can be written and it will not response if other values are written. When SCM receives the detection results from KS114, the serial port interruption can be enabled to receive the 16-it detection results; the higher 8 bits of detection results will be sent firstly before the lower 8-bit data. When returned 16-bit detection results are received, the detection instruction can be sent to start the next detection; otherwise, the serial port will return the incorrect value.

Intelligent identification of detection completion

This function is not supported in serial port mode, for KS114 will return the 16-bit detection results automatically through the serial port when detection instructions are sent.

Detection instruction

Once the detection instruction is sent, KS114 will enter the corresponding detection modes according to the detection instructions, the host will enable serial port interruption, and it is not allowed to resend the detection instruction until the returned detection results are received. Note: The format for **detection instruction** of each frame is as follows:

TTL serial port address	Register 2	8-bit data

The control instructions of all serial ports are summarized as follows:

Register	Instruction	Range of Return Value (Decimal)	Range of Return Value (Hexadecimal)	Remarks
2	**0x05**	**1-2817us**	**0x01-0xb01us**	**The default effective detection range is**

				1cm-50cm. The returned us value is divided by 58 to acquire the cm distance. This is a high-speed instruction and its execution period is not over 9ms.
2	**0x0a**	**1-3840us**	**0x01-0xf00us**	**The default effective detection range is 1cm-70cm. The returned us value is divided by 58 to acquire the cm distance. This is a high-speed instruction and its execution period is not over 9ms.**
2	**0x0f**	**1-6273us**	**0x01-0x1881us**	**The default effective detection range is 1cm-110cm. The returned us value is divided by 58 to acquire the cm distance. This is a high-speed instruction and its execution period is not over 9ms.**
2	**0xb0**	**30-5657mm**	**0x1e-0x1619mm**	**The default effective detection range is 1cm-5m. It returns mm value. The execution period of this instruction is not over 33ms.**
2	**0xb1**	**0-255**	**0-0xff**	**Send one wave only, no other function. The returned value is the value of Register 2 and 3.**
2	**0xb2**	**50-14706us**	**0x32-0x7f7fμs**	**The effective detection range is 1cm-5m. It returns us value.**
2	**0xb3**	**96-32639us**	**0x60-0x7f7fμs;**	**Receive echo only; the effective detection range is 1cm-5.6m, be used along with 0xb1 instruction. It applies to correlation distance measurement between 2 sets of KS114.**
2	**0xb4**	**10-5653mm**	**0x0a-0x1615mm**	**The default effective detection range is 1cm-5m. It returns mm value.**
2	**0xb8**	**10-5653mm**	**0x0a-0x1615mm**	**The default effective detection range is 1cm-5m. It returns mm value.**
2	**0xba**	**1504-14706us**	**0x5e0-0x7f66μs**	**The effective detection range is 1cm-3m. It returns us value.**
2	**0xbc**	**10-5653mm**	**0x0a-0x1615mm**	**The effective detection range is 1cm-5m. It returns us value.**
2	0x70	None	None	Stage 1 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to battery power supply
2	0x71	None	None	Stage 2 noise reduction. All instructions will work on Stage 1 noise reduction. Factory default setting, applies to battery power supply

2	0x72	None	None	Stage 3 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to USB power supply.
2	0x73	None	None	Stage 4 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to long-distance USB power supply.
2	0x74	None	None	Stage 5 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to power supply of switching power supply.
2	0x75	None	None	Stage 6 noise reduction. All instructions will work on Stage 1 noise reduction. Applies to power supply of switching power supply.
2	0x77	None	None	Configure the communication baud rate of serial port as 9600bps
2	0x78	None	None	Configure the communication baud rate of serial port as 57600bps
2	0x79	None	None	Configure the communication baud rate of serial port as 115200bps, factory defect setting
2	0x7a	None	None	Configuration instruction of beam angle
2	0x7b	None	None	Factory default setting. Applies to configuration of dead zone.
2	0x7c	None	None	Configuration instruction of beam angle
2	0x7d	None	None	Configuration instruction of beam angle
2	0x7e	None	None	Configuration instruction of beam angle
2	**0x80**	None	None	**Configure beam angle of instruction 0x05, 0x0a and 0x0f as horizontal 100 ° and vertical 50°**
2	**0x81**	None	None	**Configure beam angle of instruction 0x05, 0x0a and 0x0f as horizontal 90 ° and vertical 40°**

2	**0x82**	None	None	**Configure beam angle of instruction 0x05, 0x0a and 0x0f as horizontal 80 ° and vertical 35°**
2	0x8A	None	None	Return of configured serial port protocol, 0xA5 +higher 8 bits + lower 8 bits + Xor check value of the 3 bytes above
2	0x8B	None	None	Return of configured serial port protocol, current address + higher 8 bits +lower 8 bits +three bytes above and lower 8 bits
2	0x8F	None	None	Recover the serial port protocol to the default, return higher 8 bits + lower 8 bits
2	0x95	None	None	Configure the 2nd time sequence of parameter 0x70-0x8f
2	0x98	None	None	Configure the 3rd time sequence of parameter 0x70-0x8f
2	0x9c	None	None	Configure the 1st time sequence of parameter 0x70-0x8f
2	0x92	None	None	Modify the 2nd time sequence of address
2	0x9a	None	None	Modify the 1st time sequence of address
2	0x9e	None	None	Modify the 3rd time sequence of address
2	0xc4	None	None	Wait for 5s sleep
2	0xc5	None	None	Wait for 1s sleep
2	0x99	**69 a9 04 02 79 e8 71 7b e3 68 00 00 87 55 81 00 00 00 00 98 04 02**		Inquiry configuration instruction through serial port; generally, it applies to query of initialization or parameter and the configuration conditions can be seen. The codes are as follows: 0x**69**: Program version, stored in Register 0; 0x**a9:** Mark of manufacturing date, stored in Register 1; 0x**0402:** This value is uncertain

			and decided by the initialization environment; the specific value can be ignored, but it should be 16-bit data which equal to the 0x**0402** of frame tail; 0x**79**: Communication baud rate of serial port, stored in Register 4; 0x**e8**: I2C or serial port address, stored in Register 5; 0x**71**: Noise reduction level, stored in Register 6; 0x**7b**: Factory default setting for configuring dead zone. Stored in Register 7; 0x**e3**: Error code, stored in Register 8; **0x68**: Initialization completion mark, stored in Register 9; its value is 0x69 when initialization starts;

Table 3

Power supply noise reduction instruction **(0x70,0x71,0x72,0x73,0x74,0x75),** baud rate instruction **(0x77/0x78/0x79)** and beam angle configuration instruction **(0x7a-0x7e/0x80/0x81/0x82**

It is recommended to power supply KS114 with battery by default. The measured distance may have unstable fluctuation when power supply with higher noise is adopted. The user can configure the clutter suppression function of KS114 distance measurement module by sending the instruction of 0x70,0x71,0x72,0x73,0x74,0x75. 0x70 is at test level; the Instruction **0x71** can configure the module as Stage 1 noise reduction, which applies to power supply by battery, it is also the **factory defect setting**. The Instruction 0x72 can configure the module as Stage 2 noise reduction, which applies to the scenarios with certain high-frequency noise such as USB power supply. The Instruction 0x73 can configure the module as Stage 3 noise reduction, which applies to scenarios with long-distance USB power supply. The Instruction 0x74 can configure the module as Stage 4 noise reduction, which applies to the scenarios of power supply of switching power supplies. The Instruction 0x75 can configure the module as Stage 5 noise reduction, and this level is not recommended if there are no special requirements.

The user can send Instruction 0x7a, 0x7b, 0x7c, 0x7d and 0x7e to configure the beam angle, and the beam angle decreases along with the increase of this value. **The factory default setting is 0x7b**.

It can be configured simply by sending the following instruction time sequence to this module: “TTL serial port address + Register 2 + 0x9c; TTL address + Register 2 + 0x95; TTL address + Register 2 + 0x98; TTL serial port

address + Register 2 + 0x71/0x72/0x73/0x74/0x75/0x7a/0x7b/0x7c/0x7d/0x7e/0x80/0x81/0x82"; when it is sent, it will have delay for at least 2s to finish auto configuration of system, and it will rework according to the configuration.

Please put the configuration code into the initialization function of program, i.e., before the while(1) circulation, in order to protect the module. When effective configuration instruction is received by KS114, the LED lamp will be normally on, which means configuration succeeds.

Once KS114 is powered on again, it will run based on the new configuration.

Sequence Chart

Sequence chart 1: Send the detection instruction in the format of (Only register 2):

Serial port address	Delay 20~100us	Register 2	Delay 20~100us	8-bit data instruction

It is recommended to use serial port interruption for data receiving, so the SCM can have spare time to execute other work. When simulated serial port is adopted in SCM, please receive the data by judging the level fluctuation of Pin SDA/TX based on the serial port protocol; the data are:

Higher 8 bits of detection results	Lower 8 bits of detection results

When data are received, the next detection instruction can be sent (such as 0xe8+0x02+0xbc).

Set sleep wait time

It will not enter sleep status in serial port mode.

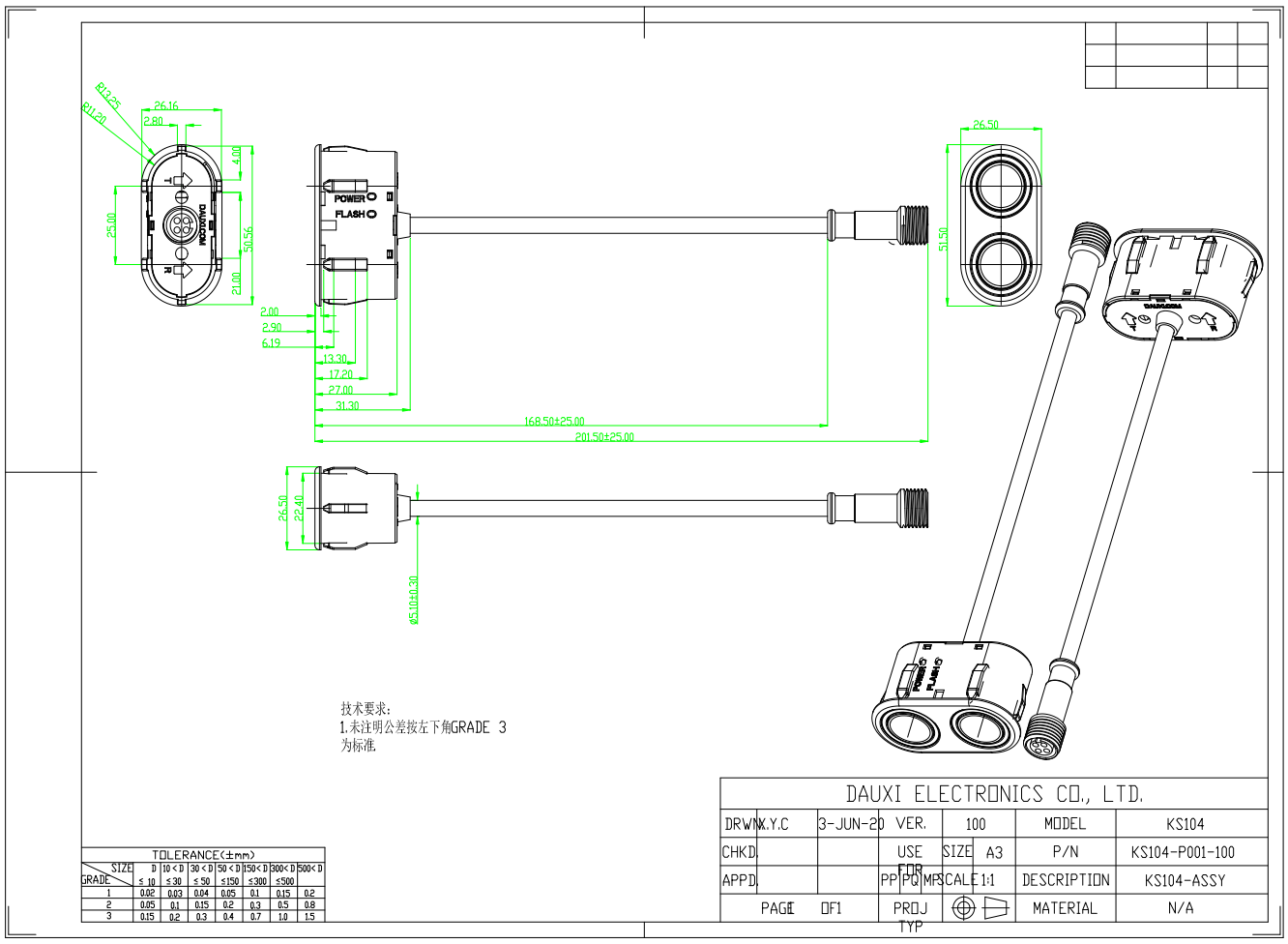
Intact List of Delivery

The black or white wire will be delivered by default. Other colors of wires can be customized.

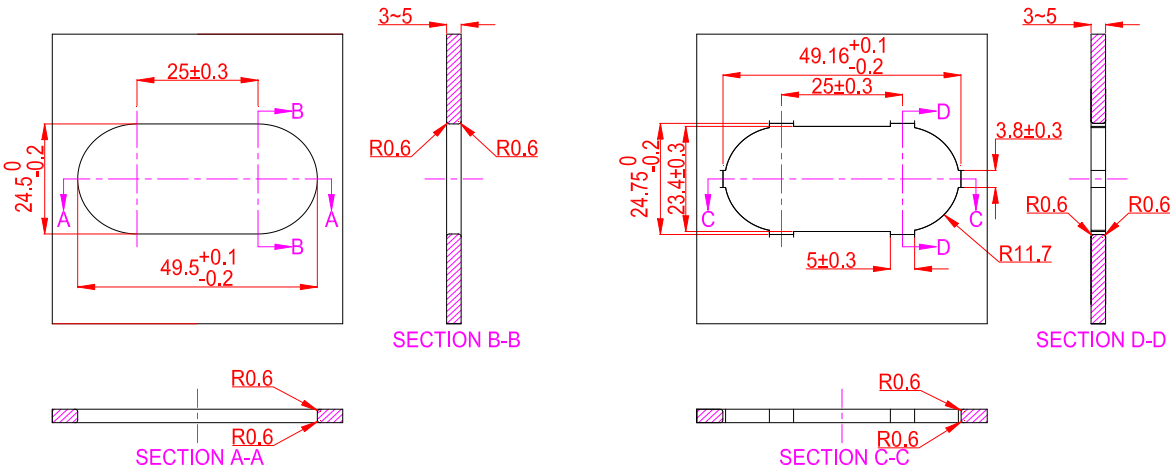
It includes 1 set of KS114 body and 1pcs of 2m extension wire. Please use the tee-junction wire *LINE-3T-6-600-110-CNT* in Page 2 of the instructions if multiple KS114 will be connected.

If customer fails to get the revision notice when the data are revised due to product improvement, please acquire the latest product data at www.dauxi.com.

KS114 Assembly Dimension Drawing:

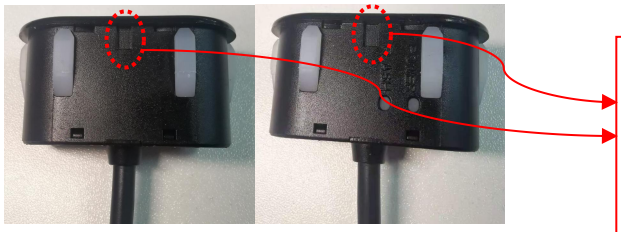


Suggestions of installation hole:



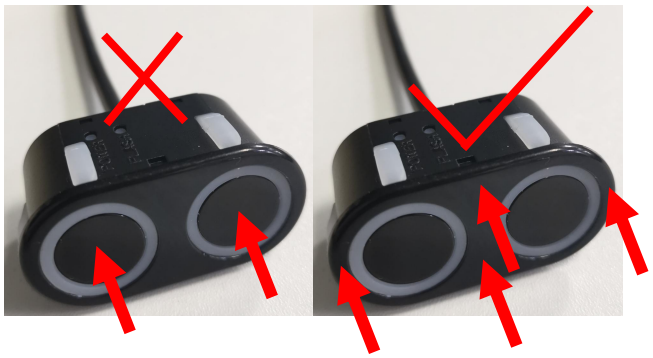
Both of the installation holes above are accepted. Both of positive and negative side of KS114 silicone contact edge should undergo smoothing for R0.5~1mm. The recommended thickness of installation panel is ≥3mm.

The following bucket installation scheme can also be adopted. Design the buckle on the shell, press the KS114 into the shell and press the buckle on shell into the square slot in picture below to realize explosion-proof installation.



The positive/negative side shown in red dotted line can be used for designing the bucket installation.

Assembly Notes:

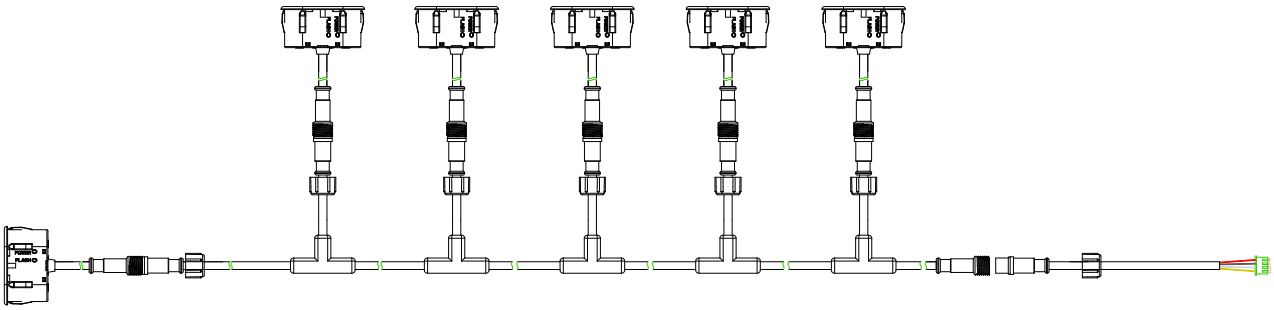


The "×" in the left picture shows the wrong stress point of operation, and it is not allowed to press the circular core vibration part at the middle directly. The arrow in the right picture shows the allowed stress point and the tick means the correct operation; press the outer plastic shell of KS114 to assemble KS114 to the proper position.

Suggestions of Use:

1) Quick start
Step 1: Download software and instruction: http://www.dauxi.com/Inc/driver_control.zip
Step 2: Open the "KS1XX test software – installation-free version-USART.exe" and "KS10R-V210.pdf" in package driver_control.zip; use and control KS114 quickly by referring to software use in Page 5 of KS10R-V210.pdf.
KS10R can also be purchased at: http://www.dauxi.com/productn.asp?ArticleID=1764
Other models of USB can be converted to 485.

2) Control algorithm
Please refer to Page 45~50 of this document for the polling algorithm;
http://www.dauxi.com/%E5%AF%BC%E5%90%91%E8%B6%85%E5%A3%B0%E6%B3%A2%E9%80%89%E5%9E%8B%E5%8F%8A%E4%BD%BF%E7%94%A8%E5%BB%BA%E8%AE%AE.pdf
It means suggested timing; for example, each module of one 15ms KS114 is distributed with fixed period.
Refer to cascade bus for the wiring and one wire is connected to the end. The robot has one wire only, as shown in picture below:



Due to the ultralow power consumption of KS114 below 50mW, the total consumption of 20 sets KS114 with parallel connection on bus is 1w.