

# **LBK System**

# Volumetric Safety System



# Instruction manual v1.5 - EN

**Original instructions** 



WARNING! Any who uses this system must read the instruction manual to ensure safety. Read and adhere to the "Safety information" chapter in its entirety before using the system for the first time.

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Requests for authorizations, additional copies of this manual or technical information about this manual must be addressed to:

Inxpect SpA Via Serpente, 91 25131 Brescia (BS) Italy safety-support@inxpect.com +39 030 5785105

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# **Glossary of terms**

#### D

#### Dangerous area

Area to be monitored because it is dangerous for people.

#### **Detection area**

Portion of the field of vision where detection is guaranteed.

#### F

#### **Field of vision**

Sensor area of vision. It is composed of two areas: detection area and uncertainty area. It can have two ranges: 110° and 50°.

#### **FMCW**

Frequency Modulated Continuous Wave

#### Μ

#### Machinery

The system for which the dangerous area is monitored.

#### **Monitored** area

Area that is monitored by the system. Includes the stopping area, and only for the access detection function, any pre-alarm area.

#### Ρ

#### Pre-alarm area

Only for the access detection function. Area where motion detection triggers the closure of the dedicated auxiliary relay.

#### R

#### Rotation

Sensor rotation around the transverse axis. The sensor inclination is the angle between the center of the field of vision of the sensor and a line parallel to the ground.

#### S

#### **Stopping area**

Portion of the area monitored by the sensor where, if motion is detected, the system safety relays are de-energized. If it does not correspond to the dangerous area defined in the risk assessment, the residual risk must be calculated and additional safety measures must be introduced.

#### Tolerance area

Portion of the monitored area where detection is not guaranteed.

#### U

Т

Uncertainty area

Area of the field of vision where detection or not of an object depends on the characteristics of the same object.

# 1. This manual

## **1.1 Information on this manual**

#### **1.1.1** Objectives of this instruction manual

This manual explains how to integrate LBK System for safeguarding machinery operators and how to install it, use it and maintain it safely.

These instructions do not pertain to the functioning of the machinery where LBK System is installed.

### 1.1.2 Obligations with regard to this manual



**NOTICE**: this manual is an integral part of the product and must be kept for its entire working life. It must be consulted for all situations related to the life cycle of the product, from its delivery to decommissioning.

It must be conserved so that it is accessible to operators, in a clean location and in good condition. In the event of manual loss or damage, contact Customer Assistance Service. Always enclose the manual when the equipment is sold.

## **1.1.3 Provided documentation**

Document	Code	Date	Distribution format
Instruction manual (this	LBK-System_	AUG	hard copy
manual)	instructions_en v1.5	2020	online PDF
			PDF downloadable from the site www.inxpect.com/industrial/tools
Instruction manual to interact with Inxpect Safety	LBK-app_ instructions_en v1.5	JAN 2020	the online help accessible from the application Inxpect Safety

### **1.1.4 Instruction manual updates**

Publication date	Code	Updates
AUG 2020	LBK-System_ instructions_	Updated "Restart prevention function" on page 20, "System log" on page 58, and "Technical data" on page 64
	en v1.5	Added "Digital input signals" on page 74
		Other minor additions and changes
JAN 2020	LBK-System_	Added "Safety symbols on the product" on page 8
	instructions_ en v1.4	Added RoHS2 China
		Updated configuration descriptions in "Calculation of position for sensor height $\leq$ 1 m" on page 30
		Added "Machinery maintenance technician" on page 57
		Updated "Event log management" on page 58
		Added " Configuration error (FEE ERROR)" on page 61
		Updated data in "Technical data" on page 64
		Updated the grounding symbol in "Terminal blocks and connectors pin-outs" on page 66 and "Electrical connections" on page 68
		Other minor changes

Publication date	Code	Updates
SEP 2019	LBK-System_ instructions_ en v1.3	Added formulas to calculate the real alarm distance (installation < 1m "Calculate the real alarm distance" on page 34 and installation > 1m "Calculate the real alarm distance" on page 36)
		Added topic "Safety functions" on page 19
		Added table "Default values" on page 72
		Integrated restart prevention function ("Restart prevention function" on page 20)
		Added anti-masking function sensitivity levels ("Sensitivity level" on page 25)
		Integrated anti-tampering function: considered rotations, disabling and checks ("Anti-tampering functions: anti-rotation around axes (accelerometer)" on page 24)
		Added reference to Metal protector kit
		Integrated muting function: signal characteristics ("Enable muting signal characteristics" on page 23)
		Integrated restrictions and conformity notes "Conformity" on page 10
		Updated procedure "Define the working frequency of the sensors" on page 48
		Alignment with new application version Inxpect Safety
		Access detection security function renamed
		Other minor changes
FEB 2019	LBK-System_	Added 50° field of vision ("Sensor field of vision" on page 28)
	it v1.2	Added application validation procedure Inxpect Safety ("Validate the safety functions" on page 53)
		Updated contents for installation of sensors at heights over 1 m
		Integration for masking signals ("Anti-tampering functions: anti-masking" on page 24)
		Added formulas for calculation of sensor position ("Calculation of position for sensor height > 1 m" on page 35
		Reorganization of topics
SEP 2018	LBK-System_ instructions_	"Anti-tampering functions: anti-rotation around axes (accelerometer)" on page 24
	en v1.1	Changed and integrated the section "Applications" on page 38
		Added working frequency setting
		Changed voltage and current values for safety relays
JUN 2018	LBK-System_ instructions_ en v1.0	First publication

#### **1.1.5** Intended users of this instruction manual

The recipients of the instruction manual are:

- The machinery manufacturer onto which the system will be installed
  System installer
  Machinery maintenance technician

# 2. SAFETY

# **2.1 Safety information**

## 2.1.1 SAFETY MESSAGES

Warnings related to safety of the user and equipment as envisaged in this document are as follows:

WARNING! indicates a hazardous situation which, if not avoided, may cause death or serious injury.

**NOTICE**: indicates obligations that if not observed may cause harm to the equipment.

#### 2.1.2 Safety symbols on the product

This symbol marked on the product indicates that the manual must be consulted. In particular, pay attention to the following activities:

- wiring of the connections (see "Terminal blocks and connectors pin-outs" on page 66 and "Electrical connections" on page 68)
- cable operating temperature (see "Terminal blocks and connectors pin-outs" on page 66)
- controller cover, which was subjected to an impact test at low energy (see "Technical data" on page 64)

## 2.1.3 PERSONNEL SKILLS

The recipients of this manual and the skills required for each activity presented herein are as follows:

Recipient	Assignments	Skills
Machinery manufacturer	• Defines which protective devices should be installed and installation specifications	<ul> <li>Knowledge of significant hazards of the machinery that must be mitigated based on risk assessment.</li> <li>Knowledge of the entire machinery safety system and the system on which it is installed.</li> </ul>
Protection system installer	<ul> <li>Installs the system</li> <li>Configures the system</li> <li>Prints configuration report</li> </ul>	<ul> <li>Advanced technical knowledge in the electrical and industrial safety fields</li> <li>Knowledge of the dimensions of the dangerous area of the machinery to be monitored</li> <li>Receives instructions from the machinery manufacturer</li> </ul>
Machinery maintenance technician	Performs maintenance on the system	<ul> <li>Advanced technical knowledge in the electrical and industrial safety fields</li> </ul>

#### 2.1.4 INTENDED USE

LBK System is certified as SIL 2 according to IEC/EN 62061 and PL d in accordance with EN ISO 13849-1. Performs the following safety functions:

- access detection function: prevents access to a dangerous area. Access to the area de-energizes the safety relays to stop the machinery's moving parts.
- **restart prevention function**: prevents unexpected starting or restarting of the machinery. Detection of motion within the dangerous area maintains the safety relays de-energized to prevent machinery starting.

LBK System is suitable for protecting the entire body.

LBK System has been designed to monitor dangerous areas in industrial environments. Thanks to IP67 protection grade, the sensors are suitable for indoor and outdoor installations. The sensor LBK-S01 is also a type 3 enclosure, according to UL 50E.

#### 2.1.5 GENERAL WARNINGS

- Incorrect installation and configuration of the system decreases or inhibits the protective function of the system. Follow the instructions provided in this manual for correct installation, configuration and validation of the system.
- Changes to the system configuration may compromise the protective function of the system. After any changes made to the configuration, validate correct functioning of the system by following the instructions provided in this manual.
- If the system configuration allows access to the dangerous area without detection, implement additional safety measures (e.g. guards).
- The presence of static objects, in particular metallic objects, within the field of vision may limit the efficiency of sensor detection. Keep the sensor field of vision unobstructed.
- The system protection level (SIL 2, PL d) must be compatible with the requirements set forth in the risk assessment.
- Check that the temperature of the areas where the system is stored and installed is compatible with the storage and operating temperatures indicated in the technical data of this manual.

### 2.1.6 WARNINGS FOR THE RESTART PREVENTION FUNCTION

- The restart prevention function is not guaranteed in blind spots. If required by the risk assessment, implement adequate safety measures in those areas.
- Machinery restarting must be enabled only in safe conditions. The restart enable button must be installed:
   outside of the dangerous area
  - not accessible from the dangerous area
  - in a point where the dangerous area is fully visible

#### 2.1.7 RESPONSIBILITY

The machinery manufacturer and system installer are responsible for the operations listed below:

- Providing adequate integration of the system's outgoing signals (both safety and auxiliary).
- Checking the monitored area of the system and validating it based on the needs of the application and risk assessment. Following the instructions provided in this manual.

## 2.1.8 LIMITS

- The system cannot detect the presence of people who are immobile and not breathing or objects within the dangerous area.
- The system does not offer protection from pieces ejected from the machinery, from radiation, and objects falling from above.
- The machinery command must be electronically controlled.

# 2.2 Conformity

#### 2.2.1 STANDARDS AND DIRECTIVES

Directives	2006/42/EC (MD - Machinery)
	2014/53/EU (RED - Radio equipment)
Standards	IEC/EN 62061: 2005 SIL 2
	EN ISO 13849-1: 2015 PL d
	EN ISO 13849-2: 2012
	IEC/EN 61496-1: 2013
	IEC/EN 61508: 2010 Part 1-7 SIL 2
	ETSI EN 300 440 v2.1.1
	ETSI EN 301 489-1 v2.2.0 (only emissions)
	ETSI EN 301 489-3 v2.1.1 (only emissions)
	IEC/EN 61326-3-1:2017
	IEC/EN 61010-1: 2010
	UL/CSA 61010-1

Note: no type of failure has been excluded during the system analysis and design phase.

#### 2.2.2 CE

The manufacturer, Inxpect SpA, states that LBK System type of radio equipment complies with the 2014/53/EU and 2006/42/CE directives. The full EU declaration of conformity text is available on the company's website at the address: www.inxpect.com.

At the same address all updated certifications are available for download.

#### 2.2.3 FCC

LBK System complies with FCC CFR title 47, part 15, subpart B. It contains FCC ID: UXS-SMR-3X4.

Operation is subject to the following two conditions:

- this device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation

**NOTICE**: changes or modifications made to this equipment and not explicitly approved by Inxpect SpA may void the FCC authorization to operate this equipment.

#### 2.2.4 INDUSTRY CANADA

en This device contains licence-exempt radio apparatus that complies with Innovation, Science and Economic Development Canada's RSS-310.

Operation is subject to the following conditions:

- this device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation.

fr L'appareil radio exempt de licence contenu dans le present appareil est conforme aux CNR d'Innovation, Sciences et Developpement economique Canada RSS-310.

L'exploitation est autorisee aux deux conditions suivantes :

- L'appareil ne doit pas produire de brouillage;
- L'appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.

#### 2.2.5 SRRC

LBK-S01 is a micro-power (short range) radio transmission equipment, type G, and does not require any type approval.

zh-CN LBK-S01是一种微功率(近程)无线电传输设备,G型,不需要任何类型认可。

#### 2.2.6 IMDA

Complies with IMDA Standards DA103787

#### 2.2.7 NCC

en The use of low-power RF devices shall not affect flight safety or interfere with legal communications; if interference is found, the user should stop using the device immediately and improve it until there is no interference.

Legal communication in the preceding paragraph refers to radio communications operating in accordance with the provisions of the Telecommunications Act. Low-power RF devices must withstand interference from legitimate communications or radio electrical equipment for industrial, scientific, and medical use.

**zh-TW** 低功率射頻電機之使用不得影響飛航安全及干擾合法通信;經發現有干擾現象時,應立即停用,並改善至無干擾時方得繼續使用。

前項合法通信,指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

#### 2.2.8 ICASA

ιςνεν

APPROVED

#### 2.2.9 ROHS2 CHINA

TA 2019-5126



According to the SJ/T 11364-2014 Standard of the People's Republic of China for the Electronic Industry.

#### Model: LBK-C22, LBK-S01

	Hazardous substances							
Component name	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr (VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)		
Aluminum, steel, copper alloy	Х	0	0	0	0	0		
Electrical contacts	0	0	Х	0	0	0		
Printed board assembly	Х	0	Х	0	0	0		
Plastics	0	0	0	0	0	0		

.

This table was developed according to the provisions of SJ/T 11364.

**O**: The content of such hazardous substance in all homogeneous materials of such component **is below** the limit required by GB/T 26572.

**X**: The content of such hazardous substance in all homogeneous materials of such component **is beyond** the limit required by GB/T 26572. Exemptions according to EU RoHS 2011/65 Annex III and IV might be applied.

This statement is based on information and data provided by third parties and may not have been verified through destructive testing methods or other chemical analysis.

**zh-CN** 本表格依据中华人民共和国SJ/T11364的规定编制。

模型:LBK-C22,LBK-S01

			有害	物质		
部件名称	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr (VI))	多溴联苯 (PBB)	多溴二苯 醚 (PBDE)
铝、铁、铜合金	Х	0	0	0	0	0
电触头	0	0	Х	0	0	0
印制板装置	Х	0	Х	0	0	0
塑料制品	0	0	0	0	0	0

本表格依据SJ/T11364的规定规制。

0:表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。

X:表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。根据欧盟 RoHS 2011/65的附件III和IV豁免可能适用

本声明基于第三方提供的信息和数据,可能未经破坏性检测方法或其他化学分析进行验证。

# 2.3 National restrictions

#### 2.3.1 FRANCE AND THE UNITED KINGDOM

LBK System is a short-range device in class 2 in accordance with the directive 2014/53/EU (RED - Radio equipment) and is subject to the following restrictions:

<b>B</b> /	FR	UK
------------	----	----

en

Restrictions in UK. In the United Kingdom, the national allocation of frequencies does not allow the free use of the whole band 24-24.25 GHz. Set the authorized band in the Inxpect Safety application.

fr Restrictions en FR. En France, la répartition nationale des fréquences ne permet pas l'utilisation libre de la totalité de la bande 24-24,25 GHz. Définissez correctement le pays dans l'application Inxpect Safety et la bande autorisée 24,05-24,25 GHz sera automatiquement sélectionnée.

#### 2.3.2 JAPAN

en Restrictions in Japan. In Japan, the national allocation of frequencies does not allow the free use of the whole band 24-24.25 GHz. Set the country correctly in the Inxpect Safety application and the authorized band 24.05-24.25 GHz will be automatically selected.

ja 日本における制限。日本では、全国的な周波数割り当てでは、24~24.25 GHzの全帯域を自由に使用 することはできません。Inxpect Safety アプリケーションで国を正し、設定すると、許可された帯域24.05-24.25 GHzが 自動的に選択されます。

#### 2.3.3 SOUTH KOREA

en Restrictions in South Korea. In South Korea, the national allocation of frequencies does not allow the free use of the whole band 24-24.25 GHz. Set the country correctly in the Inxpect Safety application and the authorized band 24.05-24.25 GHz will be automatically selected.

ko 한국의 제한. 한국에서는 국가의 주파수 할당 규정에 따라 24-24.25 GHz 전체 주파수 대역을 무료로 사용하는 것을 허용하지 않는다. Inxpect Safety 응용프로그램에서 올바른 국가를 설정하면 승인된 대역 24.05-24.25 GHz 가 자동으로 선택된다.

#### 2.3.4 ARGENTINA

en Restrictions in Argentina. In Argentina, the national allocation of frequencies does not allow the free use of the whole band 24-24.25 GHz. Set the authorized band in the Inxpect Safety application.

es-AR Restricciones en Argentina. La atribución de las bandas de frecuencia en la República Argentina no permite el uso libre de toda la banda de 24-24,25 GHz. Configure correctamente el país en la aplicación Inxpect Safety y la banda autorizada 24,05-24,25 GHz se seleccionará automáticamente.

#### 2.3.5 MEXICO

en Restrictions in Mexico. In Mexico, the national allocation of frequencies does not allow the free use of the whole band 24-24.25 GHz. Set the country correctly in the Inxpect Safety application and the authorized band 24.05-24.25 GHz will be automatically selected.

es-MX Restricciones en México. La atribución de las bandas de frecuencia en México no permite el uso libre de toda la banda de 24-24,25 GHz. Configure correctamente el país en la aplicación Inxpect Safety y la banda autorizada 24,05-24,25 GHz se seleccionará automáticamente.

#### 2.3.6 CHINA

en Restrictions in China. Use in China is strictly linked to compliance with the temperature range of operation, which can not fall below 0° C or 32° F.

zh-CN 中国的限制。在中国使用须严格符合操作温度范围,不能低于0°C或32°F。

# 3. Get to know LBK System

#### Contents

This section includes the following topics:

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3.2	Controller LBK-C22	15
3.3	Sensors LBK-S01	17
3.4	Inxpect Safety application	18

## 3.1 LBK System

## 3.1.1 Safety functions

LBK System is an active protection radar system that monitors the dangerous areas of machinery. It can perform two safety functions (see "Safety functions" on page 19):

- **access detection function**: it places the machinery in a safe condition when someone enters the dangerous area
- restart prevention function: it inhibits the machinery restart if there are people in the dangerous area

## 3.1.2 Inputs and outputs

Thanks to its digital inputs and outputs, LBK System provides an automatic control system that manages the primary safety functions of the machinery.

In addition to safety outputs, the system is also fitted with two configurable auxiliary outputs (failure, prealarm and muting status) and three digital inputs (emergency button, restart enable button and muting).

### 3.1.3 Special features

Some of the special features of this protection system are the following:

- immunity to dust and smoke
- reduction of undesired alarms caused by the presence of water or processing waste
- pre-alarm area to signal proximity or prepare the machinery for stopping
- three configurable sensitivity levels
- muting on the entire system or only on some sensors

#### 3.1.4 Main components

LBK System is composed of a controller and up to six sensors. The Inxpect Safety software application allows system operation configuration and checks.



#### 3.1.5 Controller - sensors communication

The sensors communicate with the controller via CAN bus using diagnostic mechanisms in compliance with standard EN 50325-5 to guarantee SIL 2 and PL d.

For correct functioning, each sensor must be assigned an identification (ID). Two sensors on the same bus must have different IDs.

The default settings for the sensors is ID = 0, or no assigned ID.

#### **3.1.6 Applications**

LBK System integrates with the machinery control system: when performing safety functions or detecting failures, LBK System de-energizes the safety relays and keeps them de-energized, so the control system can put the area into a safe condition and/or prevent restarting of the machinery.

In the absence of other control systems, LBK System can be connected to the devices that control the power supply or machinery start-up (e.g. external relays on the power supply line).

LBK System does not perform normal machinery control functions.

For connection examples, see "Electrical connections" on page 68.

## **3.2 Controller LBK-C22**

#### 3.2.1 Functions

The controller performs the following functions:

- Collects information from all the sensors via CAN bus.
- Compares the position of detected motion with the set stopping and pre-alarm thresholds.
- De-energizes the safety output relays when at least one sensor detects motion in the stopping area.
- De-energizes the safety output relays if a failure is detected in the sensor or the controller.
- Manages the auxiliary inputs and outputs (to learn about the functions see "Auxiliary outputs" on the next page and "Digital inputs" on the next page).
- Communicates with the Inxpect Safety software for all configuration and diagnostic functions.

#### 3.2.2 Structure



Part	Description
Α	DIP switch to include/exclude the termination resistance:
	<ul> <li>On (default) = resistance included</li> <li>Off = resistance excluded</li> </ul>
В	Digital inputs status LED
С	Sensors CAN bus terminal block
D	Micro USB port for connecting the computer and communicating with the Inxpect Safety software
E	Safety outputs status LED
F	Auxiliary outputs status LED
G	Power supply terminal block
н	Digital inputs terminal block

Part	Description
I	System status LED
L	Safety outputs terminal block
М	Auxiliary outputs terminal block

### 3.2.3 System status LED

The LEDs are each dedicated to a sensor, and can display the following statuses:

Status	Meaning
Green	Normal sensor function and no motion detected
Orange	Normal sensor function and some motion detected
Flashing red	Sensor in error. See "Controller LED" on page 57
Steady red	System error. See "Controller LED" on page 57

### 3.2.4 Inputs and outputs status LED

The meaning of the LEDs when they are on is as follows:

LED	Meaning
Safety output	Energized relay (closed contact)
Auxiliary output	Energized relay (closed contact)
Digital input	High logic level (1)

### 3.2.5 Safety outputs

The controller has one dual channel safety output realized with forced guided safety relays for alarms and, direct or indirect, safety of the machinery.

#### 3.2.6 Safety outputs status

The relay contacts are normally open. The statuses of the safety outputs are as follows:

- de-energized relay (open contact):
  - motion detected in stopping area or
  - failure detected in system
- energized relay (contact closed): no motion detected and normal functioning

### 3.2.7 Auxiliary outputs

The controller has two relay outputs, which can be configured via the Inxpect Safety application, for:

- pre-alarm
- failure
- muting status

#### 3.2.8 Auxiliary outputs status

The statuses of the auxiliary outputs are as follows:

Output	De-energized relay (open contact)	Energized relay (closed contact)
Pre-alarm	No motion detected in the pre-alarm area	Motion detected in the pre-alarm area
Failure	Failure	Normal functioning
Muting status	Muting disabled	Muting enabled

## 3.2.9 Digital inputs

The controller has three dual channel digital inputs and common reference potential for:

• muting function (signal with characteristics according to the parameters set = muting enabled, see "Enable muting signal characteristics" on page 23)

- machinery emergency button (low logic level (0) = stopping enabled)
- button for enabling machinery restart (high logic level (1) for 400 ms and transition to low logic level (0) = restart enabled)

The inputs are type1, type 2 and type 3 (see "Voltage and current limits for digital inputs" on page 67).

The function of the inputs can be configured through the Inxpect Safety application.

#### 3.2.10 SNS input

The controller also has an **SNS** input (high logic level (1) = 24 V) to check the correct functioning of the chip that detects the status of the inputs.

**NOTICE**: if at least one input is connected, the SNS input must also be connected.

## 3.3 Sensors LBK-S01

#### 3.3.1 Functions

The sensors perform the following functions:

- Detect motion in their field of vision.
- Send the motion detection signal to the controller through CAN bus.
- Signal failures detected in diagnostics on the controller through CAN bus.

#### 3.3.2 Structure



Part	Description		
Α	Sensor		
В	Screws for fastening the sensor at a specific inclination		
С	Perforated bracket for installing the sensor on the ground or on the machinery		
D	Status LED		
E	Connectors for connecting the sensors in a chain and to the controller		

#### 3.3.3 Status LED

Status	Meaning
Steady on	Normal functioning and no motion detected
Rapid flashing on (100 ms)	Normal functioning and motion detected
Other conditions	Error. See "Sensor LED" on page 57

# 3.4 Inxpect Safety application

#### 3.4.1 Functions

The application permits the following main functions to be performed:

- Configure the system.
- Print configuration report.
- Check system functioning.
- Download system log.

WARNING! The Inxpect Safety application must be used only for the system configuration and for the first validation. It cannot be used for monitoring the system continuously during the regular operation of the machinery.

#### 3.4.2 Access

The application can be downloaded free of charge at www.inxpect.com/industrial/tools.

To use the application, the computer must be connected to a LBK-C22 controller using a data micro-USB cable.

Some functions are password protected. The password can be set through the application and then saved on the controller. The available functions according to access type are presented as follows:

Available functions	Access type
<ul> <li>Display the system status (Dashboard)</li> <li>Display the sensors configuration (Configuration)</li> <li>Perform a periodic test (Maintenance)</li> <li>Download the system log and display the reports (Settings &gt; Activity History)</li> <li>Restore factory default settings (Settings &gt; General)</li> <li>Back up the configuration (Settings &gt; General)</li> <li>Validate the system (Validation)</li> </ul>	without password
<ul> <li>All the available functions without password</li> <li>Configure the system (Configuration and Settings)</li> <li>Load a configuration (Settings &gt; General)</li> <li>Change the access password (Settings &gt; User account)</li> <li>Update the firmware (Settings &gt; General)</li> </ul>	with password

#### 3.4.3 Main menu

Page	Function		
Dashboard	Display main information on the configured system.		
Configuration	Define the configuration of the sensors and monitored area.		
Validation	Start the validation procedure.		
Maintenance	Start the wizard for periodic test.		
	Display the date of the next scheduled periodic test.		
	Display the performed periodic tests report.		
Settings	Configure the sensors.		
	Configure the auxiliary inputs and outputs function.		
	Update the firmware.		
	Perform the configuration backup and load a configuration.		
	Download the log.		
	Other general functions.		
5	Ignore unsaved changes.		
Login	Enable access to the configuration functions. Password required.		

# 4. Functioning principles

#### Contents

This section includes the following topics:

4.1	Sensor functioning principles	
4.2	Safety functions	
4.3	Access detection function	
4.4	Restart prevention function	
4.5	Muting	22
4.6	Anti-tampering functions: anti-rotation around axes (accelerometer)	24
4.7	Anti-tampering functions: anti-masking	24

# **4.1 Sensor functioning principles**

#### 4.1.1 Introduction

The LBK-S01 sensor is an FMCW (Frequency Modulated Continuous Wave) radar device based on a proprietary detection algorithm. The sensor sends impulses and obtains information, analyzing the reflection of the objects that it encounters.

### 4.1.2 Factors that influence the reflected signal

The signal reflected by the object depends on several characteristics of the same object:

- material: metallic objects have a very high reflection coefficient, while paper and plastic reflect only a small portion of the signal.
- surface exposed to the sensor: the greater the surface exposed to the radar, the greater the reflected signal.
- position with respect to the sensor: objects positioned perfectly in front of the radar generate a greater signal with respect to side objects.
- motion speed: the faster the motion of the object, the greater the reflected signal

All these factors have been analyzed during the safety validation of LBK System and cannot lead to a dangerous situation. These factors may occasionally influence the behavior of the system causing spurious activation of the safety function.

This behavior can be minimized with an ad hoc installation and a metal protector kit.

### 4.1.3 Signaled and missed objects

The signal analysis algorithm takes into consideration only those objects that move within the field of vision, ignoring completely static objects.

Furthermore, a *falling objects* filtering algorithm allows ignoring undesired alarms generated by work waste products that fall within the field of vision of the sensor.

# 4.2 Safety functions

#### 4.2.1 Default operation

In LBK System's default operation all sensors perform both safety functions:

- the sensor performs the access detection function ("Access detection function" on the next page) when it is in normal operation (status No alarm)
- the sensor performs the restart prevention function ("Restart prevention function" on the next page) when in alarm status for access detection (status **Alarm**)

## **4.2.2 Selectable safety functions**

In the manual system configuration via the Inxpect Safety application, you can select which safety functions each sensor performs:

- Both (default)
- Always access detection: even when the system is in Alarm status, the sensor has the field of vision and the sensitivity of the No alarm status.
- Always restart prevention: even when the system is in **No alarm** status, the sensor has the field of vision and the sensitivity of the Alarm status

For example, if a sensor is set up with a 50° field of vision and safety function **Always access detection**, the sensor will have a 50° field of vision both in the **Alarm** status and in the **No alarm** status.

WARNING! If the access detection function is always selected, additional safety measures must be introduced to ensure the restart prevention function.

Note: in the linear barrier configuration, both functions are selected by default.

## 4.3 Access detection function

#### 4.3.1 Description

The function de-energizes the safety relays and prevents the machinery from restarting if motion is detected in the system stopping area.

For the access detection function the sensor can be set with a 50° or a 110° field of vision. For details, see "Sensor field of vision" on page 28.



WARNING! The stopping area may not correspond to the defined dangerous area according to the risk assessment. Calculate the actual dimensions based on the field of vision of the single sensor (see "Sensor position" on page 27) and perform the validation of the function (see "Validate the safety functions" on page 53). If necessary, implement additional safety measures.

**Note**: for linear barrier application, the stopping area is calculated automatically by the Inxpect Safety application based on the set dimensions of the dangerous area and the configuration of the sensors.

### 4.3.2 Pre-alarm area

A pre-alarm area can be configured where, if the machinery is functioning and the system detects motion, the dedicated auxiliary output relay closes. For example, this is useful for connecting a light or acoustic signal. The pre-alarm area is defined through the Inxpect Safety application.

# 4.4 Restart prevention function

### 4.4.1 Description

The function maintains safety relays de-energized and prevents the machinery from restarting if motion is detected in the system stopping area.

The function detects motions of just a few millimeters, such as breathing motions (with normal breathing or apnea of no more than 5 seconds), and the motions necessary for a person to remain in balance in an upright or squatting position.

The system sensitivity is higher than the sensitivity that characterizes the access detection function. For this reason, the system reaction to vibrating and moving parts is different.



WARNING! The stopping area may not correspond to the defined dangerous area according to the risk assessment. Calculate the actual dimensions based on the field of vision of the single sensor (see "Sensor position" on page 27) and perform the validation of the function (see "Validate the safety functions" on page 53). If necessary, implement additional safety measures.

**Note**: for linear barrier application, the stopping area is calculated automatically by the Inxpect Safety application based on the set dimensions of the dangerous area and the configuration of the sensors.

## 4.4.2 Function limits

The coverage of the restart prevention function is defined by the geometry of the field of vision. The field of vision of the sensor depends on the inclination and height of the sensor installation, see "Sensor position" on

page 27.

During the restart prevention function, that only occurs in Both (default) and Always restart prevention safety functions, all the sensors have a 110° angular coverage, regardless of the set angular coverages.

**NOTICE**: during the configuration phase, take this aspect into consideration to avoid generating undesired alarms.

#### 4.4.3 Cases of non-guaranteed function

The function is not guaranteed in the following cases:

- there are objects that limit or prevent the sensor from detecting motion, particularly if the limitation lasts longer than the delay time set (parameter **Restart timeout**).
- the sensor does not detect a sufficient portion of the body, for example if it detects the limbs but not the torso of a person sitting **[A]**, lying down **[B]** or leaning **[C]**.



WARNING! The position of the person is determined by the position of his or her center of gravity. This function is not guaranteed if a person has body parts within the sensor field of vision but the axis of the person's center of gravity is outside that field.

Only when there are no restrictions does the function ensure that a person is detected when standing up [D].



## 4.4.4 Types of managed restart

**NOTICE**: it is the responsibility of the machinery manufacturer to assess if automatic restart prevention can guarantee the same level of safety as manual restart (as defined in standard EN ISO 13849-1:2015, section 5.2.2).

The system manages three types of restart prevention:

Туре	Conditions for enabling machinery restart	
Automatic	The time interval set through the Inxpect Safety application ( <b>Restart timeout</b> ) has passed since the last motion detection*.	
Manual	The status of the restart enable button indicates that the restart is enabled**.	
Safe manual	<ol> <li>The time interval set through the Inxpect Safety application (<b>Restart timeout</b>) has passed since the last motion detection* and</li> <li>the status of the restart enable button indicates that the restart is enabled**.</li> </ol>	

*Note \**: machinery restart is enabled if no motion is detected up to 50 cm beyond the stopping area.

**Note \*\***: high logic level (1) for 200 ms of both digital input channels, and transition to low logic level (0) of at least one channel = restart enabled.

#### 4.4.5 Precautions for preventing undesired restarting

To prevent undesired restarting the following rules must be followed:

- the set restart timeout must be greater than or equal to 10 s.
- if the sensor is installed at a height of less than 30 cm from the ground, a minimum distance of 30 cm from the sensor must be guaranteed.

### **4.4.6 Enable the restart prevention function**

Туре	Procedure		
Automatic	In the Inxpect Safety application <b>Settings</b> > <b>Sensors</b> , set the <b>Restart timeout</b> .		
Manual	<ol> <li>Connect the machinery restart enable button conveniently, see "Electrical connections" on page 68.</li> <li>In the Inxpect Safety application Settings &gt; Sensors, set Restart timeout = 0.</li> </ol>		
Safe manual	<ol> <li>Connect the machinery restart enable button conveniently, see "Electrical connections" on page 68.</li> <li>In the Inxpect Safety application Settings &gt; Sensors, set the Restart timeout.</li> </ol>		

## 4.5 Muting

## 4.5.1 Description

Muting temporarily suspends the safety functions. Motion detection is disabled and therefore the controller maintains the safety outputs in an energized state even when the sensors detect motion in the stopping area.

## 4.5.2 Muting enabling

The muting function can be enabled as follows:

- through digital input (see "Enable muting signal characteristics" on the next page) for all the sensors simultaneously or only for a group of sensors
- only when no movement is detected in the area

Up to three groups can be configured, each associated to a digital input.

Through the Inxpect Safety application, the following must be defined:

- for each input, the group of managed sensors
- for each group, the sensors that belong to it

See "Configure the auxiliary inputs and outputs" on page 48.



WARNING! If the manual or the safe manual restart prevention function is used, in order to enable the muting function it is also necessary to push the restart enable button.

	Group 1	Group 2	Group 3
Sensor 1	$\oslash$	0	0
Sensor 2	$\oslash$	0	0
Sensor 3	0	$\odot$	0
Sensor 4	0	0	$\oslash$
Sensor 5	0	0	$\oslash$

#### 4.5.3 Example of association of sensors - groups

#### 4.5.4 Example of association of digital inputs - groups

Digital Input #1	Muting group 1	•
Digital Input #2	Muting group 2	•
Digital Input #3	Muting group 3	•

#### 4.5.5 Enable muting signal characteristics

The muting function is enabled only if both logic signals of the dedicated input meet certain characteristics. Below is a graphic representation of the signal characteristics.



In the **Inxpect Safety** application, in **Settings** > **Digital Input-Output** it is necessary to set the parameters that define the characteristics of the signal.

Note: with pulse duration = 0, it is sufficient that the input signals are at high logic level (1) to enable muting.

### 4.5.6 Muting status

Any auxiliary output dedicated to the muting status is closed if at least one of the groups of sensors is in muting.

**NOTICE**: it is the responsibility of the machinery manufacturer to assess whether the indication of the muting status is necessary (as defined in section 5.2.5 of EN ISO 13849-1:2015 standard).

# **4.6 Anti-tampering functions: anti-rotation around axes (accelerometer)**

#### 4.6.1 Anti-rotation around axes

The sensor is equipped with an accelerometer that detects rotation around its longitudinal and transverse axes.



When the system configuration is saved, the sensor also saves its position. If the sensor subsequently detects changes in rotation around these axes, it sends a tamper alert to the controller. Upon reception of a tampering signal, the controller de-energizes the safety outputs.

#### 4.6.2 Disable the anti-rotation around axes function



WARNING! If the function is disabled, the system cannot signal a change in the rotation of the sensor around the longitudinal and transverse axes and therefore any changes in the monitored area. See "Checks when the anti-rotation around axes function is disabled" below.

In the Inxpect Safety application, in **Settings** click **Sensors** to disable the anti-rotation around axes function.

#### 4.6.3 Checks when the anti-rotation around axes function is disabled

When the anti-rotation around axes function is disabled, perform the following checks.

Safety function	Schedule	Action
Access detection function	Before each machinery restart	Check that the sensor position is that defined by the configuration.
Restart prevention function	Each time the safety relays are de-energized	Check that the monitored area is the same as defined by the configuration. See "Validate the safety functions" on page 53.

#### 4.6.4 When to disable

It may be necessary to disable the anti-rotation around axes function if the sensor is installed on a moving object (e.g. carriage, vehicle) whose motion would change the sensor inclination (e.g. motion on a slope).

## 4.7 Anti-tampering functions: anti-masking

#### 4.7.1 Masking signal

The sensor detects the presence of objects that could obstruct the field of vision. When the system configuration is saved, the sensor memorizes the surrounding environment in a one meter radius. If the sensor subsequently detects variations in the environment that could influence the field of vision, it sends a masking

signal to the controller. Upon reception of a masking signal, the controller de-energizes the safety outputs.

#### 4.7.2 Environment memorization process

The sensor starts the surrounding environment memorization process when the Inxpect Safety application configuration is saved. From that moment, it waits for the system to exit the alarm status and then scans and memorizes the environment for 15 seconds.



It is recommended to start the memorization process after at least 3 minutes from turning on the system to guarantee that the sensor has reached the operating temperature.

Only at the conclusion of the memorization process it is possible for the sensor to send masking signals.

### 4.7.3 Causes of masking

Possible causes of masking signals are presented as follows:

- an object has been placed inside of the stopping area that obstructs the field of vision of the sensor.
- the environment in the stopping area changes significantly, for example, if the sensor is installed on moving parts or if there are moving parts inside of the stopping area.
- the configuration was saved with sensors installed in an environment that is different from the working environment.

#### 4.7.4 Masking signal when the system is turned on

If the system was off for several hours and there were temperature fluctuations, the sensor might send a false masking signal when it is turned on. The signal deactivates automatically within 3 minutes when the sensor reaches its working temperature.

### 4.7.5 Sensitivity level

The anti-masking function has 4 levels of sensitivity:

Level	Description	Example application
High	The system has the highest sensitivity to changes in the environment.	Installations with a static environment and a height of less than one meter, where objects could occlude the sensor.
Medium	The system has low sensitivity to changes in the environment. Occlusion must be evident (deliberate tampering).	Installations with a height of more than one meter, where masking is likely to occur only if voluntary.
Low	The system detects masking only if the sensor occlusion is complete and the objects are highly reflective (e.g. metal, water) near the sensor.	Installations on moving parts, where the environment is changing continuously, but where static objects may be near the sensor (obstacles on the route).
Disabled	The system does not detect changes in the environment.	See "When to disable" on the next page.
	WARNING! If the function is disabled the system cannot signal the presence of objects that might impede normal detection. See "Checks when the anti-masking function is disabled" below.	

To change the sensitivity level or disable the function, in the Inxpect Safety application click **Settings** and then **Sensors**.

## 4.7.6 Checks when the anti-masking function is disabled

When the anti-masking function is disabled, perform the following checks.

Safety function	Schedule	Action
Access detection function	Before each machinery restart	Remove any objects that obstruct the field of vision of the sensor.
Restart prevention function	Each time the safety relays are de- energized	installation.

### 4.7.7 When to disable

The anti-masking function should be disabled under the following conditions:

- (with restart prevention function) the monitored area includes moving parts that stop in different and unpredictable positions,
- the monitored area includes moving parts that vary their position while the sensors are in muting,
- the sensor is positioned on a part that can be moved,
- the presence of static objects is tolerated in the monitored area (e.g. loading/unloading area).

# 5. Sensor position

#### Contents

This section includes the following topics:

5.1	Basic concepts	. 27
5.2	Sensor field of vision	28
5.3	Dangerous area calculation	29
5.4	Calculation of position for sensor height ≤ 1 m	30
5.5	Calculation of position for sensor height > 1 m	35
5.6	Outdoor installations	36

# 5.1 Basic concepts

#### 5.1.1 Determining factors

The optimum position of the sensor depends on:

- sensor field of vision
- depth of the dangerous area (and therefore the stopping area)
- sensor installation height
- sensor inclination around the transverse axis
- the presence of other sensors (see "Applications" on page 38)

The actual field of vision of the sensor depends on the height of installation and inclination of the sensor.

#### 5.1.2 Sensor installation height

The installation height (h) is the distance between the center of the sensor and the ground or reference plane of the sensor.



### 5.1.3 Sensor inclination

Sensor inclination is the rotation of the sensor around its transverse axis. Inclination is defined as the angle between the center of the sensor field of vision and a line parallel to the ground. Three examples are presented as follows:

- sensor tilted upwards: α positive
- straight sensor:  $\alpha = 0$
- sensor tilted downwards: α negative



# 5.2 Sensor field of vision

## 5.2.1 Types of field of vision

During the configuration phase it is possible to select the type of field of vision for each sensor:

- 110°
- 50°

The actual field of vision of the sensor also depends on the sensor installation height and inclination. See "Calculation of position for sensor height  $\leq 1$  m" on page 30 and "Calculation of position for sensor height > 1 m" on page 35.

## 5.2.2 Features of the 50° field of vision

For the access detection function, the 50° field of vision makes the sensor more resistant to interference from materials such as iron and water, which reflect the radar signal (e.g. iron shavings, water splatters, rain). It is therefore also suitable for outdoor installations.

During the restart prevention function, that only occurs in Both (default) and Always restart prevention safety functions, all the sensors have a 110° angular coverage, regardless of the set angular coverages.

**NOTICE**: during the configuration phase, take this aspect into consideration to avoid generating undesired alarms.

## 5.2.3 Areas and dimensions of the field of vision

The sensor field of vision is composed of two areas:

- detection area [A]: where detection of objects similar to humans in any position is guaranteed.
- uncertainty area **[B]**: where the actual detection of motion depends on the characteristics of the object (see "Factors that influence the reflected signal" on page 19).

Dimensions of the 110° field of vision





Side view

Top view

Dimensions of the 50° field of vision



Top view



Side view

#### 5.2.4 Sensitivity

The system sensitivity level can be defined for the access detection function as well as the restart prevention function. The sensitivity defines the ability of the system to prevent undesired alarms. Only for the access detection function, it also defines the reaction times to motion detection: with high sensitivity the system is more prone to undesired alarms, but detection is faster.

For example, it is recommended to set a lower level of sensitivity for the access detection function if people or objects are in transit at the perimeters of the dangerous area (e.g. forklifts or trucks).

## 5.3 Dangerous area calculation

#### 5.3.1 Introduction

The dangerous area of the machinery to which LBK System is applied must be calculated as indicated in standards ISO 13855:2010 and ISO 13857:2008. For LBK System the fundamental factors for calculation are height (h) and inclination ( $\alpha$ ) of the sensor, see "Sensor position" on page 27.

#### 5.3.2 Sensor height ≤ 1 m

To calculate the depth of the dangerous area (S) for sensors with installation heights less than or equal to 1 m, use the following formula:

		•
	$\alpha$ $\nu$ $\pi$ $\alpha$ $\alpha$	
	$\mathfrak{d} = \mathfrak{h} * \mathfrak{l} + \mathfrak{l} \mathfrak{h} + \mathfrak{l} \mathfrak{h}$	
	$\sim$ $11 \cdot 1 + \circ_n + \circ_a$	
۰.		

#### Where:

Variable	Description	Value	Measurement unit
К	Maximum dangerous area access speed	1600	mm/s
Т	Total system stopping time (LBK System + machinery)	0.1 + Machinery stopping time (calculated in accordance with ISO 13855:2010 standard)	S
C <sub>h</sub>	Constant that takes into account the sensor installation height (h) according to standard ISO 13855:2010	1200 - 0.4 * H <b>Note</b> : minimum value = 850 mm. If the result of the calculation is a value less than the minimum, use 850 mm.	mm
Cα	Constant that takes into account the sensor inclination ( $\alpha$ ) according to the indications of Inxpect SpA	If $H < 500 = (20 - \alpha) * 16$ If $H \ge 500 = (-\alpha) * 16$	mm
		<b>Note</b> : minimum value = 0 mm. If the result of the calculation is a value less than the minimum, use 0 mm.	

Example 1

- Machinery stopping time = 0.5 s
- Sensor installation height (H) = 100 mm
- Sensor inclination ( $\alpha$ ) = 10°

**T** = 0.1 s + 0.5 s = **0.6 s** 

C<sub>h</sub> = 1200 - 0.4 \* 100 = 1160 mm

 $C_{\alpha} = (20 - 10) * 16 = 160 mm$ 

**S** = 1600 \* **0.6** + **1160** + **160** = **2280** mm

Example 2

- Machinery stopping time = 0.2 s
- Sensor installation height (H) = 800 mm
- Sensor inclination ( $\alpha$ ) = -20°

**T** = 0.1 s + 0.2 s = **0.3 s** 

**C**<sub>h</sub> = 1200 - 0.4 \* 800 = **880** mm

 $C_{\alpha} = (-(-20))^* 16 = 320 mm$ 

**S** = 1600 \* **0.3** + **880** + **320** = **1680** mm

#### 5.3.3 Sensor height > 1 m

To calculate the depth of the dangerous area (S) for sensors with installation heights greater than 1 m, use the following formula:

	$S = K * T + C_h$	
Where:		

Measurement Variable Description Value unit Maximum dangerous area access speed 1600 κ mm/s т Total system stopping time (LBK System + 0.1 + Machinery stopping time s machinery) (calculated in accordance with ISO 13855:2010 standard) Ch Constant that takes into account the sensor 850 mm installation height (h) according to standard ISO 13855:2010

#### Example 1

• Machinery stopping time = 0.5 s

**T** = 0.1 s + 0.5 s = **0.6 s** 

**S** = 1600 \* **0.6** + **850** = **1810** mm

# **5.4 Calculation of position for sensor height \leq 1 m**

#### 5.4.1 Introduction

The formulas for calculating the optimum position of the sensor for sensors with installation heights less than or equal to 1 m are reported as follows.



WARNING! Define the optimum sensor position based on the risk assessment requirements.

## 5.4.2 Overview of possible installation configurations

The configurations with possible heights (h) and inclinations  $(\alpha)$  are presented as follows:

- **1** = Configuration 1: the field of vision of the sensor never intersects the ground
- 2 = Configuration 2: the upper portion of the field of vision of the sensor never intersects the ground
- **3** = Configuration 3: the upper portion and the bottom portion of the field of vision always intersect the ground
- **X** = Configuration not possible



WARNING! With configurations not listed in these tables or marked with an "x", safety functions are not guaranteed.

#### **110° field of vision**

Installation configuration		α (°)					
		-20	-10	0	10	20	
	0	х	х	Х	2	1	
	10	х	х	Х	2	1	
	20	х	х	2	2	1	
	30	х	х	2	2	х	
	40	х	х	2	2	х	
h (cm)	50	х	2	2	2	х	
	60	3	2	2	х	х	
	70	3	2	2	х	х	
	80	3	2	2	х	х	
	90	3	2	2	х	х	
	100	3	2	2	х	х	

#### 50° field of vision

Installation		α (°)					
config	uration	-20	-10	0	10	20	
	0	х	х	Х	1	1	
	10	х	х	Х	1	1	
	20	х	х	2	1	Х	
	30	х	х	2	х	Х	
	40	х	х	2	х	Х	
h (cm)	50	х	3	2	х	Х	
	60	х	3	2	х	Х	
	70	х	3	2	х	х	
	80	3	3	2	х	х	
	90	3	3	2	х	х	
	100	3	3	2	х	х	

## 5.4.3 Legend

Element	Description	Measurement unit
GAP	Distance between the ground and the field of vision of the sensor	cm
α	Sensor inclination	degrees
h	Sensor installation height	cm
Dalarm	Alarm linear distance	cm
DalarmReal	Real alarm distance	cm
S <sub>1</sub>	Start detection distance	cm
S <sub>2</sub>	End detection distance	cm

#### 5.4.4 Configuration 1

In this configuration, the field of vision of the sensor never intersects the ground.

To guarantee that the sensor also detects access by people crawling, respect the following condition:

•	
	,
(AP < 30 cm	
•	
*	

#### 110° field of vision



50° field of vision



#### 5.4.5 Configuration 2

In this configuration, the upper portion of the field of vision of the sensor never intersects the ground. To guarantee that the sensor also detects the presence of people crawling near the sensor, respect the following condition:

		,
	$(\tau AP < 30 \text{ cm})$	
	diii ( boom	,
1		,

#### **110° field of vision**



50° field of vision



## 5.4.6 Configuration 3

In this configuration, the upper and the bottom portions of the field of vision of the sensor always intersect the ground.

To guarantee optimum performance, respect the following conditions:

	:
$S_1 < Dalarm < S_2$	
	:
$S_1 < D$ with $N_1 < S_2$	

#### **110° field of vision**



50° field of vision



#### 5.4.7 Calculate the real alarm distance

The actual alarm distance **DalarmReal** is the value to be entered in the Inxpect Safety application, in **Manual configuration** and in the **Alarm distance** parameter.

DalarmReal indicates the maximum distance between the sensor and the object to be detected.



DalarmReal = Dalarm

# 5.5 Calculation of position for sensor height > 1 m

#### 5.5.1 Introduction

The formulas for calculating the optimum position of the sensor for sensors with installation heights greater than 1 m are reported as follows.

WARNING! Define the optimum sensor position based on the risk assessment requirements.

**Note**: the sensor inclination can only be downwards ( $\alpha$  negative).

#### 5.5.2 Legend

Element	Description	Measurement unit
α	Sensor inclination	degrees
h	Sensor installation height	cm
Dalarm	Alarm linear distance	cm
DalarmReal	Real alarm distance	cm
s <sub>1</sub>	Start detection distance	cm
S <sub>2</sub>	End detection distance	cm

#### 5.5.3 110° field of vision

WARNING! It is only possible through the validation procedure (see "Validate the safety functions" on page 53) to check if the other configurations respect the performance levels required by the application.



#### 5.5.4 50° field of vision



WARNING! It is only possible through the validation procedure (see "Validate the safety functions" on page 53) to check if the other configurations respect the performance levels required by the application.



#### 5.5.5 Calculate the real alarm distance

The actual alarm distance **DalarmReal** is the value to be entered in the Inxpect Safety application, in **Manual configuration** and in the **Alarm distance** parameter.

DalarmReal indicates the maximum distance between the sensor and the object to be detected.



## 5.6 Outdoor installations

#### 5.6.1 Position exposed to precipitation

If the sensor installation position might be exposed to precipitation that can cause undesired alarms, it is recommended to take the following precautions:

- make a cover to protect the sensor from rain, hail or snow
- position the sensor so that it does not frame the ground where puddles might form

#### 5.6.2 Recommendations for covering the sensor

Below are some recommendations for creating and installing a sensor cover:

- height from sensor: 15 cm
- width: minimum 30 cm, maximum 40 cm
- protrusion from the sensor: minimum 15 cm, maximum 20 cm
- water outflow: at the sides or behind but not in front of the sensor (the cover should be arched and/or tilted backwards)


#### 5.6.3 Recommendations for positioning the sensor

Below are some recommendations for defining the sensor position:

- height above the ground: minimum 10 cm
- suggested inclination: 10° for 50° field of vision and 20° for 110° field of vision

Before installing a sensor facing downwards, make sure there are neither liquids nor reflective materials on the floor.



**Note**: during the restart prevention function or if the sensor has a 110° field of vision, undesired alarms may occur due to the higher sensitivity of the system.

#### 5.6.4 Position not exposed to precipitation

If the installation position of the sensor is not exposed to precipitation, no special precautions are required.

## 6. Applications

#### Contents

This section includes the following topics:

•
9
1
5

## 6.1 Applications overview

#### 6.1.1 Comparison of the managed applications

Application	Pro	Against	Configuration procedures in Inxpect Safety
Linear barrier (complete restart prevention)	<ul> <li>Blind spots absent and therefore complete coverage of restart prevention function.</li> <li>Monitoring of side access points to the dangerous area without the need for side guards.</li> <li>Configuration of sensors and area actually monitored provided by the Inxpect Safety application.</li> </ul>	• Need for more sensors in respect to the linear barrier with limited restart prevention for monitoring the same area.	Linear configuration, Full coverage option enabled (default)
Linear barrier (limited restart prevention)	<ul> <li>Monitoring of an extended area with few sensors.</li> <li>Configuration of sensors and area actually monitored provided by the Inxpect Safety application.</li> </ul>	<ul> <li>Need for side guards to prevent access to unmonitored side areas.</li> <li>Presence of blind spots and therefore limited restart prevention function.</li> </ul>	<b>Linear</b> <b>configuration, Full</b> <b>coverage</b> option disabled
Other applications	<ul> <li>Flexibility in sensors configuration to obtain maximum coverage in dangerous areas.</li> </ul>	<ul> <li>Sensors configuration and area actually monitored defined by the machinery manufacturer.</li> </ul>	Manual configuration

## 6.2 Linear barrier (complete restart prevention)

#### **6.2.1** Distance between sensors and number of sensors

The depth of the area to be monitored **[A]** determines the maximum distance between the sensors **[B]** and therefore the number of sensors necessary to cover the width of the dangerous area **[C]**. The deeper the area, the greater the possible distance between the sensors, and therefore a lower number of sensors is necessary.



Example of greater depth

#### 6.2.2 Tolerance area

The sensor works in the radial direction, therefore detection distance **[A]** is the same no matter what angle the motion is detected from. Defining the dangerous area (and pre-alarm area) with a linear distance **[B]**, a tolerance area **[C]** is generated at the periphery of the stopping area (and pre-alarm area) subject to undesired alarms because it exceeds the area of interest.



The machinery manufacturer must enclose the tolerance area to prevent transit in the area and thus avoid undesired alarms.

The tolerance area is calculated and provided by the Inxpect Safety application.

#### 6.2.3 Distance of sensors and tolerance area

The tolerance area **[A]** increases as the distance between the sensors **[B]** increases, up to a maximum of 20 cm approximately.



#### 6.2.4 Side areas and undesired alarms

Given the geometry of the field of vision, areas subject to undesired alarms are generated in the side areas of the dangerous area.



The machinery manufacturer must enclose these areas to prevent transit in the area and thus avoid undesired alarms.

The distance for installation of the delimiting barriers can be calculated based on the parameters provided by the Inxpect Safety application during the configuration phase.

#### 6.2.5 Calculation of the monitored area

The monitored area is calculated automatically by the Inxpect Safety application. Given the dimensions of the dangerous area and any pre-alarm area, the system calculates:

- the number of necessary sensors
- the sensors installation distance
- the rotation angle of the sensor around the vertical axis
- the total depth of the monitored area (dangerous area + pre-alarm area + tolerance area)
- the total width of the monitored area (dangerous area + possible distance of side delimiting barriers)
  the depth of the tolerance area

To calculate the depth of the dangerous area, "Dangerous area calculation" on page 29.



#### 6.2.6 Example of a monitored area with an odd number of sensors



Without pre-alarm area.

Part	Description
Α	Dangerous area
В	Stopping area
С	Tolerance area
D	Pre-alarm areaa

With pre-alarm area.

#### 6.2.7 Example of a monitored area with an even number of sensors



Part	Description
Α	Dangerous area
В	Stopping area
С	Tolerance area

### 6.3 Linear barrier (limited restart prevention)

**Note**: the following illustrations show, as an example, sensor configurations all with 110° field of vision. Sensor configurations with all 50° field of vision or mixed configurations are also possible.

#### 6.3.1 Distance between sensors and number of sensors

The depth of the area to be monitored **[A]** determines the maximum distance between the sensors **[B]** and therefore the number of sensors necessary to cover the width of the dangerous area **[C]**. The deeper the area, the greater the possible distance between the sensors, and therefore a lower number of sensors is necessary.



Example of lower depth



Example of greater depth

#### 6.3.2 Tolerance area

The sensor works in the radial direction, therefore detection distance **[A]** is the same no matter what angle the motion is detected from. Defining the dangerous area (and pre-alarm area) with a linear distance **[B]**, a tolerance area **[C]** is generated at the periphery of the stopping area (and pre-alarm area) subject to undesired alarms because it exceeds the area of interest.



The machinery manufacturer must enclose the tolerance area to prevent transit in the area and thus avoid undesired alarms.

The tolerance area is calculated and provided by the Inxpect Safety application.

#### 6.3.3 Distance of sensors and tolerance area

The tolerance area **[A]** increases as the distance between the sensors **[B]** increases, up to a maximum of 20 cm approximately.



#### 6.3.4 Side guards and undesired alarms

Given the geometry of the sensor field of vision, guards must be installed to prevent side access to the machinery. To prevent undesired alarms, the guards must be positioned on the exterior of the dangerous area.





Guards and possible undesired alarms

Guards without undesired alarms

The distance for installation of the guards can be calculated based on the parameters provided by the Inxpect Safety application during the configuration phase.

#### 6.3.5 Blind spots

Given the geometry of the sensor field of vision, blind spots are generated within the monitored area. Sensitivity to motion is greatly reduced in blind spots.

The greater the distance between sensors [A] the wider the blind spot areas become [B].



#### 6.3.6 Restart prevention function limits

The restart prevention function based on motion detection (automatic and safe manual type, see "Types of managed restart" on page 22) is not guaranteed in the immediate vicinity of the sensor blind spots. The guaranteed minimum detection distance depends on the distance between the sensors:

Distance between sensors (cm)	Guaranteed minimum distance (cm)
50	30
100	60
150	90

**NOTICE**: auxiliary functions are necessary in the immediate vicinity of the sensor to guarantee the system restart prevention function.

#### 6.3.7 Calculation of the monitored area

The monitored area is calculated automatically by the Inxpect Safety application. Given the dimensions of the dangerous area and any pre-alarm area, the system calculates:

- the number of necessary sensors
- the sensors installation distance
- the total depth of the monitored area (dangerous area + pre-alarm area + tolerance area)
- the total width of the monitored area (dangerous area + distance of side guards)
- the depth of the tolerance area

To calculate the depth of the dangerous area, "Dangerous area calculation" on page 29.

#### 6.3.8 Example of monitored area without pre-alarm area



Part	Description
Α	Guards to prevent side access
В	Dangerous area
С	Stopping area
D	Tolerance area

#### 6.3.9 Example of monitored area with pre-alarm area



Part	Description
Α	Guards to prevent side access
В	Dangerous area
С	Stopping area
D	Tolerance area of the stopping area
Е	Pre-alarm area

## 6.4 Other applications

#### 6.4.1 Types of applications

Thanks to the manual configuration mode, different shaped areas can be monitored. Flexibility in sensors configuration allows obtaining maximum coverage in dangerous areas.

#### 6.4.2 Calculation of the monitored area

In the configuration phase, based on the area to be monitored (see "Dangerous area calculation" on page 29), the machinery manufacturer must define:

- the number of sensors
- the distance between sensors
- sensors inclination
- the depth of the stopping area
- the depth of the possible pre-alarm area

WARNING! It is the responsibility of the machinery manufacturer to calculate the actual monitored area (total depth = dangerous area + pre-alarm area; total width = dangerous area + distance of possible side delimiting barriers) and to install guards and/or delimiting barriers to prevent access and/or undesired alarms.

#### 6.4.3 Examples



Circular dangerous area around a robot



Dangerous area on three sides out of four of a machinery



Dangerous area laterally delimited by transit areas

## 7. Installation and use procedures

#### Contents

This section includes the following topics:

7.1	Before installation	47
7.2	Install and configure LBK System	48
7.3	Validate the safety functions	.53
7.4	Manage the configuration	55
7.5	Other functions	.56

### 7.1 Before installation

#### 7.1.1 Materials required

- Two tamper-proof screws to fasten the sensors to the floor or machinery, see "Side screws specifications" on page 65.
- Cables to connect the controller to the first sensor and the sensors to one another, see "CAN bus cables recommended specifications" on page 65.
- A data micro-USB cable to connect the controller to the computer.
- A bus terminator (product code: 07000003) with resistance of 120  $\Omega$  for the last sensor of the CAN bus.
- A six-pointed star head screwdriver or an accessory for tamper-proof screws with button head ("Side screws specifications" on page 65).
- If necessary, to protect the sensor and to prevent reflections from generating undesired alarms, one Metal protector kit (product code: 90202ZAA) per sensor. See the instructions supplied with the kit for installation instructions.

**Note**: the Metal protector kit is particularly recommended if the sensor is installed on parts that are moving, vibrating or that are near vibrating parts.

#### 7.1.2 Operating system required

- Microsoft Windows 7 or later
- Apple OS X 10.10 or later

#### 7.1.3 Install the Inxpect Safety application

Note: if the installation fails, the dependencies needed by the application may be missing. Update your operating system or contact our Technical Support team to receive assistance.

- 1. Download the application from the www.inxpect.com/industrial/tools website and install it on the computer.
- 2. Start the application.
- 3. Click Login and set the password.
- 4. Memorize the password and provide it only to people who are authorized to change the configuration.

### 7.1.4 Initiate LBK System

- 1. Calculate the position of the sensor (see "Sensor position" on page 27) and the depth of the dangerous area (see "Dangerous area calculation" on page 29).

- "Install the controller" on the next page.
   "Define the working frequency of the sensors" on the next page.
   "Define the area to be monitored" on the next page.
   "Configure the auxiliary inputs and outputs" on the next page.
   "Install sensors on the floor" on page 49 or "Install the sensors on the machinery" on page 50.
- 7. "Connect the controller to the sensors and assign the IDs" on page 51. Note: connect the sensors to the controller off-site if access to the connectors becomes difficult once they are installed.
- 8. "Save and print the configuration" on page 52.
- 9. If necessary, "Install the side guards" on page 52.
- 10. "Validate the safety functions" on page 53.

## 7.2 Install and configure LBK System

#### 7.2.1 Install the controller



WARNING! To prevent tampering, make sure the controller is only accessible to authorized personnel (e.g. key-locked electrical panel).

- 1. Mount the controller on the DIN rail.
- 2. Make electrical connections, see "Terminal blocks and connectors pin-outs" on page 66 and "Electrical connections" on page 68.

**NOTICE**: if at least one input is connected, the SNS input must also be connected.

Note: to correctly connect the digital inputs, see "Voltage and current limits for digital inputs" on page 67.

#### 7.2.2 Define the working frequency of the sensors

- 1. Connect the controller to the computer via data micro-USB cable.
- 2. Supply power to the controller.
- 3. Start the Inxpect Safety application.
- 4. Click Settings and then General.
- 5. In **Operational frequency** if the system is installed in one of the countries with national restrictions, select the restricted band, otherwise select the full band. *Note:* this setting does not have any effect on system performance.

#### 7.2.3 Define the area to be monitored

WARNING! LBK System is disabled during configuration. Prepare opportune safety measures in the dangerous area protected by the system before configuring the system.

- 1. In the Inxpect Safety application, click **Login** and enter the password. **Note**: if not yet set, set a valid password. Memorize the password and provide it only to people who are authorized to change the configuration.
- 2. Click Configuration.
- 3. Define the area to be monitored and the configuration of the sensors as follows:

For	Then
linear barrier applications	<ol> <li>Select Linear configuration.</li> <li>Only for applications with limited restart prevention function, deselect Full coverage.</li> <li>Define the dimensions of the dangerous area and any pre-alarm area: the system calculates the number of sensors necessary, the sensor installation distance, and the dimensions of the actual monitored area.</li> <li>Note: when setting a parameter, the system automatically fills in the values or defines an interval of values compatible with the other parameters.</li> </ol>
	4. Scroll through the proposed configurations and leave the most suitable on the display.
other applications	<ol> <li>Select Manual configuration.</li> <li>Define the number of sensors, the selected safety functions, their position and inclination, the depth of the stopping area and any prealarm area.</li> <li>Note: it is possible to upload an image to facilitate definition of the area to be monitored.</li> </ol>

#### 7.2.4 Configure the auxiliary inputs and outputs

- 1. In the Inxpect Safety application, click **Settings**.
- 2. Click **Digital Input-Output** and define the functions of the auxiliary inputs and outputs.
- 3. If the muting is managed, click **Muting** and assign the sensors to the groups:

If	Then
only one digital input is connected for muting	assign all the sensors to group 1
several digital inputs are connected for muting	assign the sensors according to the logic of the digital inputs

4. Click APPLY CHANGES to save the configuration.

#### 7.2.5 Install sensors on the floor

Note: for installation with Metal protector kit (product code 90202ZAA), see the instructions supplied with the kit.

 Position the sensor as indicated in the configuration report and fasten the bracket with two tamper-proof screws directly onto the floor or another support.
 **NOTICE**: make sure the support does not inhibit machinery commands.



2. Loosen the side screws to tilt the sensor.

Direct the sensor up to the desired inclination, see "Sensor position" on page 27.
 Note: a notch is equal to 10° of inclination.



4. Tighten the screws.



#### 7.2.6 Install the sensors on the machinery

**Note**: if the sensor is installed on parts that vibrate and objects are present in the field of vision, the sensor could generate undesired alarms.

 Position the sensor as indicated in the configuration report and fasten the bracket with two screws to a machinery support. To select installation height, see "Sensor position" on page 27.



- 3. Position the sensor parallel to the machinery support.

2. Loosen the side screws.



Direct the sensor up to the desired inclination, see "Sensor position" on page 27.
 Note: a notch is equal to 10° of inclination.



#### 5. Tighten the screws.



#### 7.2.7 Connect the controller to the sensors and assign the IDs

#### **First installation**

- 1. Decide if the controller will be positioned at the end of the chain or inside it (see "Chain examples" on the next page).
- 2. Start the Inxpect Safety application.
- 3. Click Settings and then Sensor ID Nodes.
- 4. Set the DIP switch of the controller based on its position in the chain.
- 5. Connect the desired sensor directly to the controller.
- 6. Insert the bus terminator (product code: 07000003) into the free connector of the sensor.
- 7. Click ASSIGN ID NODES and follow the instructions displayed to assign an ID to the sensor.
- 8. To add a sensor, click ADD NEXT SENSOR
- 9. Connect the new sensor directly to the controller or to the last sensor of the chain.
- 10. To insert the bus terminator, perform the following steps:

If the sensor has been connected	Then
to the controller	insert a new bus terminator into the free connector of the sensor just connected.
to the last sensor of the chain	move the bus terminator of the previous sensor and insert it into the free connector of the sensor just connected.

- 11. Click **PROCEED** and follow the instructions displayed to assign a ID to the new sensor.
- 12. Repeat from step 8 to connect another sensor or click **TERMINATE** to conclude the procedure. *Note:* the maximum length of the CAN bus line from the controller to the last sensor of the chain is 30 m.

#### Addition of a sensor without ID

After the first installation, follow this procedure to add a sensor without ID to the end of the chain or to substitute an existing sensor.

- 1. Start the Inxpect Safety application.
- 2. Click Settings and then Sensor ID Nodes.
- 3. Connect the desired sensor directly to the controller or to the last sensor on the chain.
- 4. Set the DIP switch of the controller based on its position in the chain (see "Chain examples" on the next page).

*Note*: the maximum length of the CAN bus line from the controller to the last sensor of the chain is 30 m.

5. Insert the bus terminator (product code: 07000003) into the free connector of the sensor/sensors at the end of the chain by performing the following steps:

If the sensor has been connected	Then
to the controller	insert a new bus terminator into the free connector of the sensor just connected.
to the last sensor of the chain	move the bus terminator of the previous sensor and insert it into the free connector of the sensor just connected.

6. Click **ASSIGN ID NODES** and follow the instructions displayed to assign a new ID to the sensor.

#### Addition of a sensor with ID

After the first installation, follow this procedure to add a sensor with ID to the end of the chain or to substitute an existing sensor.

- 1. Start the Inxpect Safety application.
- 2. Click Settings and then Sensor ID Nodes.
- 3. Connect the desired sensor directly to the controller or to the last sensor of the chain.
- 4. Set the DIP switch of the controller based on its position in the chain. See "Chain examples" on the next page.

Note: the maximum length of the CAN bus line from the controller to the last sensor of the chain is 30 m.

5. Insert the bus terminator (product code: 07000003) into the free connector of the sensor/sensors at the end of the chain by performing the following steps:

If the sensor has been connected	Then
to the controller	insert a new bus terminator into the free connector of the sensor just connected.
to the last sensor of the chain	move the bus terminator of the previous sensor and insert it into the free connector of the sensor just connected.

- 6. Click **RESET ASSIGNMENTS** to remove the ID to all the connected sensors.
- 7. Disconnect all the sensors and reinstall them (see "Install and configure LBK System" on page 48).

#### 7.2.8 Chain examples



Chain with controller at the end of the chain and a sensor with bus terminator



Chain with controller inside of the chain and two sensors with bus terminator

#### 7.2.9 Save and print the configuration

- 1. In the Inxpect Safety application, click **APPLY CHANGES**: the sensors will memorize the inclination set and the surrounding environment. The application will transfer the configuration to the controller, and once transfer is complete it will generate a configuration report.
- 2. Click 📥 to save and print the report.
- 3. If necessary, complete the report with the inclination and height data of the sensors.
- 4. Require a signature by the authorized person.

#### 7.2.10 Install the side guards

Note: valid procedure for linear barrier applications with limited restart prevention function.

- 1. Calculate the installation distance of the guards, referring to the values in the configuration report: (Actual length BARRIER LENGTH) / 2.
- 2. Position the guards at the distance calculated in step 1.

## 7.3 Validate the safety functions

#### 7.3.1 Validation

Once the system has been installed and configured, check that the safety functions are activated/deactivated as expected and that the dangerous area is monitored by the system.



WARNING! The Inxpect Safety application facilitates installation and configuration of the system, but the validation process described below is still required.

#### 7.3.2 Validate the access detection function

Starting conditions	Machinery in safe conditions.
Validation procedure	<ol> <li>Access the stopping area.</li> <li>Check that the system activates the safety function (de-energizing safety outputs). See "Validate the system with Inxpect Safety" on the next page.</li> <li>If it does not activate, see "Troubleshooting validation" on the next page.</li> </ol>
Specifications	<ul> <li>Access from several points with particular attention to the side areas of the field of vision and the limit areas (e.g. intersection with any side guards), see "Example of access points" below.</li> <li>Access standing as well as crawling.</li> </ul>

• Access moving slowly and quickly.

#### 7.3.3 Example of access points





Access points for 110° field of vision

Access points for 50° field of vision

#### 7.3.4 Validate the restart prevention function

Starting conditions	<ul> <li>Machinery in safe conditions</li> <li>Safety function activated (safety outputs de-energized)</li> </ul>
Validation procedure	<ol> <li>Stand still in the stopping area.</li> <li>Check that the system maintains the safety function activated (safety outputs de- energized). See "Validate the system with Inxpect Safety" on the next page.</li> <li>If deactivated, see "Troubleshooting validation" on the next page.</li> </ol>
Specifications	<ul> <li>Stop longer than the restart timeout (Inxpect Safety &gt; Settings &gt; Sensors).</li> <li>Stop in several different points, with special attention to the areas in close proximity to the sensor and any blind spots, see "Example of stopping points" on the next page.</li> <li>Stop standing as well as laid down.</li> </ul>

### 7.3.5 Example of stopping points



Stopping points for 110° field of vision



Stopping points for 50° field of vision

#### 7.3.6 Validate the system with Inxpect Safety



The Inxpect Safety application is helpful during the safety functions validation phase and allows the actual field of vision of the sensors to be checked based on their installation position.

- 1. First, click Validation and then VALIDATION START..
- Move in the stopping area as indicated in "Validate the access detection function" on the previous
  page and "Validate the restart prevention function" on the previous page.
- 3. Check that the sensor behaves as expected (A: red area for motion detected in the stopping area, B: green area for motion detected outside of the stopping area).
- 4. Check that the distance where the motion is detected (C) is the expected value.



#### 7.3.7 Troubleshooting validation

If the sensor does not perform as expected, see the following table:

Cause	Solution
Presence of objects obstructing the field of vision	If possible, remove the object. Otherwise, implement additional safety measures in the area impacted by the object.
Position of sensors	Position the sensors to ensure that the monitored area is adequate to the dangerous area to be monitored ("Sensor position" on page 27 and "Applications" on page 38).
Inclination and installation height of one or more sensors	<ol> <li>Change the inclination and installation height of the sensors to ensure that the monitored area is adequate to the dangerous area to be monitored, see "Sensor position" on page 27.</li> <li>Note or update the inclination and installation height of the sensors in the printed configuration report.</li> </ol>
Inadequate restart timeout	Change the restart timeout through the Inxpect Safety application ( <b>Settings</b> > <b>Sensors</b> )

## 7.4 Manage the configuration

#### 7.4.1 Configuration reports

After changing the configuration, the system generates a configuration report with the following information:

- configuration data
- date and time of configuration change
- name of computer where the change was inserted

The reports are documents that cannot be changed and can only be printed and signed by the person assigned to the task.

#### 7.4.2 Change the configuration

WARNING! LBK System is disabled during configuration. Prepare opportune safety measures in the dangerous area protected by the system before configuring the system.

- 1. Start the Inxpect Safety application.
- 2. Click **Login** and enter the password.
- 3. Depending on what you want to change, follow the instructions below:

To change	Then
Monitored area and sensors configuration	Click <b>Configuration</b>
System sensitivity	Click Settings > Sensors
Sensor ID	Click Settings > Sensor ID Nodes
Function of auxiliary inputs and outputs	Click Settings > Digital Input-Output
Muting: composition of groups of sensors	Click Settings > Muting
	<b>Note</b> : if only one digital input is connected for muting, assign all the sensors to group 1.
Muting: Input signal characteristics	Click Settings > Digital Input-Output
Sensor inclination	Loosen the side screws on the sensor with a six-pointed star screwdriver and orient the sensors to the desired inclination.

#### 4. Click APPLY CHANGES.

- 5. Upon conclusion of transfer of the configuration to the controller, click due to print the report.
- Complete the report with the inclination and installation height data of the sensors and request signature 6. by the person assigned to the task.

#### 7.4.3 Back up the configuration

The current configuration can be backed up, including the input/output settings. The configuration is saved in a .cfg file, which can be used to restore the configuration or to facilitate configuration of several LBK System.

- 1. In Settings > General, click BACKUP.
- 2. Select the file destination and save.

#### 7.4.4 Load a configuration

- 1. In Settings > General, click RESTORE.
- 2. Select the previously saved .cfg file (see "Back up the configuration" above) and open it.

Note: a re-imported configuration requires new downloading onto the controller and approval according to the safety plan.

#### 7.4.5 Display previous configurations

In Settings, click Activity History and then click Configuration reports page: the reports archive opens. In **Configuration** click **.** 

## 7.5 Other functions

#### 7.5.1 Change language

- 1. First, click **Settings** and then **User account**.
- 2. Select the desired language. The language changes automatically.

#### 7.5.2 Locate the area with detected motion

First, click **Validation** and then **VALIDATION START**: the area with detected motion turns red and the detection position appears on the left.

#### 7.5.3 Change the access password

In Settings > User account, click CHANGE PASSWORD.

#### 7.5.4 Restore factory default settings

In **Settings** > **General** click **FACTORY RESET**: the configuration parameters are restored to default settings and the access password is reset.



WARNING! The factory configuration is not a valid configuration. Therefore, the system goes into an alarm status. The configuration must be validated, and if necessary modified, through the Inxpect Safety application by clicking APPLY CHANGES.

For the default values of the parameters, see "Default values" on page 72.

#### 7.5.5 Identify a sensor

In **Settings** > **Sensor ID Nodes**, click **Blink led** near the desired sensor ID: the LED on the sensor flashes for 5 seconds.

## 8. Maintenance and troubleshooting

#### Machinery maintenance technician

The machinery maintenance technician is a qualified person, with the administrator privileges required to enter the software and perform maintenance.

The machinery maintenance technician is a qualified person, with the administrator privileges required to modify the configuration of the LBK System through the software and perform maintenance.

#### Contents

This section includes the following topics:

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	-	

### 8.1 Troubleshooting

#### 8.1.1 Sensor LED

Status	Problem	Remedy
2 flashes *	ID not assigned	Assign an ID to the sensor, see "Connect the controller to the sensors and assign the IDs" on page 51.
3 flashes *	Error in communication with the controller	Check connections of all sensors in the chain starting from the last sensor in error.
4 flashes *	Wrong power supply voltage or temperature value	<ul> <li>Check the sensor connection and that the length of the cables respects maximum limits.</li> <li>Check that the ambient temperature where the system is functioning complies with the operating temperatures indicated in the technical data in this manual</li> </ul>
5 flashes *	Masking, micro-controller, micro-controller peripherals, radar or radar control in error	Check that the sensor is correctly installed and that the area is free of any objects that obstruct the field of vision of the sensors.
6 flashes *	Inclination of the sensor different from the installation inclination	Check if the sensor has been tampered with or if the side screws or fastening screws are loose.

*Note \*:* flashes at 200 ms intervals and then with a 2 s pause.

#### 8.1.2 Controller LED

LED	Status	Problem	Remedy
S1*	Steady red	At least one voltage value on the controller is wrong	If at least one digital input is connected, check that the SNS input is connected.
			Check that the input power supply is the specified type (see "General specifications" on page 64).
S2	Steady red	Controller temperature value is wrong	Check that the system is operating at the correct operating temperature (see "General specifications" on page 64).

LED	Status	Problem	Remedy
S3	Steady red	At least one relay is in error	Reset the system (in Inxpect Safety > <b>Settings</b> > <b>General</b> > <b>FACTORY RESET</b> ).
			If the problem persists, contact assistance for relay replacement.
S4	Steady red	At least one of the controller peripherals is in error	Check the status of the terminal block and connections.
S5	Steady red	Communication error with at least one sensor	Check connections of all sensors in the chain starting from the last sensor in error.
			Check that all the sensors have an assigned ID (in Inxpect Safety > <b>Settings</b> > <b>Sensor ID Nodes</b> ).
			Check that the firmware of the controller and sensors are updated to the same version.
S6	Steady red	Configuration saving error or configuration not performed	Reconfigure or configure the system, see "Manage the configuration" on page 55.
Only one LED	Flashing red	Sensor corresponding to the flashing LED in error	Check the problem through the LED on the sensor.

**Note**: fault signal on the controller (steady LED) takes priority over a faulty sensor signal. For the status of the single sensor, check the sensor LED.

#### 8.1.3 Other problems

Problem	Cause	Remedy
Undesired alarms	Transit of people or objects in close proximity to the stopping area	Change the sensors sensitivity, "Change the configuration" on page 55.
		Check that the guards are positioned as indicated in the configuration report.
	Incorrect installation of side guards	Position the guards as indicated in the configuration report, see "Install the side guards" on page 52.
Machinery in safe	No power supply	Check electrical connection.
status without movements in the		Contact the assistance service if necessary.
stopping area	Failure in the controller or one or more sensors	Check the status of the LEDs on the controller, see "Controller LED" on the previous page.
		Access the application Inxpect Safety, in the <b>Dashboard</b> page, click A in correspondence with the controller or the sensor.
The voltage value detected on the SNS input is zero	The chip that detects inputs is faulty	Contact the assistance service.
The system does not function correctly	Controller error	Check the status of the LEDs on the controller, see "Controller LED" on the previous page.
		Access the application Inxpect Safety, in the <b>Dashboard</b> page, click $\bigwedge$ in correspondence with the controller or the sensor.
	Sensor error	Check the status of the LEDs on the sensor, see "Sensor LED" on the previous page.
		Access the application Inxpect Safety, in the <b>Dashboard</b> page, click A in correspondence with the controller or the sensor.

### 8.2 System log

#### 8.2.1 Event log management

The event log recorded by the system can be downloaded. The system saves up to 512 events, displayed from the most recent to the less recent. Above this limit, the oldest events are overwritten.

Once downloaded, the events are deleted from the system memory.

#### 8.2.2 Explanation of the log file information

The log file reports the following information separated by ";":

- 1. timestamp (in ms) from system start
- 2. component that generated the event
- 3. event type
- 4. event details

#### Examples

777446;SENSOR 1;Signal error;MASKING 95659177;SENSOR 3;CAN error;TIMEOUT 1640822465;CONTROLLER;Relay error;RELAY2 INCONSISTENT FEEDBACK 198505;CONTROLLER;Power error;VREF UNDERVOLTAGE 533056;SENSOR 2;Accelerometer error;PITCH ANGLE ERROR 38380;CONTROLLER;FEE error;FEE COMMIT ERROR 0;CONTROLLER;SYSTEM BOOT;47 3674948;SENSOR 1;SYSTEM SAFETY ALARM;1426

#### 8.2.3 Download the system log

- 1. Start the Inxpect Safety application.
- 2. Click Settings and then Activity History.
- 3. Click **DOWNLOAD LOG**.

#### 8.2.4 Radar signal errors (SIGNAL ERROR)

Error	Meaning
HEAD FAULT	Radar not functioning
HEAD POWER OFF	Radar off
MASKING	Presence of object obstructing the field of vision of the radar
SIGNAL DYNAMIC	Wrong signal dynamic
SIGNAL MIN	Signal with dynamic below minimum
SIGNAL MIN MAX	Signal with out of range dynamic
SIGNAL MAX	Signal with dynamic over maximum
SIGNAL AVG	Flat signal

#### 8.2.5 CAN errors (CAN ERROR)

Error	Meaning
TIMEOUT	Timeout on message to sensor/controller
CROSS CHECK	Two redundant messages do not coincide
SEQUENCE NUMBER	Message with sequence number different from the expected number
CRC CHECK	Packet control code does not match
COMMUNICATION LOST	Impossible to communicate with the sensor
PPOTOCOL EPPOP	Controller and sensors have different and incompatible firmware versions

**PROTOCOL ERROR** Controller and sensors have different and incompatible firmware versions

#### 8.2.6 Temperature errors (TEMPERATURE ERROR)

Error	Meaning
TEMPERATURE TOO LOW	Temperature below minimum
<b>TEMPERATURE TOO HIGH</b>	Temperature above maximum

#### 8.2.7 Relay errors (RELAY ERROR)

Error	Meaning
RELAY1 BAD MOSFET STATUS	Error on diagnostics signal of MOS relay 1
RELAY2 BAD MOSFET STATUS	Error on diagnostics signal of MOS relay 2
RELAY1 INCONSISTENT FEEDBACK	Error on feedback signal of relay 1
RELAY2 INCONSISTENT FEEDBACK	Error on feedback signal of relay 2
RELAYS SHORT CIRCUIT	Short-circuit error between two relays or between two relay commands

#### 8.2.8 Sensor/controller voltage errors (POWER ERROR)

Error	Meaning
Sensor/controller voltage UNDERVOLTAGE	Undervoltage error for the indicated voltage
Sensor/controller voltage OVERVOLTAGE	Overvoltage error for the indicated voltage
ADC CONVERSION ERROR	(only for the ADC) ADC conversion error in the micro-controller

The following table describes the sensor voltage:

Screen printing	Description
VIN	Power supply voltage (+12 V dc)
V3.3	Internal chip power supply voltage
V1.2	Micro-controller power supply voltage
V+	Radar reference voltage
VDCDC	Main chip power supply internal voltage
VOPAMP	Operational amplifier voltage
VADC REF	Analog-digital converter (ADC) reference voltage
ADC	Analog-digital converter

The following table describes the controller voltage:

Screen printing	Description
VIN	Power supply voltage (+24 V dc)
V12	Relay power supply voltage
V12 sensors	Sensors power supply voltage
VUSB	USB port voltage
VREF	Inputs reference voltage (VSNS Error)
ADC	Analog-digital converter

#### 8.2.9 Sensor inclination errors (ACCELEROMETER ERROR)

Error	Meaning
PITCH ANGLE ERROR	Sensor inclination with respect to the bracket (set through the side screws) changed
ROLL ANGLE ERROR	Sensor inclination with respect to the installation surface (set through fastening screws on the bracket) changed

Error		Meaning
ACCELEROMETER READ	Accelerometer reading error	

#### 8.2.10 Peripheral error (PERIPHERAL ERROR)

Error detected by diagnostics relative to the micro-controller, its internal peripherals, or memories.

#### 8.2.11 Configuration error (FEE ERROR)

Indicates that the system must still be configured. This message can appear when the system is first turned on or after reset to default values. It can also represent another error on the FEE (internal memory).

Error	Meaning
FEE COMMIT ERROR	The system has not been configured yet
FEE COMMIT NULL	Nothing to be committed
FEE READ ERROR	Error during the reading of the data from the FEE
FEE WRITE ERROR	Error during the writing of the data on the FEE
FEE INTEGRITY ERROR	Wrong CRC

#### 8.2.12 System boot (SYSTEM BOOT)

Each time LBK System starts, a "SYSTEM BOOT" event is recorded with the incremental progressive number of the restart. The timestamp is reset to zero.

#### 8.2.13 System safety alarm (SYSTEM SAFETY ALARM)

Component	Possible event details
Controller	<b>1</b> : after previous detection, the area is now empty. Consequence: the controller closes the safety relay output.
Sensor	<i>xxxxxxx</i> : distance in millimeters between the detected motion and the sensor. Consequence: the controller opens the safety relay output.

### 8.3 Cleaning and spare parts

#### 8.3.1 Cleaning

Keep the sensor clean and free of any work residues to prevent masking and/or poor functioning of the system.

#### 8.3.2 Spare parts

Part	Product code
Sensor	LBK-S01
Controller	LBK-C22

### 8.4 Periodic tests

#### 8.4.1 Test

Frequency	Test	Object of test
At least every six months	Periodic	<ul> <li>Sensors (detection capacity)</li> <li>Digital inputs</li> <li>Safety outputs</li> <li>Auxiliary outputs</li> </ul>
Daily	Visual inspection	Sensors (integrity, position, inclination)

Note: keep a record of the date and result of the tests performed.

#### 8.4.2 Periodic test with Inxpect Safety

The Inxpect Safety application (**Maintenance** page) provides a wizard for performing the periodic test. The periodic test checks:

- correct detection of motion by the installed sensors
- correct functioning of the inputs in use
- correct functioning of the auxiliary outputs in use

Inxpect Safety also permits the following functions:

- save and print the test report
- calculate the data for performing the next test

#### 8.4.3 Perform a periodic test with Inxpect Safety

WARNING! During maintenance, LBK System is disabled. Prepare appropriate safety measures in the dangerous area monitored by the system before doing any maintenance on the system.

**NOTICE**: the maintenance procedure is complete and valid only if all the steps indicated in the software have been completed and if the maintenance manager has read and signed the maintenance report.

- 1. Start the Inxpect Safety application.
- 2. First, click Maintenance and then START MAINTENANCE.
- 3. Follow the wizard for inspecting the sensors, inputs and outputs. *Note:* to stop the procedure, click *Finish*.
- 4. Once the procedure is completed, print the report.

#### 8.4.4 Display the performed test reports

To display the report of all tests performed and download a PDF version, click **Maintenance** or **Dashboard** and then click **Maintenance report**.

### 8.5 Updates

#### 8.5.1 Download software updates

To download any software updates for the application, open the website www.inxpect.com/industrial/tools.

#### 8.5.2 Download firmware updates

*Note*: this procedure is valid for firmware versions prior to 1.80.

To download any firmware updates for the controller and the sensors, do the following:

If the software version is	Then
complete	open the website www.inxpect.com/industrial/tools.
demo kit	send an email to safety-support@inxpect.com to receive the update.

#### 8.5.3 Install firmware updates

WARNING! During firmware update, LBK System may not be fully operative. Make sure that the machinery is in safe conditions before installing updates.

**NOTICE**: the sensor and controller firmware must be updated to the same version. **Note**: this procedure is valid for firmware versions prior to 1.80.

- 1. Start the Inxpect Safety application.
- 2. First, click Settings and then General.
- 3. Click the button for the desired action and select the previously downloaded update file.
- 4. Check the system configuration after the firmware update.
- 5. Validate the correct functioning of the system (see "Validate the safety functions" on page 53)

## 9. Technical references

#### Contents

This section includes the following topics:

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## 9.1 Technical data

#### 9.1.1 General specifications

	-		
Detection method	Inxpect motion detection algorithm based on FMCW radar		
Frequency	Working band: 24–24.25 GHz		
	Transmission power: $\leq$ 13 dBm		
	Modulation: FMCW		
Detection interval	From 0 to 4 m , depending on the installation conditions.		
Field of vision	<ul> <li>110° (sensor horizontal plane: 110°, sensor vertical plane: 30°)</li> <li>50° (sensor horizontal plane: 50°, sensor vertical plane: 15°)</li> </ul>		
Guaranteed response time	< 100 ms		
SIL (Safety Integrity Level)	2		
PL (Performance Level)	d		
Category (EN ISO 13849)	2 (3 for the outputs)		
Total consumption	11 W (controller and six sensors)		
Communication protocol (sensors- controller)	CAN complies with standard EN 50325-5		
Mission time	20 years		
MTTFd	45 years		
PFH	4.27E-08 [1/h]		
SFF	99.19%		
DCavg	98.11%		
Electrical	Polarity inversion		
protections	Overcurrent through resettable integrated fuse (max. 5 s @ 8 A)		
Overvoltage category	п		
Altitude	Max 2000 m ASL		
Air humidity	Max 95%		

### 9.1.2 Controller features

Outputs	<ul><li>4 relay outputs:</li><li>1 dual channel safety output</li><li>2 auxiliary outputs</li></ul>
Safety output relays	<ul> <li>Forced guided relays</li> <li>Max voltage: 30 V dc</li> <li>Max current: 8 A dc</li> <li>Max power: 240 W</li> <li>Minimum switching load mW (V/mA): 500 (10/10)</li> </ul>
Auxiliary output relays	<ul> <li>Electromechanical relays</li> <li>Max voltage: 30 V dc</li> <li>Max current: 2 A dc</li> <li>Max power: 60 W</li> </ul>

Inputs	<ul> <li>3 dual channel digital inputs with common GND:</li> <li>1 type 1</li> <li>1 type 2</li> <li>1 type 3</li> </ul>	
	See "Voltage and current limits for digital inputs" on page 67.	
Power supply	24 V dc (20–28 V dc) *	
	Maximum current: 0.6 A	
Consumption	Max 3.8 W	
Assembly On DIN rail		
Degree of IP20 protection		
Terminals	Section: 2.5 mm <sup>2</sup> max	
	Max current: 12 A with 2.5 mm cables <sup>2</sup>	
Impact test 0.5 J, 0.25 kg ball from a 20 cm h		
Pollution degree	2	
Outdoor use	No	
Operating temperature	From -30 to +40 °C	
Storage temperature	From -40 to +80 °C	

**Note** \*: the device must be powered by an external power supply unit. An electric power supply disconnecting device is required, located in an accessible location and suitably identified. If the maximum current distributed by the power supply is greater than 20 A, insert a fuse in series with a tripping current slightly greater than 5.2 A.

The device must be connected to class 2 power sources as described in the National Electrical Code, NFPA 70, and in the Canadian Electrical Code, C22.1.





#### 9.1.3 Sensor features

Connectors 2 5-pin M12 connectors (1 male and 1 female)	
$\begin{array}{llllllllllllllllllllllllllllllllllll$	
<b>Power supply</b> 12 V dc ± 20%, through controller	
Consumption	Max 1.2 W
Degree of protectionType 3 enclosure, according to UL 50E, in addition to IP 67 rating	
Material Sensor: PA66	
	Bracket: PA66 and glass fiber (GF)
Impact test	5 J, 0.5 kg ball from a 100 cm height
Pollution degree	4
Outdoor use	Yes
Operating From -30 to +60 °C temperature	
Storage temperature	From -40 to +80 °C



## 9.1.4 CAN bus cables recommended specifications

Section	2 x 0.25 mm <sup>2</sup> power supply (recommended: 2 x 0.34 mm <sup>2</sup> ) 2 x 0.25 mm <sup>2</sup> data line (recommended: 2 x 0.34 mm <sup>2</sup> )	
Туре	Two for power supply and two for data line (recommended: two pairs of twisted pairs, power supply and data line)	
Connectors	5-pole M12, see "Connectors M12 CAN bus" on page 67 Connectors shall be type 3 (raintight)	
Impodance	$1200 \pm 120$ (f = 1 MHz)	
Impedance	120 12 112 12 (1 – 1 MHZ)	
Shield	Shield with twisted wires in tin-plated copper. To be connected to earth circuit on the power supply terminal block of the controller.	
Standards	Cables shall be listed in accordance with application as described in the National Electrical Code, NFPA 70, and in the Canadian Electrical Code, C22.1.	

#### 9.1.5 Side screws specifications

The side screws can be:

- cheese head and two-hole drive
- button head

Cheese head and two-hole drive screws



#### **Button head screws**



d <sub>1</sub>	M4
l	10 mm
d <sub>2</sub>	7.6 mm
k	2.2 mm
t	min 1.3 mm
S	2.5 mm
d <sub>3</sub>	max 1.1 mm

## 9.1.6 Bottom screws specifications

The bottom screws can be:

- cheese head
- button head

Note: Avoid using countersunk head screws.





# 9.2 Terminal blocks and connectors pin-outs

## 9.2.1 Safety outputs terminal block



Terminal	Description
СОМ	Common safety output 1
NO	Relay output normally open
СОМ	Common safety output 2
NO	Relay output normally open

Note: the operating temperature of the cables must be at least 105 °C.

**Note**: use only copper wires with 18 AWG min and tightening torque of 0.56 Nm (5 lbs in).

## 9.2.2 Auxiliary outputs terminal block



Terminal	Description
СОМ	Common auxiliary output 1
NO	Relay output normally open
СОМ	Common auxiliary output 2
NO	Relay output normally open

Note: the operating temperature of the cables must be at least 80  $^{\circ}\mathrm{C}.$ 

*Note*: use only copper wires with 18 AWG min and tightening torque of 0.56 Nm (5 lbs in).

## 9.2.3 Digital inputs terminal block



Type 2	Input 24 V dc type 2
Type 2	Input 24 V dc type 2
Туре З	Input 24 V dc type 3
Туре З	Input 24 V dc type 3
SNS	Input 24 V dc for diagnostics
<b>GND</b> Common reference for all digital inputs	

**Note**: the cables used must have a maximum length of 30 m and the operating temperature must be at least 90 °C.

**Note**: use only copper wires with 18 AWG min and tightening torque of 0.56 Nm (5 lbs in).

## **9.2.4** Voltage and current limits for digital inputs

The digital inputs (input voltage 24 V dc) adhere to the following voltage and current limits, in accordance with standard EN 61131-2:2003.

	Type 1	Type 2	Туре З
Vo	ltage limits		
0	from - 3 to 15 V	from - 3 to 11 V	from - 3 to 11 V
1	from 15 to 30 V	from 11 to 30 V	from 11 to 30 V
Current limits			
0	15 mA	30 mA	15 mA
1	from 2 to 15 mA	from 6 to 30 mA	from 2 to 15 mA

## 9.2.5 Power supply terminal block



Terminal	Description
+	+ 24 V dc
Ţ	Earth
-	GND

**Note**: the operating temperature of the cables must be at least 80 °C.

**Note**: use only copper wires with 18 AWG min and tightening torque of 0.56 Nm (5 lbs in).

#### 9.2.6 CAN bus terminal block



Terminal	Description	
+	+ 12 V dc	
Н	CAN H	
L	CANL	
-	GND	

Note: the operating temperature of the cables must be at least 80  $^{\circ}\mathrm{C}.$ 

#### 9.2.7 Connectors M12 CAN bus

2 0 1	
3 4	



Male connector

Female connector

- Pin
   Function

   1
   Shield, to be connected to earth circuit power supply terminal block of the controller.
- 2 +12 V dc3 GND
- **4** CAN H
- 4 CANH
- 5 CANL

### 9.3 Electrical connections

#### 9.3.1 Connection of safety outputs to the machinery control system



#### 9.3.2 Connection of safety outputs to an external safety relay



#### 9.3.3 Connection of emergency button



*Note*: the indicated emergency button opens the contact when pressed. *Note*: the cables used for wiring the digital inputs must have a maximum length of 30 m.

#### 9.3.4 Connection of restart enable button



*Note*: the indicated restart enable button closes the contact when pressed. *Note*: the cables used for wiring the digital inputs must have a maximum length of 30 m.



#### 9.3.5 Connection of the muting input and output (one group of sensors)

Note: the cables used for wiring the digital inputs must have a maximum length of 30 m.

#### 9.3.6 Connection of the muting input and output (two groups of sensors)



*Note*: the cables used for wiring the digital inputs must have a maximum length of 30 m.

#### 9.3.7 Pre-alarm output connection





#### 9.3.8 Diagnostic output connection

Note: the indicated light turns on in the presence of a failure.

### 9.4 Default values

#### 9.4.1 Parameter list

Parameter	Min	Max	Default value			
Settings User account						
Password	-	-	Not available			
Settings General						
Operational frequency	Full BW, Restricted BW	Full BW	Operational frequency			
Configuration						
Number of installed sensors	1	6	1			
Distance between sensors	0 mm	10000 mm	0 mm			
BARRIER LENGTH	0 mm	15000 mm	0 mm			
Actual length	0 mm	10000 mm	1581 mm			
Parameter	Min	Max	Default value			
---	--	------------------	----------------			
Plane	Dim. X: 2000 mm	Dim. X: 20000 mm	Dim. X: 8000			
	Dim. Y: 1000 mm	Dim. Y: 20000 mm	mm			
			Dim. Y: 4000			
Position (for each sensor)	X: 0 mm	X: 20000 mm	X: 2000 mm			
	Y: 0 mm	Y: 20000 mm	Y: 1000 mm			
Rotation (for each sensor)	0°	360°	0°			
Inclination (for each sensor)	0°	360°	0°			
Sensor installation height (for each sensor)	0 mm	3000 mm	0 mm			
Alarm distance(for each sensor)	1000 mm	4000 mm	1500 mm			
Pre-alarm distance (for each sensor)	0 mm	3000 mm	500 mm			
Field of vision (for each sensor)	110°, 50°		110°			
Safety functions (for each sensor)	Both (default), Always access detection, Always restart prevention		Both (default)			
	Settings Senso	irs				
Access sensitivity	Normal, High, Very High		Normal			
Restart sensitivity	Normal, High, Very High		Normal			
Restart timeout	0 ms 120 000 ms		5000 ms			
Anti-masking	Disabled, Low, Medium, High		High			
Anti-rotation around axes	Disabled, Enabled		Enabled			
	Settings Digital Inpu	t-Output				
Digital input (for each input)	Not configured, Stop signal, Restart signal, Muting group 1, Muting group 2, Muting group 3		Not configured			
Digital output (for each output)	Not configured, Pre-alarm signal, Muting enable feedback signal, System diagnostic signal		Not configured			
	Settings Mutir	ng				
Group for muting (for each sensor)	Group 1, Group 2, Group 3, both		Group 1			
Pulse width (for each Input TYPE)	0 μs (= Period and Phase shift disabled)	2000 µs	0 µs			
	200 µs					
Period (for each Input TYPE)	200 ms	2000 ms	200 ms			
Phase shift (for each Input TYPE)	0.4 ms	1000 ms	0.4 ms			

# 9.5 Digital input signals

## 9.5.1 Stop signal



Part	Description
Safety Output	De-energized on the falling edge of the input signal. The safety output remains de- energized as long as one of the two channels remains to the low logic state (0).
Stop signal CH1	Interchangeable channel. Both channels must go to high logic level (1) to disable the STOP status.
Stop signal CH2	
Dt	Activation delay. Minor than 2 ms.

## 9.5.2 Muting (with/without pulse)

Automatic restart (without pulse)



#### Automatic restart (with pulse)



*Note*: the tolerance on the input signals is +/-5% of the value for each parameter.

Manual or safe manual restart (without pulse)



#### Manual or safe manual restart (with pulse)



*Note*: the tolerance on the input signals is +/-5% of the value for each parameter.

Part	Description	
Muting signal (group <i>n</i> ) CH 1	Interchangeable channel.	
Muting signal (group <i>n</i> ) CH 2		
<b>Restart command</b>	It corresponds to the digital input of Restart signal.	
Muting status	Enabled as long as both channels are at a high logic level (1), and deactivated when one of the two goes to low logic level (0).	
	Exception for system in manual or safe manual: muting remains disabled until the restart enable button pressure.	
Dt	Activation/deactivation delay. Minor than 200 ms.	

## 9.5.3 Restart signal



Part	Description	
Safety Output	Energized on the falling edge of the first signal that goes to 0.	
Restart signal CH1	Interchangeable channel. Both signals must stay at high logical level (1) for at least 400 ms (t), and at least one of them must have a transition 0 -> 1 -> 0.	
Restart signal CH2		
Dt	Activation delay. Minor than 200 ms.	

# **10.** Appendix

## Contents

This section includes the following topics:

10.1	Disposal	78
10.2	Service and warranty	78

# **10.1 Disposal**

LBK System contains electrical parts. As set forth in European Directive 2012/19/EU, do not dispose of the product with unsorted urban waste materials.

It is the responsibility of the owner to dispose of these products, as well as other electrical and electronic equipment, through specific waste collection facilities indicated by the government or local public authorities.

Correct disposal and recycling will contribute to the prevention of potentially harmful consequences to the environment and human health.

To receive more detailed information about disposal, contact the relevant public authorities, waste disposal services or the representative from whom you purchased the product.

## **10.2 Service and warranty**

### **10.2.1** Customer service

Inxpect SpA Via Serpente, 91 25131 Brescia (BS) - Italy Tel: +39 030 5785105 Fax: +39 012 3456789 email: safety-support@inxpect.com website: www.inxpect.com

## **10.2.2** How to return the product

If necessary, return the product to the local distributor or exclusive distributor. **Use original packaging. Shipping costs are at the customer's expense**. Complete the request with information about the return on the website www.inxpect.com/industrial/rma.

Area distributor	Manufacturer
Note distributor information here:	Inxpect SpA Via Serpente, 91 25131 Brescia (BS) Italy www.inxpect.com

## **10.2.3** Service and warranty

Refer to www.inxpect.com for the following information:

- terms, exclusions and cancellation of the warranty
- general conditions of the Return Merchandise Authorization (RMA)



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