
SDKELI[®]

KLM TYPE SAFETY LIDAR

OPERATION MANUAL

(V1.1)



CE

Jining Keli Photoelectronic Industrial Co. Ltd.

Contents

I	Directives and standards	1
II	User instructions	2
III	Symbols and document conventions	3
IV	Precautions for safe use	4
1.	Product description	5
1.1	Working principle	5
1.2	Applications	5
1.2.1	Application tips	5
1.2.2	Hazardous zone protection	6
1.2.3	Access protection	7
1.2.4	Mobile hazardous zone protection	7
1.3	Specification	8
1.4	System description	8
1.5	Appearance	9
1.6	Dimensions	10
1.7	Technical parameters	11
2.	Function introduction	14
2.1	Input/output interface	14
2.2	Interface extension cable	15
2.3	Function description	17
2.3.1	Safety output	17
2.3.2	Static control inputs	17
2.3.3	Dynamic control inputs	18
2.3.4	General I/Os, General inputs	18
2.3.5	Response time	19
2.3.6	External device monitoring (EDM)	19
2.3.7	PAA mode	20
2.3.8	PP mode	20
2.3.9	Zone group switching	21
2.4	Window contamination protection	25
3.	Installation and wiring	26
3.1	Installation requirements	26
3.2	Installation Tips	26
3.2.1	Protection from external light influence	26
3.2.2	Prevent mutual interference from safety lidar	26
3.3	Safety distance	27
3.3.1	Hazardous zone protection	27
3.3.2	Access protection	28

3.3.3 Mobile hazardous zone protection (Take AGV as an example)	28
3.4 Wiring	30
3.4.1 Precautions	30
3.4.2 Power supply	30
4. Check and maintenance	31
4.1 Initial check	31
4.4.1 When perform the following operation,the initial check is needed.	31
4.4.2 The pre-check of the installation	31
4.4.3 The pre-check of the Wiring	31
4.4.4 The pre-check during the controlled machine stop	31
4.4.5 The pre-check when operating the machine.	32
4.2 Daily check	32
4.3 Regular check	32
4.4 Maintenance	32
4.4.1 Optical window cleaning	32
4.4.2 Optical window replacing	33
5. Troubleshooting	34
6. Version	35

I Directives and standards

The undersigned, representing the manufacturer, herewith declares that KLM safety lidar is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the standards and/or technical specifications stated in the EU declaration of conformity have been used as a basis for this.

➤ **EU directives**

Machinery Directive 2006/42/EC

EMC Directive 2014/30/EU

➤ **European standards**

EN 61496-1:2020 (Type 3 ESPE)

EN 61496-3:2019 (Type 3 AOPDDR)

EN ISO 13849-1:2015 (Cat. 3, PL d)

EN ISO 13849-2:2012 (Cat. 3, PL d)

EN 61326-1:2013

➤ **International Standards**

IEC 61496-1:2020 (Type 3 ESPE),

IEC 61496-3:2019 (Type 3 AOPDDR)

IEC 61508-1~7:2010 (SIL 2)

IEC 61326-1

IEC 62061

ISO 13855

KLM is designed according to the following standards :

IEC 60068-2-6

IEC 60068-2-27

EN 60529 (IP65)

IEC 60825-1 (Class 1 laser product)

IEC 61140

2014/35/EU (Low voltage directive)

II User instructions

Read this manual thoroughly and confirm the product from the appearance before installing, operating and maintaining KLM safety lidar. Please contact us if you have any questions or comments.

➤ **Quality assurance**

The quality guarantee period of KLM safety lidar is 12 months.

KELI makes no warranty or representation, express or implied, regarding non-infringement, merchantability, or fitness for particular purpose of the products. Any buyer or user acknowledges that the buyer or user alone has determined that the products will suitably meet the requirements of their intended use. KELI disclaims all other warranty, express or implied.

➤ **Limitations of liability**

KELI shall not be responsible for special, indirect, or consequential damages, loss of profits or commercial loss in any way connected with the products, whether such claim is based on contract, warranty, negligence, or strict liability.

In no event shall responsibility of KELI for any act exceed the individual price of the product on which liability is asserted.

Incorrect use, improper modification of or tampering with the safety lidar will invalidate any warranty from KELI; in addition, any responsibility and liability of KELI for damage and secondary damage caused by this is excluded.

In no event shall KELI be responsible for warranty, repair, or other claims regarding the products unless KELI's analysis confirms that the products were properly handled, stored, installed, and maintained and not subject to contamination, abuse, misuse, or inappropriate modification or repair.

➤ **Performance**

Performance data given in this document is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of KELI's test conditions, and the users must correlate it to actual application requirements.

➤ **Change in specifications**

Product specifications and accessories may be changed at any time based on improvements and other reasons.

When the product's rating, performance, or structure changes, the product's specifications will change accordingly. For the change of product specifications, our company will not notify, if in doubt, please contact us.

➤ **Errors and omissions**

The contents of the manual have been made as accurate and complete as possible, but there is no guarantee that there are no errors or omissions in this manual. The Company shall not be responsible for any errors or omissions that may have occurred in this specification.

➤ **Copyright and copy permission**

This document shall not be copied for sales or promotions without permission.

This document is protected by copyright and is intended solely for use in conjunction with KLM safety lidar. Please notify us before copying or reproducing this document in any manner, for any other purpose. If copying or transmitting this document to another, please copy or transmit it in its entirety.

III Symbols and document conventions

The following special information may appear at any place in the manual or on KLM safety lidar, as a warning of potential risk or promotion of special attention to information about clarifying or simplifying certain procedures.

WARNING indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.



WARNING

WARNING indicates an actual or potential risk or health hazard.

They are designed to help you to prevent accidents.

Read carefully and follow the warnings!

CAUTION indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.



CAUTION

CAUTION indicates the key information which, if not avoided, can result in expected legal dispute, or equipment damage.

Read carefully and follow the cautions!

IV Precautions for safe use

Make sure to observe the following precautions that are necessary for ensuring safe use of the product. Incorrect use, improper modification of or tampering with the safety lidar will invalidate any warranty from KELI; in addition, any responsibility and liability of KELI for damage and secondary damage caused by this is excluded.

- Thoroughly read this manual and understand the installation procedures, operation check procedures, and maintenance procedures before using the product.
- The safety lidar must only be used within the limits of the prescribed and specified technical data and operating conditions at all times.
- KLM cannot be used for hazard protection of non-electrical control equipment.
- The safety lidar works as an indirect protective measure and cannot provide protection from pieces thrown from the application nor from emitted radiation. Trans - parent objects are not detected.
- The protective device must be planned in, installed, connected, commissioned, and serviced by qualified safety personnel only. A qualified person is defined as “a person or persons who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work” .
- When the protective field of KLM being changed, the serial number (or production number) of the lidar , the date of the changed day and the identity of the person responsible for the change shall be recorded.
- OSSDs must satisfy the following conditions:
 - Not short-circuited with 24V.
 - OSSDs output should not exceed the rating.
 - The machine controller processes both signals of an OSSD pair separately.
- The voltage supply of KLM should meet the following conditions while meeting the rated voltage:
 - Double insulation or reinforced insulation is used between primary and secondary power supply;
 - The power supply unit is able to jumper a brief power failure of 20 ms as specified in IEC 60204-1.
 - The electrical power supply has an appropriate electrical fuse.
- Dispose of the product in accordance with the relevant rules and regulations of the country or zone where the product is used.
- Users should establish rules and regulations for safe operation management and implement them effectively.

1. Product description

1.1 Working principle

The safety lidar is an electro-sensitive protective device (ESPE) which scans its surroundings two-dimensionally using infrared laser beams.

The safety lidar forms a protective field using the invisible laser beam. As soon as an object is situated in the protective field, the safety lidar signals the protection by means of a signal change at the safety output. The machine or its control must safely analyze the signals (for example using a safe control or safety relays) and stop the dangerous state.

The safety lidar operates on the principle of time-of-flight measurement. It emits light pulses in regular, very short intervals. If the light strikes an object, it is reflected. The safety lidar receives the reflected light. The safety lidar calculates the distance to the object based on the time interval between the moment of transmission and moment of receipt (Δt).

1.2 Applications

KLM is mainly used in industrial sites, and typical applications include the protection of fixed hazardous zones and the collision avoidance of automated guided vehicles (AGV).

1.2.1 Application tips

- The protected objects of KLM must meet the following conditions:
 - 1) Only objects intruding into the protected zone are protected.
 - 2) KLM cannot detect transparent and translucent objects.
 - 3) The size of the object intruding into the protection zone must be greater than or equal to the protection capability of the KLM.
- Ensure the installation environment for KLM to achieve security protection:
 - 1) Places within the range of the environment (temperature, humidity, interference light, shock and vibration, etc.) specified in this manual.
 - 2) Places without flammable and explosive gases.
 - 3) A place free of smoke, particles, corrosive chemicals and other substances.
 - 4) A place where there will be no strong light interference (such as direct light) to the KLM.
 - 5) Make sure that there are no mirrors or other highly reflective objects in the protection field of the safety lidar.
 - 6) Prevent interference in the optical beam path. If, for example, the device is installed in a paneling, the viewing slit must be sufficiently large.
 - 7) Do not use an additional front screen.
 - 8) Ensure that there are no small objects (e.g. cables) in the protective field of the safety lidar, even if they do not trigger a field interruption.

WARNING

Installation conditions that do not comply with the above regulations may result in the risk of failure of the protective equipment!

Certain optical and electromagnetic ambient conditions can affect the safety lidar and thus reduce the availability of the machine. Examples:

- Condensation on the optics cover
- Strong electrical fields (e.g. welding cables or induction cables)

➤ Auxiliary protective measures:

- 1) No obstacles interfere with the view in the protective field of the safety lidar. Where there are unavoidable obstacles, additional protective measures are applied.
- 2) If people can stay between the protective device and the hazardous point without being detected, additional protective measures (e.g. restart interlock) are applied.
- 3) Reaching under, over and around, crawling beneath and stepping over the safety lidar, as well as moving it, are prevented.

➤ Prevent interference:

- 1) Avoid external light sources in the scan plane.
- 2) Avoid direct sunlight in the scan plane.
- 3) Do not position halogen lights, infrared light sources or stroboscopes directly on the scan plane.
- 4) Mutual interference of several safety laser scanners is unlikely. To avoid mutual interference in all cases, you need to choose a suitable mounting method. Examples:

- Offset mounting so that the scan planes are on different planes.
- Slightly inclined, tilted mounting, so that the scan planes intersect one another.

➤ Prevent unprotected zones

There may be zones behind the safety laser scanner which cannot be detected by the safety laser scanner. The undetected zones become larger if the safety laser scanner is mounted using a mounting kit.

- Mounting of deflector plates to protect the undetected zones.
- Mount the safety lidar in the machine or vehicle's paneling.

1.2.2 Hazardous zone protection

The KLM can protect the hazardous zone in a fixed position, preventing people or objects from entering the hazardous zone and being injured. When the KLM detects an object in the set "alarm zone", it will send out an alarm signal. When the KLM detects an object in the set "protection zone", it will send a stop signal to stop the equipment and prevent the danger from happening.

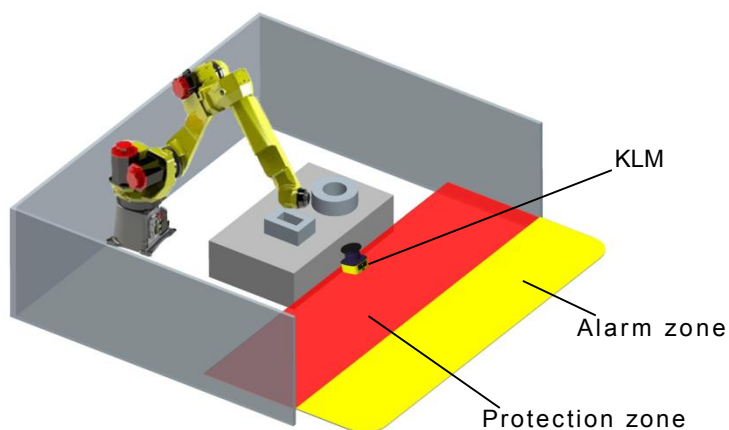


Fig.1.1 Hazardous zone protection

1.2.3 Access protection

If a person is detected to pass through the protective door (the set protection zone), the KLM will issue a stop signal, the controlled equipment will stop running, and the danger will be prevented.



Once people have passed through the protective door, the KLM cannot detect people in the danger zone!

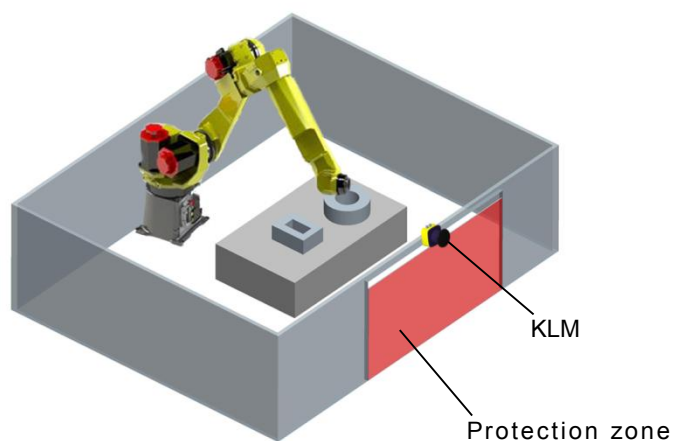


Fig.1.2 Access protection

1.2.4 Mobile hazardous zone protection

The KLM can be installed on mobile devices such as automated guided vehicles (AGVs) and forklifts. During the transportation of the AGV, the KLM can monitor the driving direction field in real time. When an object is detected in the set "protection zone", the KLM will send a stop signal. The KLM can switch between several protection zones according to external signals.

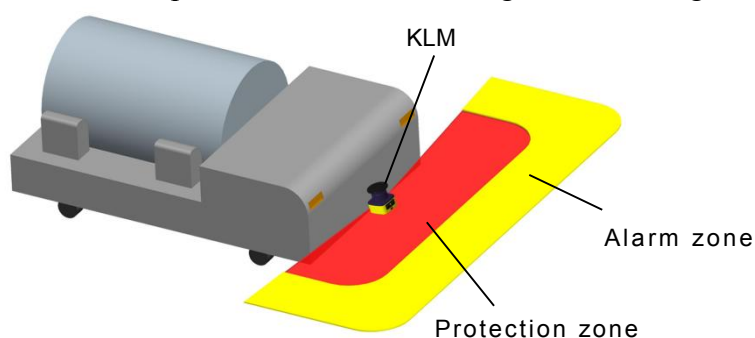
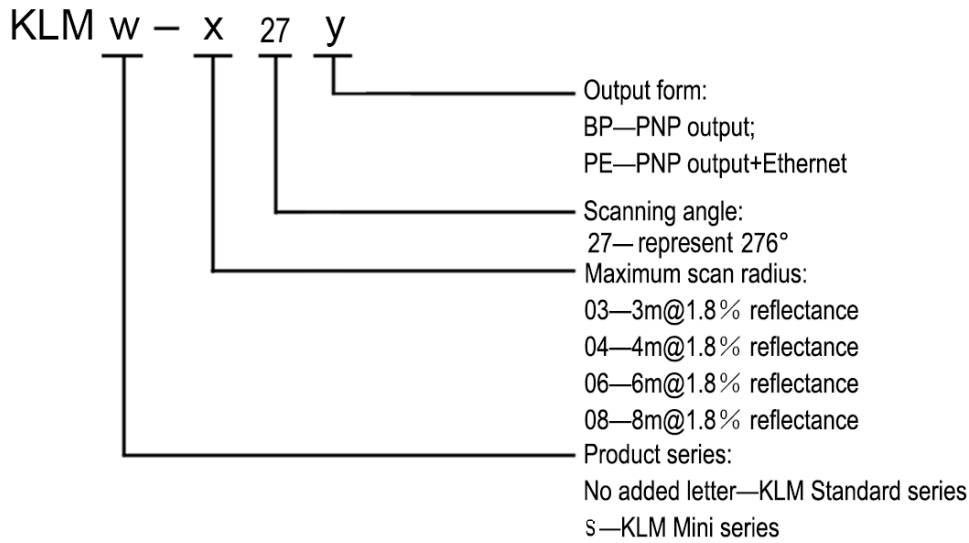


Fig.1.3 Mobile hazardous zone protection

1.3 Specification



All specifications are shown in the table below:

Specification	Maximum scan radius	Scanning angle	Output form
KLM-0627PE	6m@1.8% reflectance	276°	PNP+Ethernet
KLM-0627BP	6m@1.8% reflectance	276°	PNP
KLM-0827PE	8m@1.8% reflectance	276°	PNP+Ethernet
KLM-0827BP	8m@1.8% reflectance	276°	PNP
KLMs-0327PE	3m@1.8% reflectance	276°	PNP+Ethernet
KLMs-0327BP	3m@1.8% reflectance	276°	PNP
KLMs-0427PE	4m@1.8% reflectance	276°	PNP+Ethernet
KLMs-0427BP	4m@1.8% reflectance	276°	PNP

Note: In the following chapters of this document, *KLM* is used to describe the use of lidars. When differences in appearance and size are involved, *KLM Mini series lidars* are introduced separately.

1.4 System description

The KLM is connected to the control system of the monitoring equipment through the power/output interface cable thrown out from the rear and the power extension cable (optional). The PE lidar can be connected to the PC software of the computer through the network connection interface or the front USB interface to configure the safety-related applications. The BP lidar is connected with the PC software of the computer through the front USB interface to configure the safety-related applications.

1.5 Appearance

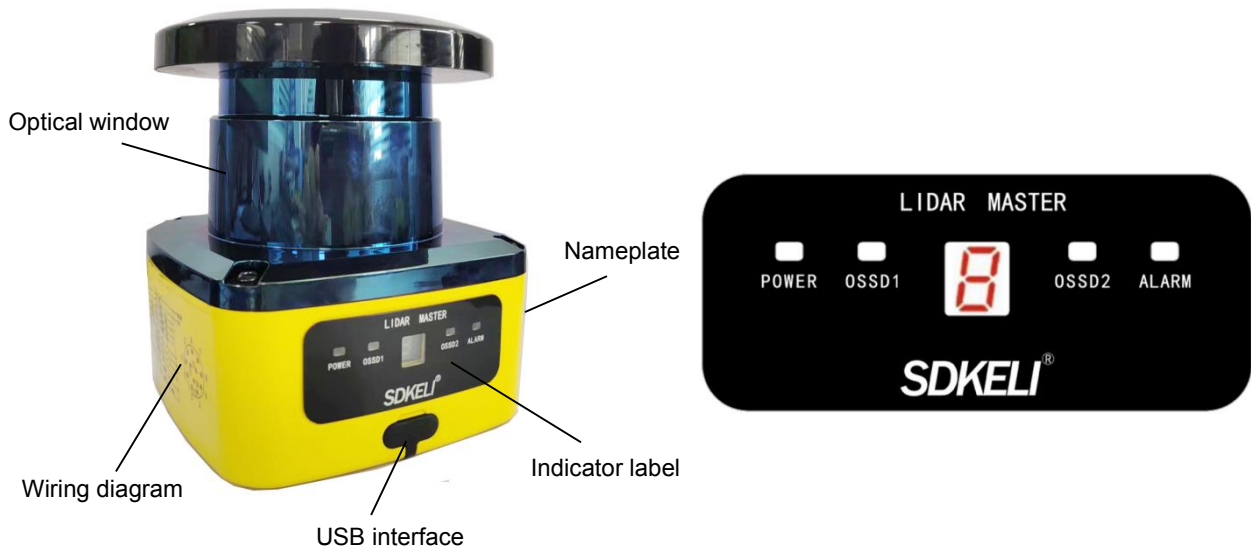


Fig.1.4 Appearance of KLM

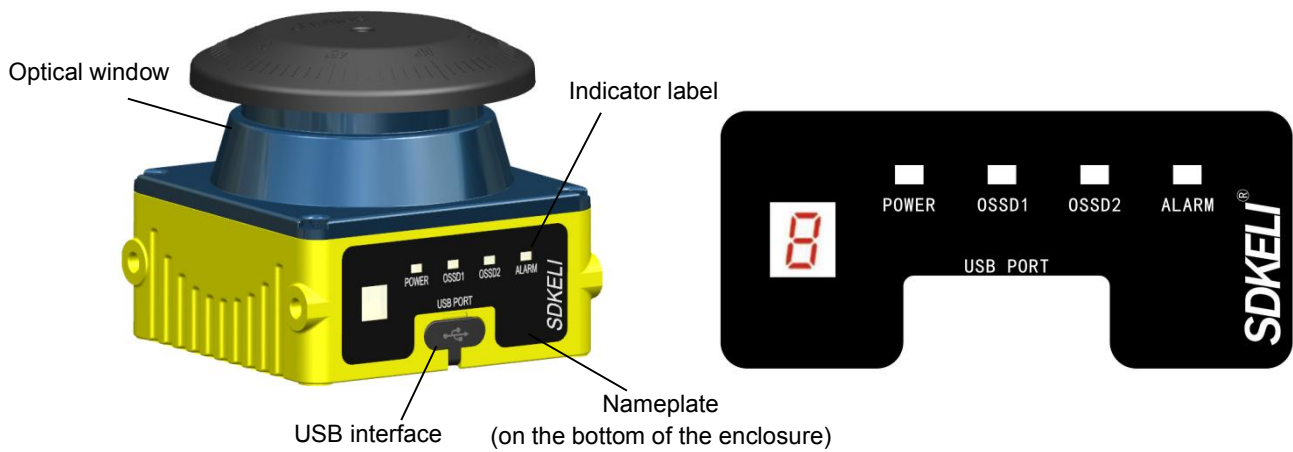


Fig.1.4 Appearance of KLMs

Table 1.2 Appearance information description

No.	Part name	Description
1	Nameplate	Indicate the technical parameters of the lidar
2	Wiring diagram	Indicate the power/output interface of the lidar
3	USB interface	Lidar connects to the computer through this interface and the configuration cable
4	Indicator label	The indicator label contains four indicator lights and a digital tube
5	Optical window	The scanning beam of KLM is sent out through the optical window

Table 1.3 Instruction mark description

Indicator	Definition of indicator	Color	Description
POWER	Power	Red	KLM is powered on
OSSD1	Safety output 1	Green	There is no obstacle detected in protection zone 1
		Red	There is an obstacle detected in protection zone 1
OSSD2	Safety output 2	OFF	OSSD2 is not configured
		Green	There is no obstacle detected in protection zone 2
		Red	There is an obstacle detected in protection zone 2
ALARM	Alarm output	OFF	ALARM is not configured or There is no obstacle detected in alarm zone
		Red	There is an obstacle detected in alarm zone
8	Nixie tube	Red	0 : Protection zone is not configured or failure of input signal
			1 : A valid zone group is being monitored
			5 : Fault of OSSD output
			6 : Establishing communication with computer
			8 : Flashing during power-on initialization
			9 : Configuration is succeeded
			E : Fault of EDM monitor
			F : Fault of KLM system
			C : Optical window is contaminated to cause abnormal protection

Note: When multiple statuses coexist, multiple status words are displayed cyclically.

1.6 Dimensions

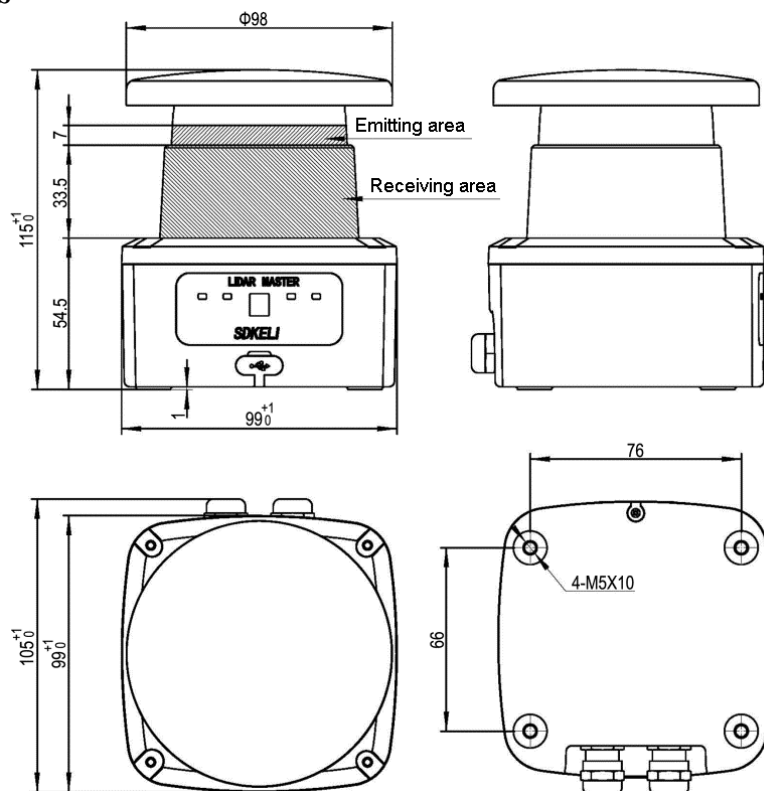
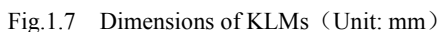


Fig.1.6 Dimensions of KLM (Unit: mm)



1.7 Technical parameters

	KLM	KLMs
Safety-related parameters		
Type	Type 3 (IEC 61496)	
Safety integrity level	SIL 2 (IEC 61508)	
Category	Cat. 3 (ISO 13849-1)	
Performance level	PL d (ISO 13849-1)	
PFH _D (mean probability of a dangerous failure per hour)	1.67× 10 ⁻⁸	
Safe status when a fault occurs	At least one OSSD is in the OFF state.	
Detection features		
Laser light source	Wavelength: 905nm; Class 1 laser product	
Scanning angle range	276° (−48°...228°)	
Max. protection range	8m@1.8% reflectance	4m@1.8% reflectance
Angular resolution	0.12°	
Scan cycle time	40ms	
Multiple sampling	2...16	
Response time	Defaults 100 ms (Configurable) ¹⁾	
Min. protective resolution	70mm@Max. protection range	

Generally necessary protection zone supplement (TZ) ²⁾	65mm	
Additional supplement Z _R for reflection-based measurement errors	350mm	
Electrical data and interfaces		
Supply voltage	DC24V±20%	
Power consumption	<10W（No load on output）	
Safety output（OSSD1）	PNP×2 (ON state: maximum I _{out} = 200mA, V _{out} ≥V _{cc} -3V, OFF state: I _{out} <1mA, V _{out} <2V), overcurrent protection, capacitive load ≤100nF. It is ON when there is no object in the protection area, and is OFF when there is an object or a fault.	
Input interface	There are 8 in total, the input impedance of 3.3K ohms, can be configured as static input or dynamic input. Static input: input high level 24V (11V-28V), input low level 0V (<2V). Sampling time (debounce) 10ms. Dynamic input (encoder input): input high level 24V (11V-28V), input bottom level 0V (<2V). Input frequency <100KHz. Encoder type, dual channel, 90° phase difference.	
I/O interface	There are 4 in total, of which General I/O 1 and 4 can be configured as static input or alarm output, and General I/O 2 and 3 can be configured as static input or OSSD2 output. Static input: the input impedance is 4.7K ohms, the input high level is 24V (11V-28V), and the input low level is 0V (<2V). Sampling time (debounce) 10ms. OSSD2 output: the same as safety output OSSD1. Alarm output: PNP (ON state: maximum I _{out} = 200mA, V _{out} ≥V _{cc} -3V, OFF state: I _{out} < 1mA, V _{out} < 2V), OFF state when there is an object in the alarm zone.	
Permissible resistivity between load and device	≤ 4 Ω	
Date output interface	Ethernet	
Configuration interface	microUSB	
Power-on time	Typical 10s	
Length of cable	≤1m	
Mechanical data		
Dimensions	100×100×115mm	81×90×75mm
Enclosure material	Aluminum (ADC12)	
Enclosure color	PANTONE 107C (bright yellow)	
Optical window material	Polycarbonate	
Ambient data		

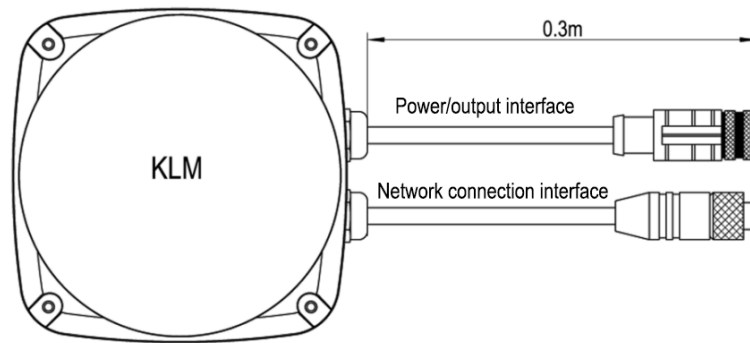
Ambient temperature	Operating: -30...50°C; Storage: -30...70°C
Ambient humidity	Operating: 35%...85%RH; Storage: 35%...95%RH (No frost and condensing)
Ambient light immunity	Incandescent lamp: maximum 1500Lux ³⁾
Vibration resistance	Frequency: 10...55Hz, 1 octave/min, Amplitude/Acceleration: 0.35 mm , 20 cycles for each of 3 mutually perpendicular axes ⁴⁾
	Frequency: 5...200Hz, Amplitude/Acceleration: 1.5 mm /0.5g, 10 cycles for each of 3 mutually perpendicular axes ⁵⁾
Shock resistance	Acceleration: 10g, Pulse duration: 16ms, 1000 for each direction of 3 mutually perpendicular axes (6000 in total) ⁴⁾
	Acceleration: 5g, Pulse duration: 11ms, 3 for each direction of 3 mutually perpendicular axes (18 in total) ⁵⁾
IP code	IP65
1) See chapter 2.3.5 for details. 2) TZ = tolerance zone of the lidar. 3) Ambient light source for direct exposure to the scanning plane (according to IEC 61496-3) : ≤ 1500 lux. 4) Parameters according to IEC 61496-3. 5) Parameters according to the 5M1 level of IEC 60721-3-5.	

2. Function introduction

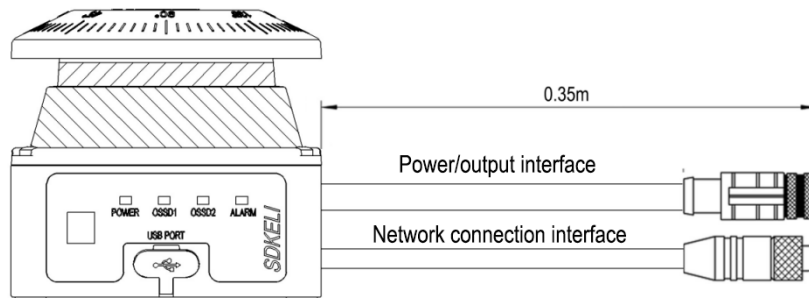
2.1 Input/output interface

The power/output interface of KLM is M12-17 pin header with a cable length of 0.3m. The network connection interface is M12-4 core hole head, and the cable length is 0.3m.

The power/output interface of KLMs is M12-17 pin header with a cable length of 0.35m. The network connection interface is M12-4 core hole head, and the cable length is 0.35m.



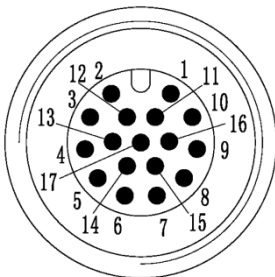
Input/output interface of KLM (There is no network connection interface of BP type)



Input/output interface of KLMs (There is no network connection interface of BP type)

Fig.2.1 Input/output interface

Table 2.1 Interface assignment

Power/output	Pin	Designation	Function
	1	24V	Supply voltage (+24V DC)
	2	0V	Supply voltage (0V DC)
	3	OSSD1.A	OSSDpair 1, OSSD.A
	4	OSSD1.B	OSSDpair 1, OSSD.B
	5	General I/O 1	Configurable: Static control input B1 General output: Alarm output 1/Alarm output 2
	6	General I/O 2	Configurable: Static control input A1 General output: Alarm output 1/Alarm output 2/OSSD pair 2
	7	General I/O 3	Configurable: Static control input A2 General output: Alarm output 1/Alarm output 2/OSSD pair 2

	8	General I/O 4	Configurable: Static control input B2 General output: Alarm output 1/Alarm output 2
	9	Input 01	Configurable: Static control input C1 Dynamic control input 1a (0°)
	10	Input 02	Configurable: Static control input C2 Dynamic control input 1b (90°)
	11	Input 03	Configurable: Static control input D1 Dynamic control input 2a (0°)
	12	Input 04	Configurable: Static control input D2 Dynamic control input 2b (90°)
	13	Input 05	Configurable: Static control input E1 Dynamic control input 3a (0°)
	14	Input 06	Configurable: Static control input E2 Dynamic control input 3b (90°) General input: EDM1(external device monitoring 1)
	15	Input 07	Configurable: Static control input F1 Dynamic control input 4a (0°)
	16	Input 08	Configurable: Static control input F2 Dynamic control input 4b (90°) General input: EDM2 (external device monitoring 2)
	17	NC	Not connected
Network connection	Pin	Designation	Function
	1	TX+	Send data +
	2	RX+	Receive data+
	3	TX-	Send data -
	4	RX-	Receive data -

2.2 Interface extension cable

■ Power/output interface extension cable with flying leads, 17-wire

The standard length of the power/output interface extension cable is 1m, and the color of the core and the corresponding interface assignment are shown in Table 2.2.

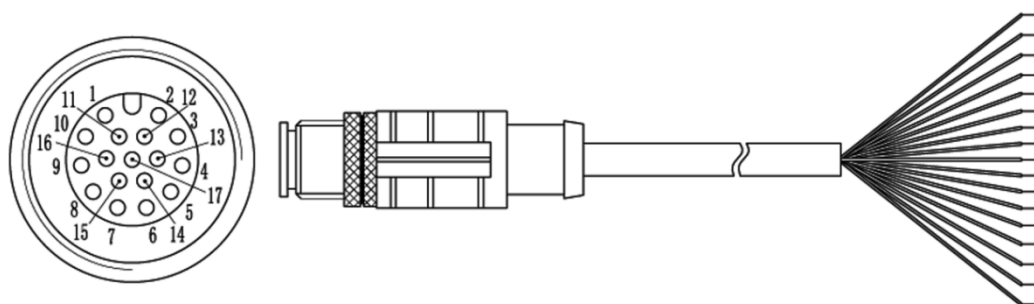


Fig.2.2 Power/output interface extension cable

Table 2.2 Pin assignment of the power/output interface extension cable

Pin	Wire color	Designation	Function
1	Red	24V	Supply voltage (+24V DC)
2	Green	0V	Supply voltage (0V DC)
3	Gray/White	OSSD1.A	OSSDpair 1, OSSD1.A
4	Gray	OSSD1.B	OSSDpair 1, OSSD1.B
5	Yellow/White	General I/O 1	Configurable: Static control input B1 General output: Alarm output 1/Alarm output 2
6	Violet/White	General I/O 2	Configurable: Static control input A1 General output: Alarm output 1/Alarm output 2/OSSD pair 2
7	Violet	General I/O 3	Configurable: Static control input A2 General output: Alarm output 1/Alarm output 2/OSSD pair 2
8	Yellow	General I/O 4	Configurable: Static control input B2 General output: Alarm output 1/Alarm output 2
9	Blue	Input 01	Configurable: Static control input C1 Dynamic control input 1a (0°)
10	Brown	Input 02	Configurable: Static control input C2 Dynamic control input 1b (90°)
11	Pink	Input 03	Configurable: Static control input D1 Dynamic control input 2a (0°)
12	Orange/White	Input 04	Configurable: Static control input D2 Dynamic control input 2b (90°)
13	White	Input 05	Configurable: Static control input E1 Dynamic control input 3a (0°)
14	Black/White	Input 06	Configurable: Static control input E2 Dynamic control input 3b (90°) General input: EDM1(external device monitoring 1)
15	Black	Input 07	Configurable: Static control input F1 Dynamic control input 4a (0°)
16	Pink/White	Input 08	Configurable: Static control input F2 Dynamic control input 4b (90°) General input: EDM2 (external device monitoring 2)
17	-	NC	Not connected

■ Network connection interface extension cable with RJ45 connector, 4-wire

The network connection interface extension cable is a 4-core industrial network connection cable, one end is M12-4-core needle, the other end is RJ45 connector, and the standard cable length is 1m. See Table 2.1 for the core color and the corresponding interface assignment.

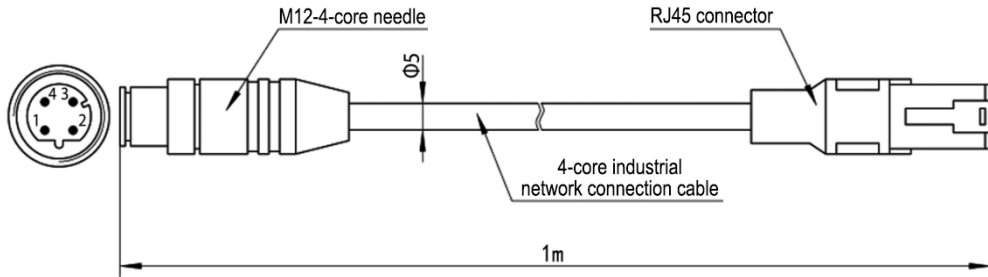


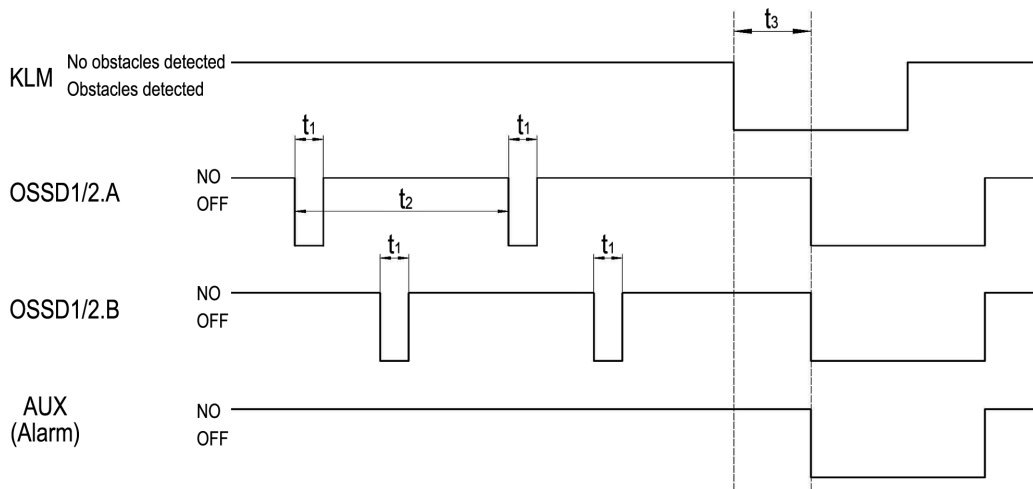
Fig.2.3 Network connection interface extension cable

2.3 Function description

2.3.1 Safety output

When no object is detected in the protective zone, the OSSD signals the ON state (ON) with the signal level HIGH (non-isolated). When an object or lidar failure is detected in the protected zone, the OSSDs signal the OFF state (OFF) via the signal level LOW.

When the OSSDs are in the ON state, a periodic OFF state signal is output, as shown in Fig. 2.4. When the OSSDs output circuit fails or is short-circuited with other interface signals, the system enters the OFF state.



t_1 : Protection pulse time, about 200us;

t_2 : Protection pulse period, i.e. time of scanning a circle, 40ms;

t_3 : Response time when obstacles detected, 100ms (Configurable).

Fig.2.4 Timing diagram of output signal

2.3.2 Static control inputs

A static control input consists of 2 channels. The channels of a static control input are switched inversely. The following table takes static control input A as an example to show which status the static control input's channels must have to define logical input condition 1 and 0 at the relevant control input. The logic input states of other static control inputs B to F are the same as A.

Table 2.3 Status of the channels of the control inputs with complementary evaluation

A1	A2	Logical input status	Explanation
0	1	0	When the input level status of pins 6 and 7 are 0 and 1 respectively, the logical input status of terminal A judged by KLM is 0
1	0	1	When the input level status of pins 6 and 7 are 1 and 0 respectively, the logical input status of terminal A judged by KLM is 1
0	0	Error	When the input level status of pins 6 and 7 are both 0, the logical input status of terminal A judged by KLM is error
1	1	Error	When the input level status of pins 6 and 7 are both 1, the logical input status of terminal A judged by KLM is error



CAUTION

A short-circuit or cross-circuit on one or more channels of the static control inputs can cause the wrong monitoring case to be activated.

2.3.3 Dynamic control inputs

A dynamic control input receives speed information from an incremental encoder, compares it with the speed information set by the lidar, and switches the zone group according to the comparison result. To obtain accurate speed information, the lidar must monitor 2 or 4 incremental encoders simultaneously. Each incremental encoder must have a 0° output and a 90° output so that the direction of travel can be detected.

Requirements for incremental encoders:

- Dual-channel encoder with 90° phase separation
- Outputs: push-pull
- Shielded cable
- Max pulse rate: 100 kHz
- Minimum number of pulses: 100 pulses per cm
- Only a single safety laser scanner is connected to each incremental encoder.
- Each incremental encoder (with one wire each for 0° and 90°) is connected to only one control input.



WARNING

If both encoders fail at the same time, the lidar receives no speed information and will switch to the monitoring case defined by the static control input and contour recognition input. Under this condition, the lidar cannot monitor the status of the mobile device.

2.3.4 General I/Os, General inputs

General I/Os can be configured as general input or general output. When configured as a general output (alarm output), it must not be used for safety-related applications. In addition, pins 6 and 7 used as general I/Os can be configured as an OSSD pair 2 as a control output for a separate protective zone.

General inputs can be used for static control inputs, dynamic control inputs and external device monitoring (EDM) depending on the device.

2.3.5 Response time

The KLM response time refers to the time from when a person or object enters the protection zone to when the KLM detects a person or object and causes the OSSD to enter the OFF state.

KLM response time = $40\text{ms} \times n + 20\text{ms}$

- n = set multiple sampling (default: $n = 2$)

The default response time of KLM is 100ms, corresponding to 2 scan cycles.

The user can configure the response time by setting the number of scans. The setting range is 100ms-660ms, corresponding to 2-16 scans. For specific methods, please refer to the "KLM Safety Lidar Configuration Software User Manual".

Table 2.4 Correspondence between multiple sampling and response time

n	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Response time (ms)	100	140	180	220	260	300	340	380	420	460	500	540	580	620	660

The advantage of fast response time: Shorter safety distances.

The advantage of slow response time: the increased number of multiple sampling can prevent the KLM from going into the OFF state due to light interference or instantaneous protection of objects entering the protected zone, reducing the probability of machine downtime caused by insects, welding sparks or other tiny particles.

2.3.6 External device monitoring (EDM)

The lidar judges the state of the external devices (such as safety relays or contactors) driven by the OSSD by monitoring the state of the external input signal EDM.

The wiring between the KLM and external devices (normally closed contacts) must be made according to Fig.2.5.

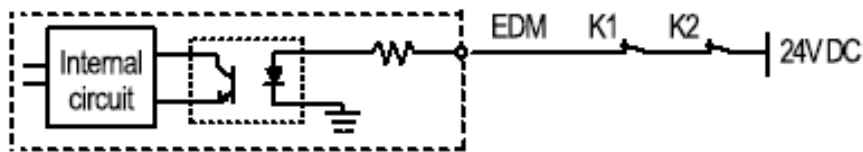


Fig.2.5 EDM function wiring

When the OSSD enters the OFF state from ON state, the normally closed contact of the external device is not closed, then the KLM detects the EDM input signal error and enters the fault state.



CAUTION

- In order to use external device monitoring, positively guided contactors must be used to switch off the machine and the auxiliary contacts of the positively guided contactors are connected to the external device monitoring interfaces of the lidar.
- To ensure the safety of the EDM function, it is necessary to use the positively guided safety relay or contactors.

2.3.7 PAA mode

The default protection zone group mode of the system is PAA mode, that is, each zone group consists of 1 protection zone and 2 alarm zones (alarm zone 1 and alarm zone 2). At this time, the user can configure any two of the general I/Os 01 to 04 as ALARM output 1 and ALARM output 2 signals through the configuration software, and OSSD pair 2 are no longer assigned to the general I/Os. Under the PAA mode, the toolbar in **【Zone Settings】** option corresponds to display protection zone, alarm zone1 and alarm zone 2. Click the button of each zone to configure them respectively, as shown in Fig.2.6.

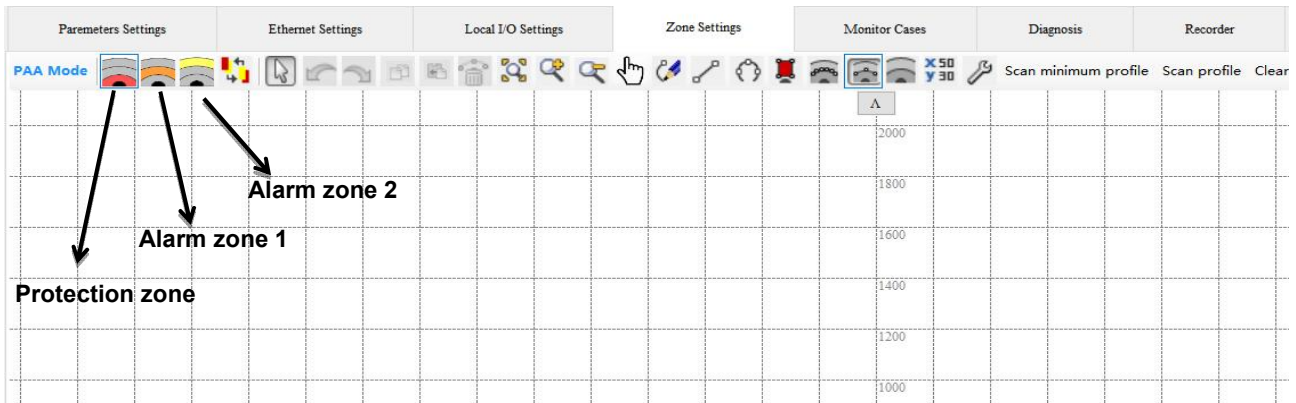


Fig.2.6 Zone Settings under the PAA mode

2.3.8 PP mode

When two independent protection zones need to be configured, the user can assign the signals of the general I/O 02 and 03 to OSSD pair 2 through the configuration software. At this time, the protection zone group mode changes from PAA mode to PP mode, that is, each zone group consists of 2 protection zones (protection zone1 and protection zone 2). Under the PP mode, the toolbar in **【Zone Settings】** option corresponds to display protection zone 1 and protection zone 2. Click the buttons of each zone to configure them respectively, as shown in Fig.2.7.

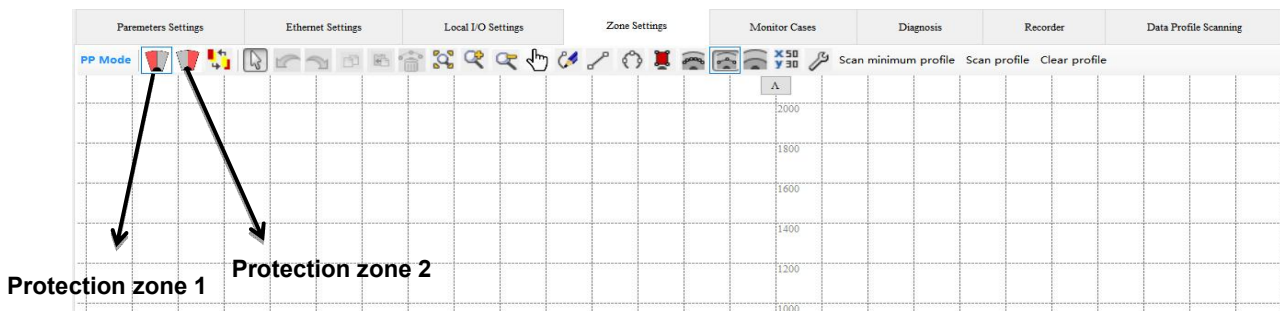


Fig.2.7 Zone Settings under the PP mode

CAUTION

- When the protection zone group mode enters the PP mode from the PAA mode, the relevant configuration of the alarm zone (alarm zone 1 and alarm zone 2) will be cleared.
- When the protection zone group mode enters the PAA mode from the PP mode, the relevant configuration of the protection zone 2 will be cleared.

2.3.9 Zone group switching

KLM can set up to 64 zone groups with different shapes respectively. Users can assign different zone groups to different **【Monitor Cases】** according to their needs, and configure the conditions for realizing the protection of this zone group. When the configured conditions are met, they will automatically switch to the corresponding zone group.

The conditions for realizing the switching between different zone groups include static control input, dynamic control input and contour recognition input. The three conditions can be configured individually or in combination as conditions for the zone group to be activated.

Parameters Settings		Ethernet Settings		Local I/O Settings		Zone Settings		Monitor Cases		Diagnosis		Recorder		Data Profile Scanning	
+Add ①		-Delete		* The range of speed 1 and speed 2 is : [-10000,10000]											
Monitor case		Input condition								Cut-off path					
Number	Name	A	B	C	D	E	F	Speed 1 (mm/s)	Speed 2 (mm/s)	Contour Recognition Field		Zone Group			
1	monitor case 1	1	0					Range -1000 1000	Range 3000 6000	Not used ⑤		Zone Group 1 ⑥			
										Recognition field		Protection Zone Warning Zone 1 Warning Zone 2			
2	monitor case 2	0	1					Range 2000 3000	Range 3000 4000	Not used		Zone Group 2			
										Recognition field		Protection Zone Warning Zone 1 Warning Zone 2			

①-Add/Delete monitoring case ②-Monitoring case name field ③-Static control input condition field ④-Dynamic control input condition field ⑤-Contour recognition field ⑥-Zone group assignment field

Fig.2.8 Monitoring case

The static control input monitors the signal level status of the configured static control input interface; the dynamic control input monitors the speed value signal of the incremental encoder configured as dynamic control input interface; the contour recognition input monitors the matching result between the real-time scanning contour and the configured reference contour.

■ Switching zone groups by static control input

The 6 configuration boxes in the static control input condition field correspond to the static control input interface A to F under the **【Local I/O Settings】** option page in turn. If a pin is not configured as a static control input interface, the corresponding configuration box cannot be activated. When the logic input status formed by the input signal of the static control input interface is consistent with the configured input status, the corresponding zone group under this condition will be activated. There are three statuses of "0", "1" and "/" to choose for static input condition , which represent low level, high level and any level signal respectively. See 2.3.9 for the logic input status of the static control interface.

Example:

The static input condition for the activation of zone group 1 is that the level signal corresponding to the static control input interface from A to F is "11100/", which can be configured as shown in Fig.2.9.

Parameters Settings		Ethernet Settings		Local I/O Settings		Zone Settings		Monitor Cases		Diagnosis		Recorder		Data Profile Scanning		
+Add -Delete																
Monitor case		Input condition								Cut-off path						
Number	Name	A	B	C	D	E	F	Speed 1 (mm/s)	Speed 2 (mm/s)	Contour Recognition Field	Zone Group					
1	monitor case 1	1	1	1	0	0	/	Not used	Not used	Not used	Zone Group 1 Protection Zone Warning Zone 1 Warning Zone 2					

Parameters Settings	Ethernet Settings	Local I/O Settings	Zone Settings	Monitor Cases	Diagnosis
Pin No.	Identification	Optional signals	Signal type	Assigned signal	More configuration
3	OSSD 1.A	OSSD 1.A	Output	OSSD pair 1	/
4	OSSD 1.B	OSSD 1.B	Output	OSSD pair 1	/
6	General-I/O 02	OSSD 2.A A1 Alarm	Input	Static control input A	/
7	General-I/O 03	OSSD 2.B A2 Alarm	Input	Static control input A	/
5	General-I/O 01	B1 Alarm	Input	Static control input B	/
8	General-I/O 04	B2 Alarm	Input	Static control input B	/
9	Input 01	C1 Encoder1(0°)	Input	Static control input C	/
10	Input 02	C2 Encoder1(90°)	Input	Static control input C	/
11	Input 03	D1 Encoder2(0°)	Input	Static control input D	/
12	Input 04	D1 Encoder2(90°)	Input	Static control input D	/
13	Input 05	E1 Encoder3(0°)	Input	Static control input E	/
14	Input 06	E2 Encoder3(90°) EDM1	Input	Static control input E	/
15	Input 07	F1 Encoder4(0°)	Input	Static control input F	/
16	Input 08	F2 Encoder4(90°) EDM2	Input	Static control input F	/

Fig.2.10 Example of static control input configuration

CAUTION

- Different zone groups corresponds to unique static control input condition.
- When the static control input signal combination is different from the one in the configuration, the KLM will display  on the digital tube, prompting "zone group input signal error", until the external input combination is consistent with the configuration, "zone group input signal error" is canceled, and the protection zone switches to the configured zone group.

Switching zone groups by dynamic control input

When configuring the input interface Input 01 to Input 08 to receive the encoder signal under the **【Local I/O Settings】** option page, the dynamic control input condition field are activated .

When any one of Input 01 to Input 04 is configured as an encoder input interface, the other three are automatically configured as encoder input interfaces (not selectable). Input 01/02 simultaneously receives the signal of encoder 1, and Input 03/04 simultaneously receives the signal of encoder 2. When any one of Input 05 to Input 08 is configured as an encoder input interface, the other three are automatically configured as encoder input interfaces (not selectable). Input 05/06

simultaneously receives the signal of encoder 3, and Input 07/08 simultaneously receives the signal of encoder 4.

After the interface signals of encoders 1 and 2 are configured, speed 1 is activated, and after the interface signals of encoders 3 and 4 are configured, speed 2 is activated, see Fig.2.10.

+Add -Delete * The range of speed 1 and speed 2 is : [-10000,10000]

Monitor case		Input condition				Cut-off path	
Number	Name	A	B	C	D	E	F
1	monitor case 1						

Number	Name	Input condition	Input	Encoder	Speed
8	General-I/O 04	B2 Alarm		Unassigned	/
9	Input 01	C1 Encoder1(0°)	Input	Encoder 1	Speed Incremental encoder 1(pin 9) pulse 100 per 10 mm route Incremental encoder 2(pin 11) pulse 100 per 10 mm route *The values (pulses per cm of path) must be between 1000 (max) and 100 (min).
10	Input 02	C2 Encoder1(90°)	Input	Encoder 1	
11	Input 03	D1 Encoder2(0°)	Input	Encoder 2	
12	Input 04	D1 Encoder2(90°)	Input	Encoder 2	
13	Input 05	E1 Encoder3(0°)	Input	Encoder 3	Incremental encoder 3(pin 13) pulse 100 per 10 mm route Incremental encoder 4(pin 15) pulse 100 per 10 mm route *The values (pulses per cm of path) must be between 1000 (max) and 100 (min). Speed Range (Unit: mm/s) MIN Value: -10000 MAX Value: 10000
14	Input 06	E2 Encoder3(90°) EDM1	Input	Encoder 3	
15	Input 07	F1 Encoder4(0°)	Input	Encoder 4	
16	Input 08	F2 Encoder4(90°) EDM2	Input	Encoder 4	

Fig.2.10 Encoder speed setting

Example:

The dynamic control input condition for the activation of zone group 1 is that the range of speed 1 is -1000 to 1000mm/s, and the range of speed 2 is 2000 to 10000mm/s, which can be configured as shown in Fig.2.11.

+Add -Delete * The range of speed 1 and speed 2 is : [-10000,10000]

Monitor case		Input condition				Cut-off path	
Number	Name	A	B	C	D	E	F
1	monitor case 1						

Number	Name	Input condition	Input	Encoder	Speed
1	monitor case 1				

Fig.2.11 Example of dynamic control input configuration



CAUTION

While selecting the encoder signal input on the 【Local I/O Settings】 option page, the velocity pulse value should be given to it in the pop-up dialog box. The speed range is determined by the set minimum speed of the different incremental encoders. After the speed range is set, the speed range in the monitoring case changes accordingly. A different speed range can also be set manually, but the range should not exceed the minimum and maximum speed range after pulse setting.

■ Switching zone groups by contour recognition input

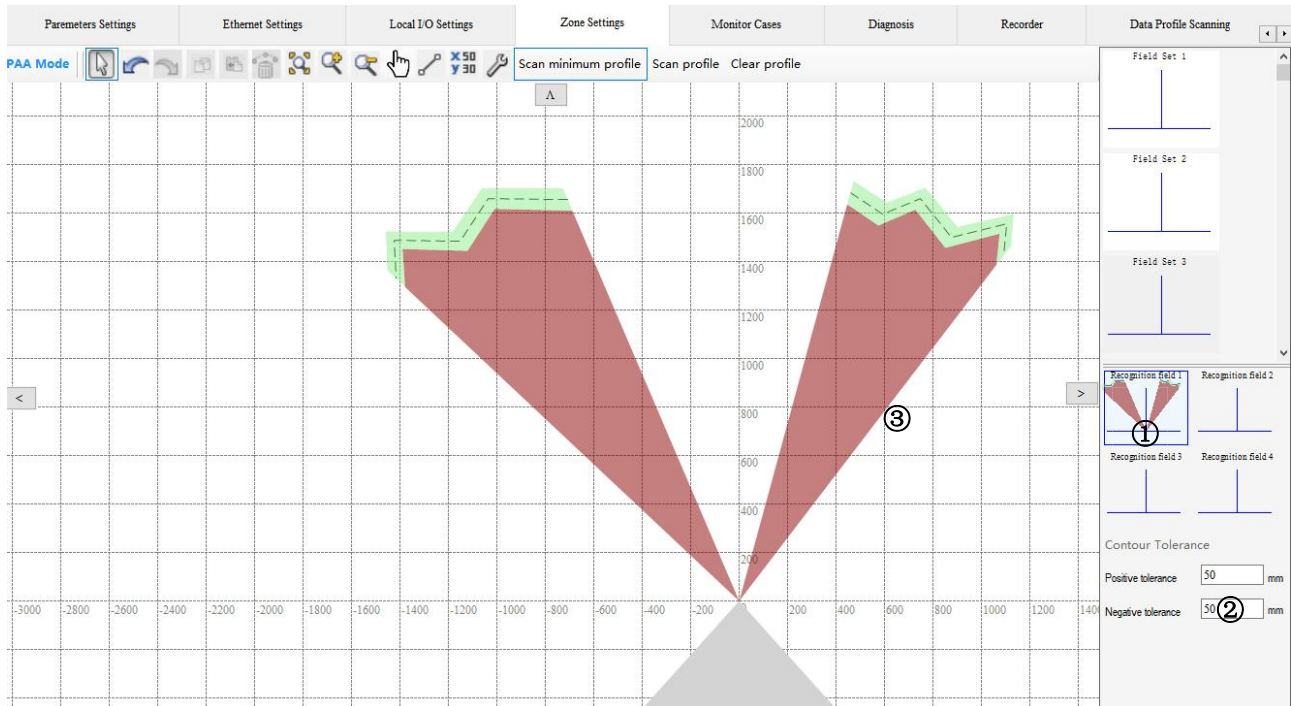
When it is necessary to monitor the surrounding contours, under the **【Monitor Cases】** option page, select the identification zone corresponding to the zone group in the drop-down list of ⑤-Contour recognition field shown in Fig.2.8, and activate it as the same monitoring case at the same time.

A maximum of 4 reference contour zones can be configured, which can be configured under the page shown in Fig.2.12.

➤ Click different contour identification zone in ①-Small view of contour recognition zone selection to draw reference contours.

➤ Enter the positive tolerance value (the tolerance away from the safety lidar) and the negative tolerance value (the tolerance towards the safety lidar) of the contour in ②-Contour tolerance zone setting field.

➤ Use the Line tool  to draw a reference contour in the ③-Reference contour drawing field.



①-Small view of contour recognition zone selection ②-Contour tolerance zone setting field

③-Reference contour drawing field

Fig.2.12 Draw reference contour

Example:

The contour recognition input condition for the activation of zone group 2 is that the scanned real-time contour matches the reference contour of the recognition zone 1, which can be configured as shown in Fig.2.13.

Monitor case		Input condition						Cut-off path						
Number	Name	A	B	C	D	E	F	Speed 1 (mm/s)	Speed 2 (mm/s)	Contour Recognition Field	Zone Group	Cut-off path		
1	monitor case 1	/	/					Not used	Not used	Recognition field 1	Zone Group 2	Protection Zone	Warning Zone 1	Warning Zone 2

Fig.2.13 Example of contour recognition input configuration



CAUTION

When selecting "Unable to match the recognition zone 1-4" for the contour identification zone, it means that the condition is satisfied when the contour scanned in real time does not match the configured reference contour.

2.4 Window contamination protection

The optical window is an important part of the KLM, and if the window is contaminated, the protection capability is diminished due to light attenuation. When the pollution is serious, the KLM will detect the pollutant as an object close to the protection zone, and the OSSD will enter the OFF state. When it is detected that the window is dirty, the nixie tube of the KLM displays .



CAUTION

- Always keep optical window clean. Whenever there is dust or contamination on the window, wipe the contamination with a soft cloth moistened with a mild detergent that will not attack polycarbonate.
- When the optical window is damaged, it should be replaced. When replacing, make sure the window is not contaminated or scratched during unpacking and installation, avoid fingerprints on the window, and replace the window in a dry, dust-free, and stain-free environment.
- Never replace the optical window during continuous operation, as dust particles could penetrate into the safety lidar.
- Avoid soiling the inside of the optical window, e.g. by fingerprints.

3. Installation and wiring



- Before installation, please read the warning information in this manual carefully to avoid personal injury caused by wrong installation!
- Make sure the controlled equipment is stopped during installation, otherwise, personal injury may occur!

3.1 Installation requirements

1) The equipment on which KLM will be installed can be easily emergency stopped at all operating points within its operating cycle, do not install KLM on equipment with irregular stop times.

2) KLM cannot be used for the hazard protection of non-electrical control equipment, otherwise, before the operator touches the dangerous parts, the controlled equipment cannot be stopped and serious injury is caused.

3) KLM does not have the function of splash protection. If there are splashes in the dangerous zone that may cause harm to the human body, a protective cover or protective net should be installed.

4) The installation result of the KLM must be such that the operator of the controlled equipment can enter or approach the hazardous zone only through the protected zone of the KLM. Absolutely avoid installations that allow the equipment operator or parts of the equipment operator's body to enter or approach the hazardous zone without passing through the KLM's protection zone, or to stay in a position between the KLM's protection zone and the hazardous zone.

3.2 Installation Tips

3.2.1 Protection from external light influence

Strong external light sources in the scan plane can influence the safety laser scanner and thus reduce the availability of the machine. Measures to increase availability:

- Avoid external light sources in the scan plane.
- Avoid direct sunlight in the scan plane.
- Do not position halogen lights, infrared light sources or stroboscopes directly on the scan plane.

3.2.2 Prevent mutual interference from safety lidar

If multiple KLM are installed, the OSSDs may go into OFF state due to mutual interference. To avoid mutual interference, the KLM should be installed as follows.

- Install shielding plates between adjacent machines.
- Offset mounting so that the scan planes are on different planes.
- Slightly inclined, tilted mounting, so that the scan planes intersect one another.

3.3 Safety distance

The safety distance varies with the specified minimum protection object and response time. The setting of the protection zone should be based on the safety distance calculated by the laws, regulations and standards of the relevant countries and regions.

CAUTION

If there is a retroreflector in the vicinity of the safety lidar, the supplement $Z_R = 350$ mm must be taken into account when calculating the safety distance.

3.3.1 Hazardous zone protection

Calculation example of the safety distance S according to ISO 13855.

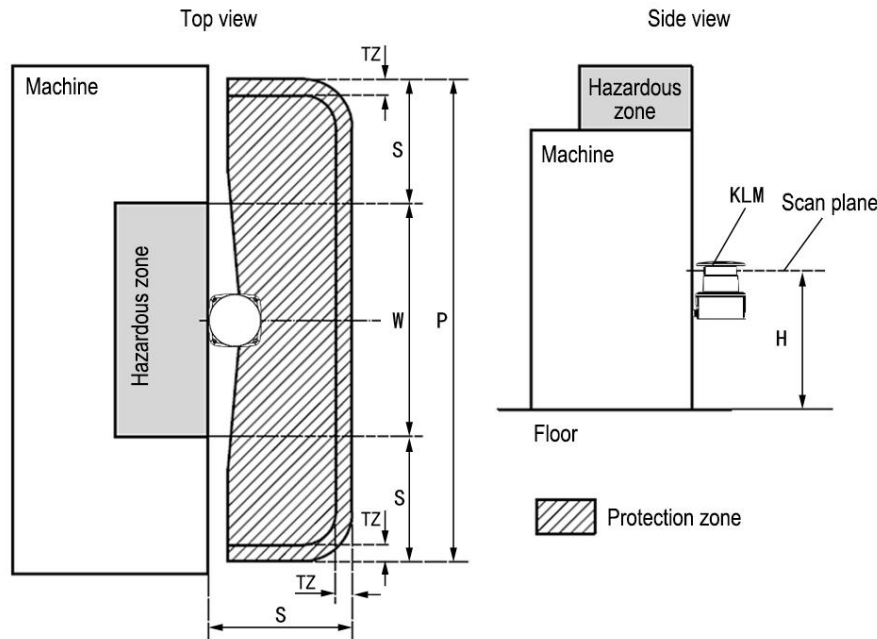


Fig.3.1 Safety distance calculation for hazardous zone protection

$$S = K \times T + C + TZ + Z_R$$

• S : Safety distance (mm)

• K : Approach speed to the protection zone (mm/s); $K=1600$ mm/s

• T : Total response time ($t_1 + t_2$) (s)

t_1 : Response time of KLM (s)

t_2 : Machine's stopping/run-down time, including response time of the machine's control system and signal propagation time (s)

• C : Supplement to protect against reaching over (mm)

If there is sufficient space in front of the hazardous zone, use $C = 1200$ mm.

If the safety distance should be as small as possible, calculate C using the following formula:

$$C = 1200 \text{ mm} - (0.4 \times H)$$

H : Height of the protection zone above the floor (mm)

If the result is $C \geq 850$ mm, then use the calculated value as supplement C .

If the result is $C < 850$ mm, then use $C = 850$ mm.

• TZ : Tolerance range of the safety laser scanner (mm); $TZ=65$ mm

- Z_R : Supplement for reflection-based measurement errors (mm); $Z_R=350\text{mm}$
- P : The width of the protection zone to be set
- W : The width of the hazardous zone

3.3.2 Access protection

Calculation example of the safety distance S according to ISO 13855.

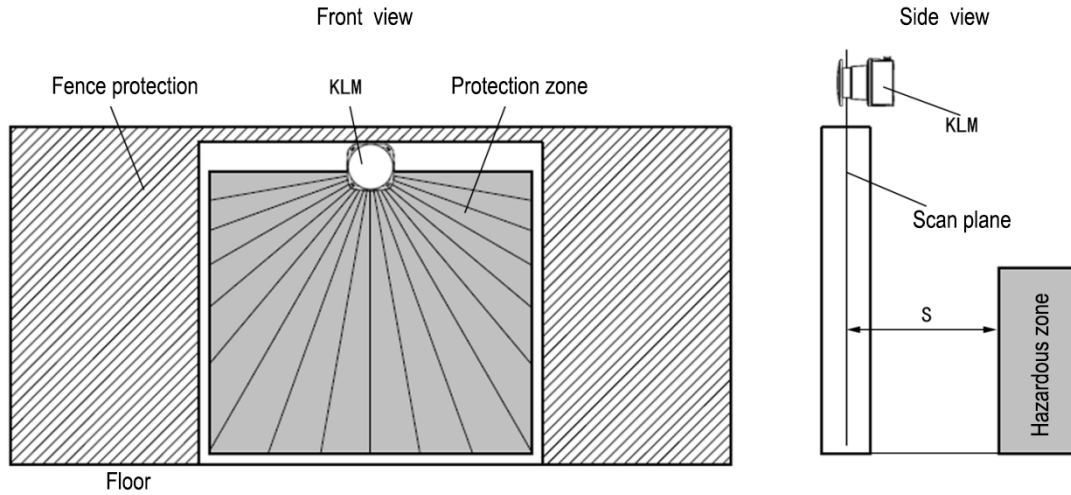


Fig.3.2 Safety distance calculation for access protection

$$S = K \times T + C$$

- S : Safety distance (mm)
- K : Approach speed to the protection zone (mm/s); $K=1600\text{ mm/s}$
- T : Total response time ($t_1 + t_2$) (s)
- t_1 : Response time of KLM (s)
- t_2 : Machine's stopping/run-down time, including response time of the machine's control system and signal propagation time (s)
- C : Supplement to protect against intrusion before the protective equipment being activated (mm); $C=850\text{ mm}$

3.3.3 Mobile hazardous zone protection (Take AGV as an example)

Calculation example for the protection zone length S_L :

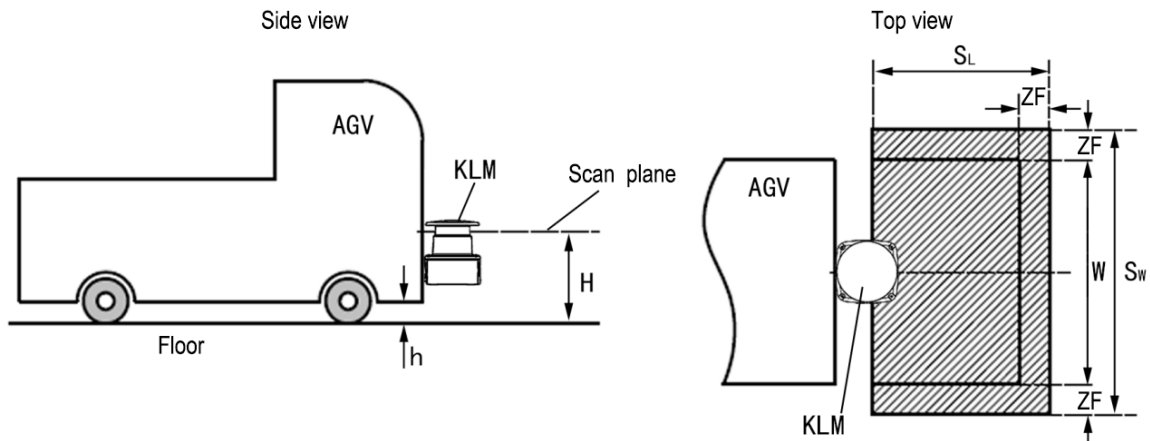


Fig.3.3 Safety distance calculation for mobile hazardous zone protection

$$S_L = V \times T + S_B \times L + TZ + Z_F$$

- S_L : Protection zone length (mm)
- V : Maximum speed of AGV (mm/s)
- T : Total response time ($t_1 + t_2$) (s)
- t_1 : Response time of KLM (s)
- t_2 : Response time of AGV (s)
- S_B : Braking distance of AGV (mm)
- L : Safety factor for AGV braking distance (based on brake wear)
- TZ : Tolerance range of the safety laser scanner (mm); $TZ=65\text{mm}$
- Z_F : Supplement for lack of ground clearance h

This supplement is necessary, because, generally, a person is detected above the foot and the braking process cannot take account of the length of the foot in front of the point of protection. A person's foot could be injured if a vehicle has no ground clearance.

The lump supplement for ground clearance under 120 mm is 150 mm. This supplement may be reduced further in individual cases, see Fig.3.4.

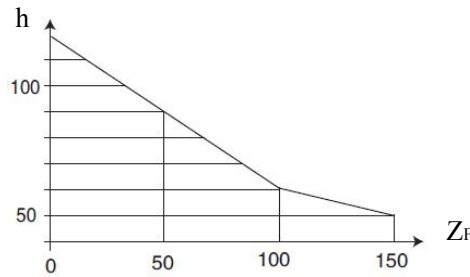


Fig.3.4 Minimum supplement for lack of ground clearance

Calculation example for the protection zone width S_W :

$$S_W = W + 2 \times (TZ + Z_F + Z_R)$$

- S_W : Protection zone width (mm)
- W : Width of AGV (mm)
- TZ : Tolerance range of the safety laser scanner (mm); $TZ=65\text{mm}$
- Z_F : Supplement for lack of ground clearance h
- Z_R : Supplement for reflection-based measurement errors (mm); $Z_R=350\text{mm}$
- H : Height of the scan plane above the floor (mm)

The scan plane must be at a maximum height of 200 mm everywhere. Otherwise, persons lying horizontally may not be detected. In many cases, a mounting height of 150 mm above the floor is suitable.

3.4 Wiring

3.4.1 Precautions

- 1) Wiring when the power of KLM must be turned OFF.
- 2) Double or reinforced insulation must be applied between the input/output interface and dangerous voltage.
- 3) Cables of KLM must be kept away from high-voltage wires and power lines.
- 4) For the occasions where 0V grounding is not allowed, KLM must be installed in isolation.
- 5) Do not short-circuit OSSDs to the 24V DC .
- 6) The two OSSDs must be used together; otherwise it may reduce the safety of the system.
- 7) It is forbidden for users to change cables without permission.
- 8) Properly perform the wiring after confirming the signal names of all the terminals.

3.4.2 Power supply

- 1) The DC power supply for KLM must meet all of the following requirements:
- 2) The output voltage is within the rated voltage range of KLM (24VDC $\pm$ 20%).
- 3) Meet the demand of load current.
- 4) Double insulation or reinforced insulation is used between the primary and secondary.
- 5) The power supply unit is able to jumper a brief power failure of 20 ms.
- 6) Dynamic characteristics of output current $\geq 1A$, with automatic recovery of overcurrent protection characteristics.
- 7) The power supply must have output overvoltage and overcurrent protection.
- 8) Must meet the user's local laws and regulations on EMC and electrical equipment safety requirements.

4. Check and maintenance

4.1 Initial check



WARNING

Make sure to test the operation of KLM after installation to verify that KLM operates as intended. Make sure to stop the machine until the test is complete. Unintended function settings may cause a person to go undetected, resulting in serious injury.

4.4.1 When perform the following operation, the initial check is needed.

- 1) Put it into use for the first time
- 2) After long machine standstill
- 3) After the controlled machine is reconfigured.
- 4) After the KLM is reconfigured.

4.4.2 The pre-check of the installation

- 1) There are no loose screws on the scanner after installation.
- 2) When the OSSD is on the OFF state, the machine controlled by the scanner stops running.
- 3) The installation of KLM should ensure that the machine operator cannot enter or be close to the danger zone if he does not pass through the protection zone.
- 4) The installation of KLM should ensure that the machine can not run if there are people or objects in the danger zone.
- 5) Ensure that calculation of the minimum safety distance conforms to the laws, regulations and standards of the countries where KLM is used.
- 6) KLM should be installed the place where there are no disturbance light (such as incandescent lamps, stroboscopic lamps).
- 7) When two or more scanners are installed in adjacent position, the measure to prevent mutual interference should be adopted.
- 8) The optical window surface is clean and there is no damage.

4.4.3 The pre-check of the Wiring

- 1) The power of KLM is $DC24V \pm 20\%$.
- 2) Both of OSSD1 and OSSD2 should be connected to the safety control system of the controlled machine.
- 3) Power supply polarity
- 4) No damage to the cable insulation.

4.4.4 The pre-check during the controlled machine stop

To ensure the normal operation of the scanner when the controlled machine is stopped, the specimen should be used to perform the following pre-check. In this case, Power should be only supplied to KLM. The specimen object should comply with size of the minimum detectable object.

- 1) When the test piece appears in the protection zone, the red stop indicator light is on. The whole protection zone should be tested.
- 2) KLM works normally after being supplied power. If no object is detected in the protection zone, the green normal indicator light is on.

4.4.5 The pre-check when operating the machine.

- 1) When the test piece appears in the protection zone, the machine will stop operating. The whole protection zone should be tested.
- 2) When the power of KLM is cut off, the controlled machine should stop running.
- 3) When output of OSSD is OFF, the controlled machine should stop operating.
- 4) The overall response time of the safety control system (from the test piece enter into the protection zone to the machine stop) should be less than the response time that is used to calculate the safety distance.

4.2 Daily check

The operator of the controlled equipment should check the safety lidar for the following items each time the equipment is re-run.

- 1) There are no loose screws on the scanner after installation.
- 2) When the OSSD is on the OFF state, the machine controlled by the scanner stops running.
- 3) The surface of optical window surface is clean and there is no damage.

4.3 Regular check

The machine administrator should perform regular check one time no more than six months. The regular check includes the following items beside the “4.2 daily check”.

- 1) To make sure the position of the lidar has not been changed.
- 2) All the wires are connected to the external device correctly, and the connection is safe and reliable.
- 3) No damage to the cable insulation.

4.4 Maintenance

4.4.1 Optical window cleaning

Depending on the ambient conditions, the optical cover must be cleaned regularly and in the event of contamination. For example, static charges can cause dust particles to be attracted to the optical cover.

Use the cleaner that can not erode polycarbonate and soft cloth to clean the window.

If the window is dirty, the protection function may be weakened due to the light attenuation. When pollution is serious, pollutants will be detected as an object in the protection zone, and the OSSD enters the OFF state. When the window pollution is detected, the nixie tube will display  .

Be sure to keep the window clean to avoid OSSD enter the OFF state unnecessarily.



CAUTION

- Do not use aggressive or abrasive cleaning agents.
- Recommendation: Use anti-static cleaning agents.

4.4.2 Optical window replacing

If the optical window is scratched or damaged, it must be replaced. Only professionally trained personnel is permitted to replace the window.

Steps to replace the optical window:

- 1) First, clean the safety laser scanner from the outside, so that no foreign bodies penetrate into the open device.
- 2) Unscrew the fixing screws for the optical window.
- 3) Slowly and carefully detach the optical window from the enclosure of the lidar.
- 4) If the sealing ring comes out of the groove of the enclosure along with the window, you should press the sealing ring into the groove again, and make sure that the sealing ring is flat and not twisted.
- 5) Take out the new optical window and assemble it to the enclosure from top to bottom in the correct direction, perpendicular to the enclosure, taking care not to let the window touch the internal parts of the lidar.
- 6) Screw on the window with the new fixing screws.



CAUTION

- Replace the optical window in a dry environment free of dust and dirt.
- Never replace the optical window during continuous operation, as dust particles could penetrate into the lidar.
- Avoid soiling the inside of the optics cover, e.g. by fingerprints.
- Mount the optics cover according to the following instructions to ensure IP65 leak tightness of the enclosure. Enclosure rating IP65 only applies if the optics cover and the system plug are mounted and the USB connection is closed with the protective cover.
- Only use a new optics cover as a replacement.
- When replacing the optical window, it is strictly forbidden to touch the light-passing surface of the new window and the internal structure of the lidar, especially the emitting and receiving lenses.
- If the sealing ring on the casing is loose, put the sealing ring in the groove specified by the casing again.



WARNING

If maintenance for optical window is not carried out correctly, persons and parts of the body to be protected may not be detected!

5. Troubleshooting

The condition display nixie tube of KLM can show the reason of the fault.

Table 5.1 Shows the common faults and solutions

Display of nixie tube	Reason	Solution
	Zone group input signal fault	Reconfigure the zone group by the configuration software and transmit to the scanner
	OSSD output error	Check whether there is a connection error, or Replace the lidar and send it to the manufacturer for repair.
	EDM fault	Check condition of contact of monitored device
	System fault	Replace the lidar and send it to the manufacturer for repair.
	Optical window dirty	Stop the machine, clean or change the optical window

6. Version

Version	Date	Modification
V1.1	2022-07	

Special dealers within the EC

Please visit the company website:

www.sdkeli.com

TEL: 86-537 2168110

FAX: 86-537 2331667

WEB: *www.sdkeli.com*

Service Tel: 400 666 0416

ADD: No.46, Haichuan Road, Jining High-Tech Zone, Shandong Province, P. R. China