

Machine Safety Guide 2012

Creating a safe industrial world!

realrzing



TECHNOGR SAFETY SERVICE

Your partner for industrial machine safety throughout the entire machine lifecyle.



LECHNOGR Member of Omron Europe

Creating a safe industrial world

Nowadays, all responsible industries recognise the duty of care they owe their employees.

Taking all possible measures to avoid accidents in the workplace is not only a moral obligation, it also makes sound financial sense. Accidents are expensive – not only in lost working days, compensation for injury and higher insurance premiums, but also in other costs less easy to quantify like disrupted production, and the costs of accident investigations and of training new personnel to replace those injured in industrial accidents.

In every way, therefore, creating a safe industrial environment is a wise investment. Omron has many years' experience working closely with the world's leading machine manufacturers and with governing bodies that define today's international safety standards.



Content

2 Overview

Selected industry applications

- 4 Safety in material handling & logistics
- 6 Safety in food packaging
- 8 Safety in beverage industry
- **10** Safety in automotive parts industry
- 12 Safety in photovoltaic and electronics industry

Machine directive and European standards

- 14 Basic procedure
- 14 Harmonized standards
- 17 Six steps towards a safe machine
- 22 Performance level calculation
- 26 Example

Product information

- 30 Control- and signalling devices
- 52 Safety limit switches
- 60 Safety door switches
- 70 Safety sensors
- 94 Safe control systems
- 114 Safe actuating
- 130 Technical appendix

SELECTED INDUSTRY APPLICATIONS

MACHINE DIRECTIVE AND EUROPEAN STANDARDS



PRODUCT INFORMATION



SAFETY IN MATERIAL HANDLING & LOGISTICS

Global products for a safe local stop

A smooth and disturbance free operation is key for today's global distribution systems.

- Reliable products to stop only in case of an emergency for disturbance free operation.
- Global sourcing of products based on Omron's worldwide representatives for smooth maintenance.

BASICS FIRST

The Basic element to be used at certain danger points in every machine is the Emergency stop pushbutton. Its special design makes it easy for workers to recognize which pushbutton to press in case of a dangerous situation. At least one of them is mounted on every machine.

EMERGENCY STOP ON THE LINE

Mounting and wiring Emergency Stop pushbuttons on a conveyor system takes a lot of time and effort.

Omron Rope pull safety switches provide the safety function along the whole rope span and help to reduce installation, setup and maintenance cost.





More on Emergency Stop Pushbuttons A22E on page 37







SAFETY CHECKPOINT

Areas that operate automatically need protection. This can be done in many cases by using fixed guards. A safe and reliable seperation between a person and material is the key where material needs to go into or out of an automatic operating area. Omron Muting Control Systems and Muting Sensors are safeguarding these checkpoints.

NO TRESPASSING

Fences as a protective measure are commonly used to prevent access of persons to dangerous areas. Access is only allowed via maintenance doors when the machine is stopped. Omron Safety Door Switches detect if the door is open by use of well proved principles and prevent a restart of the machine if the door is open and a person is still in the machine.



More on Safety Sensors with Muting function F3S-TGR-CL_-K_C on page 74 More on Muting Sensors E3Z in the Industrial Sensing Guide





SAFETY IN FOOD PACKAGING

Made to last in demanding environments

The design of food packaging machines follows its own rules. Flexibility in packaging material and packed goods goes along with high hygienic demands and easy cleaning.

- Stainless steel housing for high detergent resistance.
- Flexible Safety Sensors design to follow machine design.
- Accessories for Safety light Curtains to improve cleaning resistance.

ENHANCED WATER RESISTANCE

Enhanced resistance against water is a key factor in food packaging industry due to the frequent cleaning cycles. Transparent plastic housings widen the applications for standard safety light curtains.





More on Safety Sensors MS2800 and MS4800 on page 72



FLEXIBLE INSTALLATION

The design of food packaging machines follows the requirements of easy to clean design. Single beam safety sensors in compact M18 housing protect workers without a lot of extra space needed.

READY FOR CLEANING

The cleaning procedure is a key factor in food production. The high-grade 316L Stainless steel housing of the F3S-TGR-N non contact switches is designed for high detergent resistance.





More on single beam safety sensors E3FS page 82



More on F3S-TGR_N page 66

SAFETY IN BEVERAGE INDUSTRY

Safe in normal operation and maintenance

Producing and handling of beverages is a high-speed automatic process. Flexible and modular machine design covers the growing demand for containers in various shapes and materials.

- Programmable standalone safety controllers to support modular safety control systems
- Hold-to-run devices for safe maintenance operation

FLEXIBLE INSTALLATION

Modular machine design is supported by our range of programmable standalone safety controllers G9SP, offering a simple and clear programming of the safety function, drastically reducing design and engineering effort.

SAFETY INSIDE

Inverters with an integrated safety function minimize time in installation, wiring and maintenance by removing the external contactors, without mechanical contacts wearing out.





More on G9SP page 108



More on V1000 page 119 More on MX2 page 122



HAND IN HAND WITH THE ROBOT

Workers need to be very close to the dangerous area inside the machine in teach-in or maintenance mode. For maximum protection, Enabling Grip Switches as hold-to-run devices guarantee a safe stop if the worker is in danger.

MATERIAL ONLY

Preconfigured Muting Systems with integrated muting lamp reduce the time for installation, wiring and setup of the safety system.





More on Enabling Grip Switches A4EG on page 101



More on Muting Systems F3S-TGR-CL_-K_C on page 74

SAFETY IN THE AUTOMOTIVE PARTS INDUSTRY

Zero defect, zero stop production

Producing high quality parts to order for the automotive industry requires the highest precision and machine availability during production. Robust and reliable design of the Safety System ensures minimum downtime and maximum productivity.

ENHANCED DURABILITY

Enhanced mechanical durability is a key factor in the automotive industry. Robust stands protect standard safety light curtains and minimize installation and maintenance downtime of the machine.

CLEAR GUIDANCE

Mechanical and electrical durability is a key feature of signal towers since machine operators rely on the signals they show. LED modules together with an impact and heat resistant ABS resin housing are the elements to give clear guidance of the operator for a long service life.





More on MS4800 page 72 More on F3S-TGR-CL page 74





More on LME Signal towers page 50

FLEXIBILITY IS KEY

Advanced intelligence in safety light curtains with precise detection capability allow close co-work between man and machine. Manually guided bending of metal is one of the applications.

ROBOT IN A CAGE

Robots are moving fast and carry heavy loads. Fixed guards protects workers from being hit by the robot or parts handled by the robot. Doors in the guards allow access to the robot in maintenance mode if the robot is stopped and the Safety Door locking switch is released.





More on MS4800 page 72 More on F3S-TGR-CL on page 74





SAFETY IN SEMICONDUCTOR, PHOTOVOLTAIC & ELECTRONICS INDUSTRY

For small, fast and flexible machines

Continuous miniaturisation and higher performance of electronic components and the ever increasing pressure to increase productivity, result in the demand for small sized, specialised safety systems with the highest value-performance ratio.

- · Optimized safety components for dedicated applications
- Reliable Safety Components for Never Stop Machines

CONTROL AND SIGNALLING ALIGNED

Stopping a process in the electronics or photovoltaic industry by accident will lead to a big loss of time and money. To prevent unintentional pressing of an Emergency Stop pushbutton, specially designed mounting kits provide an even machine surface.

If a machine stops during production, a fast reaction of the operator is needed. LED signal towers show to the operator, where to react first to minimize downtime and production loss.

WIRING IN MODULAR MACHINES MADE EASY

Covers and doors in the electronics industry are frequently used in maintenance or to check production. Monitoring is made easy by providing a system with up to 30 non-contact switches connected to one flexible safety unit, still providing individual diagnosis on every switch.









More on Non-contact system D40A page 99 More on signal towers LU7 page 45



SAFE POWER CONTROL

Forcibly guided contacts and a track mounting socket control pumps or heaters in small machines safely. For higher currents, contactors with integrated safety function are the right choice.





MACHINE DIRECTIVE AND EUROPEAN STANDARDS

Basic procedure for complying with the requirements of the Machinery Directive



The EU Machinery Directive stipulates that machinery should not present a risk to persons working in an industrial area (risk assessment in accordance with EN ISO 12100). Given that there is no zero risk in technology, the target is to

achieve an acceptable residual risk which may vary in the European countries, based on additional local technical test and maintenance rules.

If safety is dependent on control systems, these must be designed so that the probability of functional errors is sufficiently low. If this isn't possible, any errors that occur shall not lead to the loss of the safety function. To meet this requirement it makes sense to use harmonized standards that have been created in accordance with a mandate from the European Commission and are published in the Official Journal of the European Communities (presumption of conformity). This is the only way to avoid spending extra time and effort demonstrating conformity in the event of a claim.



Machine Directive 2006/42/EC is in place since December 29th, 2009 and is very clear in the requirements regarding risk assessment and documentation for the use of the machine along the complete lifecycle, including design,

manufacturing, setting-up, operation, maintenance and finally putting the machine out of service.

Harmonized Standards

The Past: EN954-1



In the past, the safety related parts of a machine's control system were designed in accordance with EN954-1. This was based on the calculated risk and formed into safety categories. The aim was to set an appropriate system behaviour ("control class") against a category. Once electronics, and programmable electronics in particular, had made their mark on safety technology, safety could no longer be measured purely in terms of the simple category system found in EN 954-1. Furthermore, it was unable to provide information on probability of failure.





 i i



Basic requirements

Harmonized Standards

ards a sa

Six steps towards Perfor a safe machine level ca

Performance level calculation

Presence and future: EN ISO 13849-1 and EN62061

Now, there are two standards dealing with safety of machinery listed under machine directive: EN ISO 13849-1 and EN 62061. Both of them are suitable for a certain range of technology used in machines and below table can be found in both standards:

	Technology implementing the safety-related control function(s)	EN ISO 13849-1	EN 62061
Α	Non-electrical, e.g. hydraulics	applicable	not covered
В	Electromechanical, e.g. relays, and/or non complex electronics	Restricted to designated architectures and up to $PL=e$	All architectures and up to SIL3
C	Complex electronics, e.g. programmable	Restricted to designated architectures and up to $PL=d$	All architectures and up to SIL3
D	A combined with B	Restricted to designated architectures and up to $PL=e$	For non-electrical technology, use parts in accordance with ISO 13849 as subsystems
E	C combined with B	Restricted to designated architectures and up to $PL=d$	All architectures and up to SIL 3
F	C combined with A, or C combined with A and B	For complex electronics: use designated architectures according to EN ISO 13849 up to $PL = d$ or any architecture according to EN 62061	For non-electrical technology, use parts in accordance with ISO 13849 as subsystems

A) EN ISO 13849-1:

Safety related parts of control systems, Part 1: General principles for design.

This standard may be applied to SRP/CS (safety-related parts of control systems) and all types of machinery, regardless of the type of technology and energy used (electrical, hydraulic, pneumatic, mechanical, etc.). EN ISO 13849-1 also lists special requirements for SRP/CS with programmable electronic systems.

Brief overview:

EN ISO 13849-1 is based on the familiar categories from EN 954-1:1996. It examines complete safety functions, including all the components involved in their design.

EN ISO 13849-1 goes beyond the qualitative approach of EN 954-1 to include a quantitative assessment of the safety functions. A performance level "PL" is used for this, building upon the categories.

Components/devices require the following safety parameters:

- Category (structural requirement)
- PL: Performance level
- MTTF_d: Mean time to dangerous failure

- B_{10d}: Number of cycles by which 10% of a random sample of wearing components have failed dangerously
- DC: Diagnostic coverage
- CCF: Common Cause Failure
- T_M: Mission time

The standard describes how to calculate the performance level (PL) for safety-related parts of control systems, based on designated architectures, for the designated mission time T_M .

A basic set of Safety parameters for the calculation is mentioned in the EN ISO 13849-1. Additionally Omron supplies these parameters for certain product families on demand. Therefore please refer to the technical information in this guide or contact your Omron partner.

EN ISO 13849-1 refers any deviations to IEC 61508. Where several safety-related parts are combined into one overall system, the standard describes how to calculate the PL that can be achieved.

For additional guidelines on validation EN ISO 13849-1 refers to Part 2 of this standard, which was published at the end of 2003. This part provides information on fault considerations, maintenance, technical documentation and usage guidelines.

B) EN 62061

Functional safety of safety-related electrical, electronic and programmable electronic control systems.

This standard defines requirements and gives recommendations for the design, integration and validation of safety-related electrical, electronic and programmable electronic control systems (SRECS) for machinery. It does not define requirements for the performance of non-electrical (e.g. hydraulic, pneumatic, electromechanical) safety-related control elements for machinery.

Brief overview:

EN 62061 represents a sector-specific standard under IEC 61508. It describes the implementation of safety-related electrical and electronic control systems on machinery and examines the overall lifecycle from the concept phase through to decommissioning. Quantitative and qualitative examinations of the safety-related control functions form the basis.

The performance of the safety system is described through the safety integrity level (SIL).

The safety functions identified from the risk analysis are divided into safety sub-functions; these safety sub-functions are then assigned to actual devices, called subsystems and subsystem elements. Both hardware and software are handled this way.

A safety-related control system is made up of several subsystems. The safety-related characteristics of these subsystems are described through parameters (SIL claim limit and PFH_D).



Safety-related parameters for subsystems:

- SIL_{CL}: SIL claim limit
- PFH_D: Probability of dangerous failure per hour
- T₁: Lifetime

These sub-systems may in turn be made up of various interconnected sub-system elements (devices) with parameters to calculate the sub-system's corresponding PFH_D value.

Safety-related parameters for sub-system elements (devices):

- λ: Failure rate; for wearing elements: describe via the B₁₀ value
- SFF: Safe failure fraction

On electromechanical devices the failure rate is indicated by the manufacturer as a B_{10} value, based on the number of cycles. The time-based failure rate and lifetime must be determined through the switching frequency for the respective application.

Internal parameters to be established during design or construction for a sub-system comprised of sub-system elements:

- T₂: Diagnostic test interval
- β: Susceptibility to common cause failure
- DC: Diagnostic Coverage
- PFH_D: The PFH_D value of the safety-related control system is calculated by adding the sub-systems' individual PFH_D values.

Users have the following options when designing a safety-related control system:

- Use devices and sub-systems that already comply with EN 954-1 and IEC 61508 or EN 62061. The standard specifies how to incorporate qualified devices when implementing safety functions.
- Develop their own sub-systems.
 - Apply IEC 61508 for programmable, electronic sub-systems or complex sub-system.
 - Apply EN 62061 for simple devices and sub-systems.

The standard represents a comprehensive system for the implementation of safety-related electrical, electronic and programmable electronic control systems. EN 62061 has been harmonized standard since December 2005.





Standards



a safe machine level calculation

Six steps towards

Performance

SIX STEPS TOWARDS A SAFE MACHINE



For further information please refer to the next pages...

MACHINE DIRECTIVE AND EUROPEAN STANDARDS

Basic procedure to achieve safety step-by-step

Step 1 – Risk assessment in accordance with EN ISO 12100

Sooner or later, a hazard on a machine will result in harm to a person if no safety measures are put in place. Safety measures are a combination of these measures taken by the designer and those implemented by the user. Measures taken at the design phase are preferable to those implemented by the user, and generally they are also more effective.

Approach during the machine design





The designer must follow the sequence described below, bearing in mind the experience gained by users of similar machinery and information gained from discussions with potential users (if this is possible):

- Establish the limits and the intended use of the machinery;
- Identify the hazards and any associated hazardous situations;
- Estimate the risk for each identified hazard and hazardous situation;
- Evaluate the risk and decide on the need for risk reduction.

Step 2 – Define the measures required to reduce the calculated risks

The objective is to reduce risk as much as possible, taking various factors into account. The process is iterative; making the best possible use of the available technologies where it may be necessary to repeat the process several times in order to reduce the risk.

When carrying out the process, the following priority ranking shall apply:

- 1. Safety of the machine in all phases of its lifetime;
- 2. The ability of the machine to perform its function;
- 3. User friendliness of the machine.

Only then shall the machine's manufacturing, operating and disassembly costs be taken into consideration.

The hazard analysis and risk reduction process requires hazards to be eliminated or reduced through a hierarchy of measures:

- 1. Hazard elimination or risk reduction through design
- Risk reduction through technical protection devices and potential additional protective measures
- 3. Risk reduction through the availability of user information about residual risk.











Basic requirements

Harmonized Six si Standards a sa

Six steps towards Perform a safe machine level calo

Performance level calculation

Step 3 – Risk reduction through control measures

If safety-related control parts are used to control a protective measure in order to achieve the necessary risk reduction, the design of these control parts shall be an integral part of the whole design procedure for the machine. The safety-related control system provides the safety function(s) with a Category, Safety integrity level (SIL) or Performance Level (PL) that achieves the necessary risk reduction.



Step 4 – Implementation of control measures using EN ISO 13849-1 or EN 62061

Step 4.1: Determination of the required performance level

Serious (normally irrereversible injury including death)

Seldom to less often and/or the exposure time is short

Frequent to continuous and/or the exposure time is long

Possibilities of avoiding the hazard or limiting the harm

This determination needs to be done independent if conformity according to EN ISO 13849-1 of EN 62061 is needed. Both standards refer to the severity of the injury, the frequency or exposure time to the hazard and the possibility to avoid the dangerous condition.

EN ISO 13849:

S -

S₁ -

S₂ -

F -

F₁

F₂

P₁

 P_2

-

EN 62061:

Determination of the required performance level (PL)

Frequency and/or exposure to a hazard

Possible under specific conditions

Severity of injury

Scarcely possible

Slight (reversible injury)

Low contribution to risk reduction



High contribution to risk reduction

* Starting point for evaluation of safety functions contrbition to risk reduction.

Risk assessment and definition of the required safety integrity level

Consequences		Frequenzy		Probability of		Avoidance		Class C	I .			
and severity	Se	and duration	Fr	hazardous event	Pr		Av	3-4	5-7	8-10	11-13	14-15
Death, losing an eye or arm	4	< 1 hour	5	Very high	5			SIL 2	SIL 2	SIL 2	SIL 3	SIL 3
Permanent losing fingers	3	> 1 hour - ≤ 1 day	5	Likely	4				OM	SIL 1	SIL 2	SIL 3
Reversible, medical attention	2	> 1 day - ≤ 2 weeks	4	Possible	3	Impossible	5			OM	SIL 1	SIL 2
Reversible, first aid	1	> 2 weeks - ≤ 1 year	3	Rarely	2	Possible	3				OM	SIL 1
		> 1 year	2	Negligible	1	Likely	1					
									014	othor m		oquirod

For a more detailed view on how to determine the performance level and the required safety integrity level, please refer to the calculations shown in the standards.

Step 4.2: Specification

The specification of the functional requirements shall describe each safety function that is to be performed. Any interfaces with other control functions shall be defined and any necessary error reactions established. The required SIL or PL must be defined.

Step 4.3: Design of the control architecture

Part of the risk reduction process involves the definition of the machine's safety functions. This includes the safety functions on the control system, e.g. to prevent unexpected start-up. When defining the safety functions it is always important to consider that a machine has different operating modes (e.g. automatic & setup mode) and that the safety measures in these different modes may be totally different (e.g. safety limited speed in setup mode <-> two-hand in automatic mode). A safety function may be implemented via one or more safety related control parts and several safety functions may be divided over one or more safety-related control parts (e.g. logic module, energy transmission element(s)).

Step 4.4: Determination of the achieved performance level of the safety system

EN ISO 13849-1:

The PL shall be estimated for each selected SRP/CS and/or combination of SRP/CS that performs a safety function.

The PL of the SRP/CS shall be determined by the estimation of the following parameters:

- the MTTF_d value for single components
- the DC
- the CCF
- the structure (category)
- the behaviour of the safety function under fault condition(s)
- · safety-related software
- systematic failures
- the ability to perform a safety function under expected environmental conditions

EN 62061:

The selection or design of the SRECS shall always meet the following minimum requirements:

Requirements for hardware safety integrity, comprising

- Architectural constraints for hardware safety integrity
- Requirements for the probability of dangerous random hardware failures plus requirements for systematic safety integrity, comprising
- Requirements for avoidance of failures and
- Requirements for the control of systematic failures

EN 62061 also describes requirements for implementing application programs.

Safety-related parameters for sub-systems:

- SIL_{CL}: SIL claim limit
- PFH_D: Probability of dangerous failure per hour
- T₁: Lifetime

Safety-related parameters for subsystem elements (devices):

- λ : Failure rate
- B₁₀: for wearing elements
- T₁: Life time
- T₂: Diagnostic test interval
- β: Susceptibility to common cause failure
- DC: Diagnostic coverage
- SFF: Safe failure fraction
- HFT: Hardware fault tolerance







PL

Basic requirements Harmonized Standards Six steps towards a safe machine

s Performance level calculation

Step 5 – Verification

After setting up the safety system, a cross check between the required "safety levels" and finally reached "safety levels" is mandatory. The realized system has to fulfill at least the minimum requirements specified during the risk assessment.

EN ISO 13849-1:

For each individual safety function, the PL of the corresponding SRP/CS must match the "Required Performance Level". Where various SRP/CS form part of a safety function, their PLs shall be equal to or greater than the performance level required for this function.

EN 62061:

The probability of dangerous failure of each safety-related control function (SRCF) as a result of dangerous random hardware failures shall be equal to or less than the failure threshold value defined in the specification of the safety requirements.

The SIL that is achieved by the SRECS on the basis of architectural constraints shall be less than or equal to the lowest SIL_{CL} of any sub-system involved in performing the safety function.

Step 6 – Validation

The design of a safety-related control function shall be validated. The validation must show that the combination for each safety function of the safety-related parts meets the relevant requirements.

The results of the validation need to be documented in detail because they show what the machine builder considered during risk analysis and implementation of the safety measures. Additionally the documentation should show a clear test plan and how it was carried out.

Conclusion:

Independent of which standard is used to declare conformity to machine directive – the steps to take in the process are quite similar. If you have open questions regarding this whole process, please contact your Omron representative or one of our specialized Omron Safety Partners.

PERFORMANCE LEVEL CALCULATION

Implementation of control measures using EN ISO 13849-1

This chapter shows a short summary of the EN ISO 13849-1 content. To claim conformity according EN ISO 13849-1 please read this standard carefully. For further information or support, please contact your local Omron partner or the Omron Safety Service Network. The approach according to EN ISO 13849-1 is quite similar to the approach that is known from EN 954-1. The first step is the determination of the required performance level. EN ISO 13849-1 shows a risk graph that helps evaluate the level of risk for each individual hazard in the machine. Of course it is possible to use other methods for risk evaluation as well.

Determination of the required performance level (PL)

- S Severity of injury
- S₁ Slight (reversible injury)
- S₂ Serious (normally irrereversible injury including death)
- F Frequency and/or exposure to a hazard
- ${\sf F}_1~$ ~ Seldom to less often and/or the exposure time is short
- F_2 Frequent to continuous and/or the exposure time is long
- P Possibilities of avoiding the hazard or limiting the harm
- P1 Possible under specific conditions
- P₂ Scarcely possible

Low contribution to risk reduction



* Starting point for evaluation of safety functions contrbition to risk reduction.





Ĭ



Basic requirements

Harmonized Six Standards a s

Six steps towards Performance a safe machine level calculation

Components and Subsystems

Knowing the required performance level (PL_r), it is possible to design the safety function, which is built on several parameters:

1) Hardware structure formed into categories (B, 1, 2, 3 and 4)

- 2) Reliability data of the system or components (MTTF_d)
- 3) System reliability, diagnostic coverage (DCavg)
- 4) Design integrity (CCF)

Additionally, the installation of a proper quality management system is a basic requirement to the management.

1) Hardware structure (Safety category)

Every safety system is built of three subsystems: input, logic and output. The way this hardware is designed describes the architecture of the safety system. In the end, the hardware structure is the successor of the known safety categories from EN954-1.

Single channel hardware structure:

This hardware structure uses only one channel to stop the dangerous movement of the machine. This structure is known from category B and category 1 acc. EN954-1. The main difference between category B and 1 is the reliability of the used components. In category 1, well proven safety principles like well tried components are used to reduce the risk of loosing the safety function. A single fault in the system may result in the loss of the safety function.



Dual channel hardware structure:

Most of the machine safety systems are based on dual channel hardware structure. This structure can be build of:

a) a single channel system + test system (category 2)



This example shows a category 2 system with two separate outputs. The Test equipment (TE) monitors (m) the correct function of the Input, Logic and Output. If the test results are ok, the test output (OTE) is activated. A failure in the safety system can be detected by the Test equipment and will not result in a loss of the safety function since the shutdown still can be done via the second channel.



A category 3 safety system is build of two channels, which can be done homogenous (same technology in both channels) or divers (different technology in both channels, e.g. electronics in channel 1 and electromechanics in channel 2). Some Category 3 systems require monitoring (m) of the outputs or cross monitoring (C) of the logic system, depending on the individual design. A failure in one channel does not lead to a loss of the safety function. Accumulation of failures is not covered by a category 3 system.

c) two similar channels + test system (category 4)



Category 4 systems use two channels as well (homogenous or divers). Monitoring (m) and cross-monitoring (C) is used to detect multiple failures in the system without loosing the safety function.

2) Reliability of the system or individual components (MTTFd)

There are two things that are important for safety systems. They have to be safe and reliable. Reliability is directly linked to productivity and therefore important since each and every unnecessary shutdown due to a failure of the system or one component stops production and will increase the risk of manipulation. System failures happen more frequently in the beginning and close to the end of the lifetime of a system or an individual component.

a) Mechanical, electromechanical, pneumatic and hydraulic systems Failure of these components is linked to the lifetime and/or the number of operations. A common way to test and to describe the behavior is to do a lifetime test until 10% of the units under test fail. This is called B₁₀. For safety, the test is more specific and B_{10d} shows the value until 10% of the units in test fail to the dangerous side. Typical components that come with a B_{10d} value are safety limit switches, safety door switches and safety relays.

b) Electronic systems

In electronic systems, the failure rate is a probabilistic value that is calculated by using the individual data of all components in use since there is a FIT value (failures in time) for all kinds of components.

MTTF _d classification					
Low	3 years <=	MTTF _d	< 10 years		
Medium	10 years <=	MTTF _d	< 30 years		
High	30 years <=	MTTF _d	< 100 years		

For electronic systems (b), MTTF_{d} is part of the documentation and supplied by the manufacturer.

For mechanical, electromechanical, pneumatic and hydraulic systems (a) MTTF_d can be calculated by the parameter B_{10d} that is also part of the documentation and the number of operations per year n_a according to:











Basic requirements Harmonized Standards

Six steps towards a safe machine

Performance level calculation

3) System reliability, diagnostic coverage (DCavg)

EN ISO 13849-1 describes four levels how the safety system is tested internally.

System reliability			
None		DCavg	< 60%
Low	60% <=	DCavg	< 90%
Medium	90% <=	DCavg	< 99%
High	99% <=	DC _{avg}	

The quality of the tests in the system is a measure how failures are detected. The better the system is tested, the higher is the level of safety. This method is applicable instead of a detailed FMEA acc. EN ISO 13849-1.

4) Design integrity and common cause failures (CCF)

External impacts like overvoltage or high temperature may damage a safety system even if it consists of two channels. This impact influences both channels in the same way since there is one common cause that makes both channels fail.

EN ISO 13849-1 uses a point system to check if the minimum requirements are met by the system. The minimum number of points is 65 out of 100:

Requirements		Maximum
Separation	Separation of signals, Isolation etc.	15 Points
Diversity	Different technologies or components	20 Points
Design, Application,	Overload, overvoltage or protection	15 Points
Experience	Use of well proven components or technologies	5 Points
Analysis	Failure analysis is used to avoid common cause failures	5 Points
Competence, Training	Training of designers to understand CCF and learn how to avoid	5 Points
Environment	EMC Test	25 Points
Training	Shock, vibration or temperature test and learn how to avoid	10 Points
Environment	EMC Test	25 Points
	Shock, vibration or temperature test	10 Points

Performance level of a subsystem

EN ISO 13849-1 summarizes all this information in one graph



How to read this graph for a PL = d system:

Option 1: Cat.2 system with $MTTF_d$ = high and DC = medium Option 2: Cat. 3 system with $MTTF_d$ = medium and DC = medium Of course there are other options possible as well according to this graph.

Setting up a safety system

EN ISO 13849-1 describes a simple process to combine subsystems if the PL for all the subsystems is known.

1. Determine the subsystem with the weakest PL (PL low).

2. Determine the number of subsystems (n low) with PL low.

PL low	n low		PL
Weakest PL of the subsystems	Number of subsystems with PL low		Maximum PL that can be achieved
а	>3	→	-
	<=3	→	а
b	>2	→	а
	<=2	→	b
С	>2	→	b
	<=2	→	С
d	>3	→	С
	<=3	→	d
е	>3	→	d
	<=3	→	е

Example

Risk analysis showed a required performance level $PL_r = e$ for a safety system. The system in use to solve this is shown below:



In this example, MTTF_d is known for F3S-TGR-CL and G9SX-BC. The two contactors are part of the output system, where G9SX-BC is used for test purposes (relay monitoring of the mirror contacts). For the contactors, a subsystem is defined and the calculation of MTTF_d is done as shown:

Step 1: Define Subsystem Output

The subsystem output includes the G9SX-BC and the two contactors. Each of the G9SX-BC outputs drives one contactor. Each contactor is equipped with mirror contacts. The feedback signal of the mirror contacts is checked by the G9SX-BC.







i



Basic requirements

Harmonized S Standards

Six steps towards Perf a safe machine level of

Performance level calculation

Step 2: Hardware architecture of the subsystem output:

Safety relay unit G9SX-BC is a two channel system (L1 and L2) using cross-checking (c). 01 and 02 are the two contactors. So the hardware structure is able to fulfill the requirements of a category 3 or category 4.



Step 3: Calculation of subsystem MTTFd

Calculation of the MTTFd per channel (calculation is needed only once since the two contactors are operated in the same way):

$$\mathsf{MTTF}_{\mathsf{d}} = \frac{\mathsf{B}_{10\mathsf{d}}}{\mathsf{0,1 x n}_{\mathsf{a}}}$$

where:

na

 $B10_d$ of the Contactor = 1500000 Cycle time (t) = 30 min (assumption) Daily operation hours (h) = 14 hours/day Yearly operation days (d) = 220 days/year

$$= \frac{d x h x 60 \min/h}{t} = \frac{220 day/year x 14 h/day x 60 \min/h}{30 \min/cycle} = 6160 cycles/year$$

MTTF_d =
$$\frac{1500000}{0.1 \times 6160}$$
 = 2435 years

A MTTF_d of 2435 years is "high" according to EN ISO 13849-1.

Step 4: Check diagnostic coverage

DC can be assumed high acc. EN ISO 13849-1 since the feedback monitoring of the forcibly guided contacts allow precise testing and diagnosis.

Step 5: Verify Design Integrity of the Subsystem

For Design integrity (CCF), we can select:

Separation	15 points
Design and Development	20 points
Competence and training	5 points
Environment	35 points

This results in 75 points for the output subsystem.

Step 6 Performance level of the subsystem

As result, the graph now can be used to find the PL for the subsystem:



Step 7: Calculation of the complete system (values are just for calculation and do not represent real data):





 $\begin{array}{l} \textbf{Safety Light Curtain F3S-TGR-CL} \\ \textbf{MTTF}_d = 100 \text{ years} \\ \textbf{Category 4} \\ \textbf{DC}_{avg} = 99\% \end{array}$







 $\begin{array}{l} \mbox{Contactor (with mirror contacts)} \\ \mbox{MTTF}_d = 2435 \mbox{ years} \\ \mbox{Category 4} \\ \mbox{DC}_{avg} = 99\% \end{array}$

Step 8: Calculation of the total MTTFd:

$$MTTF_{d} = \frac{1}{\sum_{i=1}^{3} \frac{1}{MTTF_{d}i}} = \frac{1}{\frac{1}{100} + \frac{1}{100} + \frac{1}{2435}} = \frac{1}{0,0201} = 48,99 \text{ years}$$

Step 9: Calculation of the total DCavg:

$$DC_{avg} = \frac{\sum_{i=1}^{2} \frac{DC_{i}}{MTTF_{di}}}{\sum_{i=1}^{2} \frac{1}{MTTF_{di}}} = \frac{\frac{0,99}{100} + \frac{0,99}{2435}}{\frac{1}{100} + \frac{1}{2435}} = 0,99$$

Step 10: Check results

Hardware structure:

F3S-TGR-CL and G9SX-BC use an internal hardware structure acc. category 4, the subsystem output is suitable for category 4 as well. A MTTF_d of 48,99 years is considered as "high" acc. EN ISO 13849-1. and a DC of 0,99 is considered "high" as well. In the end, the total system fulfills the requirements of a PL = e system, so all requirements regarding the performance level of the safety system are met.

28









Basic requirements Harmonized Standards

Six steps towards

Performance a safe machine level calculation

Further information and tools

Further information is available from your Omron partner or the local notified bodies working in machine safety.

CONTROL AND SIGNALLING DEVICES

Interact with your machine

Machines that are stopped during production are creating extra cost, our signal towers are used to show this status and guide workers to service the machines efficiently, minimizing downtime and production loss.



	SAFE CONTROL SYSTEMS FOR CONTROL AND SIGNALLING DEVICES						
Safety F	Relay Units	Flexible Safety Units	Safety Co	ntrollers	Safety Sensors		
G9SB	G9SA	G9SX	G9SP	NE1A	F3S-TGR-CL		
see page 97	see page 98	see page 103	see page 108	see page 111	see page 74		

Control devices

Standard- and E-Stop pushbutton switches family

- 16 mm mounting diameter
- Wide range of switching capacity
- · Short mounting depth
- High protection class IP65
- UL, CSA and VDE approved
- Conforms to EN60947-5-1 and IEC 947-5-1
- 22 mm mounting diameter
- Wide range of switching capacity
- Modular design for flexibility in application
- High protection class IP65
- UL, CSA and VDE approved
- Conforms to EN60947-5-1 and IEC 947-5-1





E-Stop pushbutton







16 mm pushbutton switch

These sub-assembled pushbutton switches have a modular construction: pushbutton + case + lamp (if applicable) + switch. A16 is a nut-mounted pushbutton switch with a short mounting depth of less than 28.5mm below panel.

- Wide variety of control and signal devices: lighted, non-lighted and buzzer
- Quick and easy assembly, snap-in switch
- Wide range of switching capacity from standard load to micro load
- High reliability, IP65
- UL, cUL, CSA and VDE approved, conforms to EN60947-5-1 and IEC947-5-1

Ordering information

Туре	Colour	Order code				
		Degree of protection: Oil-resistant IP65				
		Rectangular	Square	Round		
Non-lighted	Red	A165L-JR	A165L-AR	A165L-TR		
LED	Yellow	A165L-JY	A165L-AY	A165L-TY		
incanuescent lamp	Pure yellow	A165L-JPY	A165L-APY	A165L-TPY		
	White	A165L-JW	A165L-AW	A165L-TW		
	Blue	A165L-JA	A165L-AA	A165L-TA		
Non-lighted	Black	A165L-JB	A165L-AB	A165L-TB		
LED	Green	A165L-TGY	A165L-AGY	A165L-TGY		
Non-lighted/incandescent lamp	Green	A165L-JG	A165L-AG	A165L-TG		

Cases

Appearance	pearance Classification		Order code
			Oil-resistant IP65
đ	Momentary operation	Rectangular (2-way guard)	A165-CJM
		Square	A165-CAM
		Round	A165-CTM
	Alternate operation	Rectangular (2-way guard)	A165-CJA
		Square	A165-CAA
		Round	A165-CTA

A

Switches

Appearance	Classification				Order code
Lighted/ non-lighted (common use)	Lighted/ non-lighted	Standard load/ microload (common	SPDT	Solder terminal	A16-1
	use)	DPDT		A16-2	
			SPDT	PCB terminal	A16-1P
		DPDT		A16-2P	
			DPDT	Screw- less clamp	A16-2S

Switches with reduced voltage lighting

opearance	Classi	fication	Order code		
()	100 V	Standard load/ microload	SPDT	Solder terminal	A16-T1-1
E.	(common use)	DPDT		A16-T1-2	
	100 V		DPDT	Screw-less clamp	A16-T1-2S
5	200 V				A16-T2-2S

Lamps

Туре	Colour	Order code				
		5 VDC	12 VDC	24 VDC		
LED	Red	A16-5DSR	A16-12DSR	A16-24DSR		
	Yellow	A16-5DSY	A16-12DSY	A16-24DSY		
	Green	A16-5DSG	A16-12DSG	A16-24DSG		
	White *1	A16-5DSW	A16-12DSW	A16-24DSW		
	Blue	A16-5DA	A16-12DA	A16-24DA		
Туре		5 VAC/VDC	12 VAC/VDC	24 VAC/VDC		
Incandescent lamp		A16-5	A16-12	A16-24		

 $^{\star 1}\,$ Use the white LED together with white or pure yellow pushbuttons.

Standard pushbutton switches

Accessories				
Name	Appearance	Classification	Remarks	Order code
Switch guards		For rectangular models	Cannot be used with the dust cover	A16ZJ-5050
		For square and round models		A16ZA-5050
Dust covers		For rectangular models	Cannot be used with the switch guard	A16ZJ-5060
		For square models		A16ZA-5060
		For round models		A16ZT-5060
Panel plugs		For rectangular models	Used for covering the panel cutouts for future panel expansion	A16ZJ-3003
		For square models		A16ZA-3003
		For round models		A16ZT-3003

Specifications

Allowable operating frequency	Mechanical	Momentary operation: 120 operations/minute max. Alternate operation: 60 operations/minute max.
	Electrical	20 operations/minute max.
Durability	Mechanical	Momentary operation: 2,000,000 operations min. Alternate operation: 200,000 operations min.
	Electrical	100,000 operations min.
Ambient temperature		Operating: -10 to 55°C (with no icing or condensation) Storage: -25 to 65°C (with no icing or condensation)
Weight		Approx. 10 g (in the case of a lighted DPDT switch with solder terminals)
Size in mm (HxWxD)		Round/square: 18x18x28.5 rectangular: 18x24x28.5

Operating	Pushbutton switch		Item	Item		Screw-less clamp			
characteristics	Oil-resistant IP65	-resistant IP65		Recommended wire size		0.5 mm ² twisted wire or 0.8 mm dia. solid wire			
	SPDT	DPDT	Usable wires and	Twisted wire	0.3 mm ²	0.5 mm ²	0.75 mm ²	1.25 mm ²	
Operating force (OF) max.	2.94 N	4.91 N	tensile strength	Solid wire	0.5 mm dia.	0.8 mm dia.	1.0 mm dia.		
Releasing force (RF) min.	0.29 N			Tensile strength	10 N	20 N	30 N	40 N	
Total travel (TT)	Approx. 3 mm		Length of expose	d wire	10 ±1 mm				
Pretravel (PT) max.	2.5 mm								
Lock stroke (LTA) min.	0.5 mm								



Emergency stop switch

The A165E line-up offers E-Stop switches with various head types. For flexible application, a wide range of accessories is provided. To set up easy installation and maintenance, various contact combinations are available.

- Direct opening mechanism with minimum contact separation of 3 mm
- Safety lock mechanism prevents misuse
- Short mounting depth
- Modular construction; easy installation using snap-in switch

Ordering information

Switches	Rated voltage	Pushbutton color	Pushbutton size	Terminal	Contact	Order code
						Standard Ioad (125 VAC at 5 A, 250 VAC at 3 A, 30 VDC at 3 A)
LED	24 VDC	Red	30 dia. 40 dia.	Solder terminal	SPST-NC	A165E-LS-24D-01
					DPST-NC	A165E-LS-24D-02
None	-				SPST-NC	A165E-S-01
					DPST-NC	A165E-S-02
					TPST-NC	A165E-S-03U
LED	24 VDC				SPST-NC	A165E-LM-24D-01
					DPST-NC	A165E-LM-24D-02
None	-				SPST-NC	A165E-M-01
					DPST-NC	A165E-M-02
					TPST-NC	A165E-M-03U

Note: The above models have a surface indication of "RESET." Models with "STOP" indication are also available. For further information, contact your Omron representative.

Accessories (order separately)

Item	Туре	Precautions	Order code
Yellow plate	Yellow, 45 dia.	Use this as an emergency stop nameplate.	A16Z-5070
Panel plug	Round	Used for covering the panel cutouts for future panel expansion.	A16ZT-3003
Tightening tool	-	Useful for repetitive mounting. Be careful not to tighten excessively.	A16Z-3004
Extractor	-	Convenient for extracting the switch and lamp.	A16Z-5080

Specifications

Rated voltage	Resistive load		Features	Characteristics
	A165E series	A165EU series	Operating force (OF) max.	14.7 N
125 VAC	5 A	1 A	Releasing force (RF) min.	0.1 N·m
250 VAC	3 A	0.5 A	Pretravel (PT)	3.5±0.5 mm
30 VDC	3 A	1 A		(3±0.5 mm In case of A165E_U series)
Minimum applicable load	150 mA at 5 VDC	1 mA at 5 VDC		

Item		Emergency stop switch			
Allowable operating frequency	Mechanical	20 operations/minute max.			
	Electrical	10 operations/minute max.			
Insulation resistance		100 MΩ min. (at 500 VDC)			
Dielectric strength		1,000 VAC, 50/60 Hz for 1 min between terminals of same polarity 2,000 VAC, 50/60 Hz for 1 min between terminals of different polarity and also between each terminal and ground 1,000 VAC, 50/60 Hz for 1 min between lamp terminals ^{*1}			
Durability	Mechanical	100,000 operations min.			
	Electrical	100,000 operations min.			
Ambient temperature		Operating: -10 to 55°C (with no icing or condensation) Storage: -25 to 65°C (with no icing or condensation)			
Protection against electric shock		Class II			

^{*1} LED not mounted. Test them with the LED removed.


22 mm pushbutton switch

A22 comes in a wide variety of shapes and colours and is installable in 22-dia. or 25-dia. panel cutouts. The switch unit can easily be mounted. A22 is mounted using either open-type (fork-type) or closed-type (round-type) crimp terminals.

- Finger-protection mechanism on switch unit provided as standard feature
- Increased wiring efficiency with three-row mounting of switch blocks
- IP65 oil-resistant (non-lighted models), IP65 (lighted models)
- Lighted and non-lighted, flat, projection and half- and full-guard versions
- EN60947-5-1, UL and cUL approved

Ordering information

Pusnbutton	rusnoutton								
Illumination	Colour	Order code							
		Flat type	Projection type	Full-guard type	Half-guard type	Square/ projection type	Square/ full-guard type	Round/ mushroom type (30-dia. head)	Round/ mushroom type (40-dia. head)
		<u>کې</u>	S	S	S		N		
Non-lighted	Red	A22-FR	A22-TR	A22-GR	A22-HR	A22-CR	A22-DR	A22-SR	A22-MR
	Green	A22-FG	A22-TG	A22-TG	A22-HG	A22-CG	A22-DG	A22-SG	A22-MG
	Yellow	A22-FY	A22-TY	A22-GY	A22-HY	A22-CY	A22-DY	A22-SY	A22-MY
	White	A22-FW	A22-TW	A22-GW	A22-HW	A22-CW	A22-DW	A22-SW	A22-MW
	Blue	A22-FA	A22-TA	A22-GA	A22-HA	A22-CA	A22-DA	A22-SA	A22-MA
	Black	A22-FB	A22-TB	A22-GB	A22-HB	A22-CB	A22-DB	A22-SB	A22-MB
Lighted	Red	-	A22L-TR	A22L-GR	A22L-HR	A22L-CR	A22L-DR	-	-
	Green	-	A22L-TG	A22L-GG	A22L-HG	A22L-CG	A22L-DG	-	-
	Yellow	-	A22L-TY	A22L-GY	A22L-HY	A22L-CY	A22L-DY	-	-
	White	-	A22L-TW	A22L-GW	A22L-HW	A22L-CW	A22L-DW	-	-
	Blue	-	A22L-TA	A22L-GA	A22L-HA	A22L-CA	A22L-DA	-	-
Buttonsize in r	nm	29.7 dia. x 12D	29.7 dia. x 19D	29.7 dia. x 19D	29.7 dia. x 12/18.5D	29.8 mm ² x 18D	29.8 mm ² x 18D	30 dia. x 32D	40 dia. x 32D

Switches

Swit

10

Switch	Contacts	Oder code					
operation		Non- lighted models	Lighted models				
		Without vol	tage	With voltage red	luction unit		
		reduction unit		110 VAC	220 VAC		
			A	A	A		
Momentary	SPST-NO	A22-10M	A22L-10M	A22L-10M-T1	A22L-10M-T2		
	SPST-NC	A22-01M	A22L-01M	A22L-01M-T1	A22L-01M-T2		
	SPST-NO + SPST-NC	A22-11M	A22L-11M	A22L-11M-T1	A22L-11M-T2		
	DPST-NO	A22-20M	A22L-20M	A22L-20M-T1	A22L-20M-T2		
	DPST-NC	A22-02M	A22L-02M	A22L-02M-T1	A22L-02M-T2		
Alternate	SPST-NO	A22-10A	A22L-10A	A22L-10A-T1	A22L-10A-T2		
	SPST-NC	A22-01A	A22L-01A	A22L-01A-T1	A22L-01A-T2		
	SPST-N0 + SPST-NC	A22-11A	A22L-11A	A22L-11A-T1	A22L-11A-T2		
	DPST-NO	A22-20A	A22L-20A	A22L-20A-T1	A22L-20A-T2		
	DPST-NC	A22-02A	A22L-02A	A22L-02A-T1	A22L-02A-T2		
Switch block	witch blocks						

ch blocks		
	Standard load	Order code
ch blocks	SPST-NO	A22-10
	SPST-NC	A22-01
	DPST-NO	A22-20
	DPST-NC	A22-02

Lamp – LED								
AC/DC	LED light	Order code						
		Operating voltage	Operating voltage					
		6 V	12 V	24 V	24 V superbright			
DC	Red	A22-6DR	-	-	-			
	Green	A22-6DG	-	-	-			
	Yellow *1	A22-6DY	-	-	-			
	Blue	A22-6DA	-	-	-			
AC	Red	A22-6AR	-	-	-			
	Green	A22-6AG	-	-	-			
	Yellow *1	A22-6AY	-	-	-			
	Blue	A22-6AA	-	-	-			
AC and DC	Red	-	A22-12AR	A22-24AR	A22-24ASR			
	Green	-	A22-12AG	A22-24AG	A22-24ASG			
	Yellow *1	-	A22-12AY	A22-24AY	A22-24ASY			
	Blue	-	A22-12AA	A22-24AA	A22-24ASA			

 $^{\star1}\,$ Used when the pushbutton colour is yellow or white

Lamp - incandescent lamp

Order code					
Operating voltage					
5 VAC/VDC	12 VAC/VDC	24 VAC/VDC			
A22-5	A22-12	A22-24			



Accessories

A0003301103					
Item				Remarks	Order code
Lamp sockets	Direct lighting Voltage-reduction lighting 220 VAC			Used when changing the lighting method (LED only)	A22-TN
					A22-T2
Mounting latches	For momentary	models		Order mounting latches only when mounting switch blocks or lamp sockets are purchased individually	A22-3200
Legend plate frames	Large size With snap-in legend plate, without text, black			Snap-in legend plate is acrylic	A22Z-3333
	Without snap-in legend plate				A22Z-3330
Sealing caps	For projection m	or projection models		Used to prevent dust or water from entering the operation unit (pushbutton, etc.), colour: Opaque, material: Silicon	A22Z-3600T
Three-throw spa	acer			Used when mounting three non-lighted switches	A22Z-3003
Control boxes (enclosures)	Exclusively for A22 One h Two h		One hole	Do not use DPST-NO or DPST-NC switches, material: Polycarbonate resin	A22Z-B101
			Two holes		A22Z-B102
	Three				A22Z-B103
Snap-in legend	Standard size	Without text	White	Attached to the standard-size legend plate frame, material: Acrylic	A22Z-3443W
plates			Transparent		A22Z-3443C
		White text on black background	ON		A22Z-3443B-5
			OFF		A22Z-3443B-6
			DOWN		A22Z-3443B-8
			POWER ON		A22Z-3443B-9
	Large size	Without text	White	Attached to the large-size legend plate frame, material: Acrylic	A22Z-3453W
			Transparent		A22Z-3453C
	For emergency	60-dia. round plate with black letters on a yello	ow background	"EMERGENCY STOP" is engraved on the plate.	A22Z-3466-1
	stop switch	90-dia. round plate with black letters on a yello	ow background	Used as an emergency stop switch legend plate	A22Z-3476-1
Lamp extractor				Rubber tool used to easily replace lamps	A22Z-3901
Tightening wren	Tightening wrench			Tool used to tighten nuts from the back of the panel	A22Z-3905

Specifications

Recognized organization	Standards	File number
UL, cUL	UL508	E41515
-	EN60947-5-1	-

Contact ratings (standard load)

Rated carry	Rated voltage	Rated current (A)			
current (A)		AC15 (inductive load)	AC12 (resistive load)	DC13 (inductive load)	DC12 (resistive load)
10	24 VAC	10	10	-	-
	110 VAC	5	10	-	-
	220 VAC	3	6	-	-
	380 VAC	2	3	-	-
	440 VAC	1	2	-	-
	24 VDC	-	-	1,5	10
	110 VDC	-	-	0,5	2
	220 VDC	-	-	0,2	0,6
	380 VDC	-	-	0,1	0,2

Pushbutton switches

Non-lighted Lighted

Momentary operation:

Momentary operation: 5,000,000

500,000

IP65

60 operations/minute max.

30 operations/minute max.

IP65

Emergency stop switches

30 operations/minute max.

Momentary operation: 300,000

IP65

Non-lighted Lighted

300,000

-20 to 70°C -20 to 55°C -20 to 70°C -20 to 55°C

-40 to 70°C -40 to 70°C -40 to 70°C -40 to 70°C

IP65

Contacts (microload)

Mechanical

Electrical

Electrical

Operating

Storage

Mechanical

Item

Allowable

operating frequency

Durability (number of

operations min.)

Ambient

temperature

Degree of protection

Rated applicable load	Minimum applicable load
50 mA at 5 VDC (resistive load)	1 mA at 5 VDC

	LED indicators without voltage reduction unit						
	Rated voltage	Rated current	Operating voltage				
	6 VDC	60 mA (20 mA)	6 VDC ±5%				
	6 VAC	60 mA (20 mA)	6 VAC/VDC ±5%				
	12 VAC/VDC	30 mA (10 mA)	12 VAC/VDC ±5%				
	24 VAC/VDC	15 mA (10 mA)	24 VAC/VDC ±5%				
	Super-bright LED indicate	or					
	Rated voltage	Rated current	Operating voltage				
	24 VAC/VDC	15 mA	24 VAC/VDC ±5%				
	Incandescent lamp						
	Rated voltage	Rated current	Operating voltage				
	6 VAC/VDC	200 mA	5 VAC/VDC				
	14 VAC/VDC	80 mA	12 VAC/VDC				
	28 VAC/VDC	40 mA	24 VAC/VDC				
	130 VAC/VDC	20 mA	100 VAC/VDC				
	Voltage-reduction lighting	9					
	Rated voltage	Operating voltage	Applicable lamp (BA8S/13_ gold)				
	110 VAC	95 to 115 VAC	LED Lamp (A22-24A_)				
	220 VAC	190 to 230 VAC					
	Knob-type selector switches		Key-type selector switch				
	Non-lighted	Lighted	Non-lighted				
	Manual release: 30 operations/minute max., automatic release: 30 operations/minute max.						
30 operations/minute max.							
	500,000	100,000	500,000				
	500,000	100,000	500,000				
	-20 to 70°C	-20 to 55°C	-20 to 70°C				

-40 to 70°C

IP65

-40 to 70°C

IP65 (oil-resistant)

 (oil-resistant)
 (oil-resistant)

 Size in mm (in-panel only)
 34Hx34Wx54.7D, 34Hx34Wx72.7D for DPST switches



-40 to 70°C

IP65 (oil-resistant)



Emergency stop switch

The A22E line-up of E-Stop switches offers various head types as well as lighted models. E-stop shrouds and control boxes as accessories provide flexibility in application.

- Direct opening mechanism with minimum contact separation of 3 mm
- Safety lock mechanism prevents misuse
- Easy mounting of switch block
- Lighted models for easy diagnosis and maintenance
- Modular design for flexibility in application

Ordering Information

A22E

Non-lighted models						
Description	Output	Color of cap	Order code			
30-dia. head	SPST-NC	Red	A22E-S-01			
Push-lock	SPST-NO/SPST-NC		A22E-S-11			
Tum-teset	DPST-NC		A22E-S-02			
40-dia. head	SPST-NC		A22E-M-01			
Push-lock	SPST-NO/SPST-NC		A22E-M-11			
Tum-teset	DPST-NC		A22E-M-02			
60-dia. head	SPST-NC		A22E-L-01			
Push-lock	SPST-NO/SPST-NC		A22E-L-11			
Tum-reset	DPST-NC		A22E-L-02			

Lighted models

0							
Description	Output	Lighting	Rated voltage	Color of cap	Order code		
40-dia. head	SPST-NC	PST-NC LED PST-NC PST-N	24 VAC/VDC	Red	A22EL-M-24A-01		
Push-lock	SPST-NO/SPST-NC		24 VAC/VDC		A22EL-M-24A-11		
Tum-reset	DPST-NC		24 VAC/VDC		A22EL-M-24A-02		
40-dia. head	SPST-NC		220 VAC		A22EL-M-T2-01		
Push-lock	SPST-NO/SPST-NC		220 VAC		A22EL-M-T2-11		
Tum-reset	DPST-NC		220 VAC		A22EL-M-T2-02		

Accessories (Order separately)

······································						
Item	Classification	Remarks	Order code			
Control boxes (enclosures)	One hole	Material: Polycarbonate resin	A22Z-B101			
	One hole, yellow box (for emergency stop)		A22Z-B101Y			
	Two holes		A22Z-B102			
	Three holes		A22Z-B103			
Legend plates for emergency stop	60-dia. black letters on yellow back-ground	"EMERGENCY STOP" is indicated on the plate.	A22Z-3466-1			
	90-dia. black letters on yellow back-ground		A22Z-3476-1			

Specifications

Contacts (standard load)							
Rated carry	Rated voltage	Rated curren	t (A)				
current		AC15	AC12	DC13	DC12		
10	24 VAC	10	10				
	220 VAC	3	6				
	24 VDC			1.5	10		
	220 VDC			0.2	0.6		
 Rated current values are determined according to the testing conditions. The above ratings were obtained by conducting tests under the following conditions. (1) Ambient temperature: 20×±2°C (2) Ambient humidity: 65±5% (3) Operating frequency: 20 operations/minute Minimum applicable load: 10 mA at 5 VDC 							
Contacts (mid	croload)						
Rated applicat	le load	M	inimum applic	able load			

50 mA at 5 VDC (resistive load)

) 1 mA at 5 VDC

Characteristics

Item		Emergency stop switches			
		Non-lighted model: A22E	Lighted model: A22EL		
Dielectric strength		2,500 VAC, 50/60 Hz for 1 min between terminals of same polarity 2,500 VAC, 50/60 Hz for 1 min between terminals of different polarity and also between each terminal and ground			
Durability	Mechanical	Momentary operation: 300,000 operations min.			
	Electrical	300,000 operations min.			
Degree of protection		IP65 (oil-resistant)	IP65		

ER-series rope pulls



Emergency stop switch

- Tension indicator the tension indicator makes the system easy to set up and to maintain the proper rope tension
- Heavy-duty housing the die-cast housing and stainless steel eye nut makes the ER series rope pull switches suitable for demanding industrial applications
- Vibration tolerant the snap-acting switch contacts protect against nuisance tripping due to vibration
- Integral E-stop the E-stop button provides emergency stopping capability at the extreme end of the installation and is field serviceable
- ER6022 available in stainless steel housing
- ER6022, ER1022 and ER1032 available in explosion proof housing

Ordering information

Standard models				
Aluminium die-cast housir	ıg			
E-Stop	Indicator beacon	Contacts	Wiring entry	Order code
Not included	-	2 N/C + 1 N/O	3 x M20	ER5018-021M
Not included	-	3 N/C	3 x M20	ER5018-030M
Included	-	2 N/C + 1 N/O	3 x M20	ER5018-021ME
Included	-	3 N/C	3 x M20	ER5018-030ME
Not included	Not included	2 N/C + 1 N/O	3 x M20	ER6022-021M
Not included	Not included	3 N/C + 1 N/O	3 x M20	ER6022-031M
Not included	Included (24 VDC)	2 N/C + 1 N/O	3 x M20	ER6022-021ML
Not included	Included (24 VDC)	3 N/C + 1 N/O	3 x M20	ER6022-031ML
Included	Not included	2 N/C + 1 N/O	3 x M20	ER6022-021ME
Included	Not included	3 N/C + 1 N/O	3 x M20	ER6022-031ME
Included	Included (24 VDC)	2 N/C + 1 N/O	3 x M20	ER6022-021MEL
Included	Included (24 VDC)	3 N/C + 1 N/O	3 x M20	ER6022-031MEL
Included	Included (24 VDC)	4 N/C + 2 N/O	4 x M20	ER1022-042MELL
Included	Included (24 VDC)	4 N/C + 2 N/O	4 x M20	ER1022-042MELR
Included	Included (24 VDC)	4 N/C + 2 N/O	4 x M20	ER1032-042MEL
Stainless steel housing				
E-Stop	Indicator beacon	Contacts	Wiring entry	Order code
Not included	Not included	2 N/C + 2 N/O	3 x M20	ER6022-022MSS
Not included	Not included	3 N/C + 1 N/O	3 x M20	ER6022-031MSS
Not included	Included	2 N/C + 2 N/O	3 x M20	ER6022-022MLSS
Not included	Included	3 N/C + 1 N/O	3 x M20	ER6022-031MLSS
Included	Not included	2 N/C + 2 N/O	3 x M20	ER6022-022MESS
Included	Not included	3 N/C + 1 N/O	3 x M20	ER6022-031MESS
Included	Included	2 N/C + 2 N/O	3 x M20	ER6022-022MELSS
Included	Included	3 N/C + 1 N/O	3 x M20	ER6022-031MELSS

Explosion proof models

Aluminium die-cast housing						
E-Stop	Indicator beacon	Contacts	Wiring entry	Order code		
Not included	Not included	1 N/C + 1 N/O	pre-wired, 3 m	XER6022-011C3		
Not included	Not included	1 N/C + 1 N/O	pre-wired, 3 m	XER1022-011C3L		
Not included	Not included	1 N/C + 1 N/O	pre-wired, 3 m	XER1022-011C3R		
Not included	Not included	1 N/C + 1 N/O	pre-wired, 3 m	XER1032-011C3		
Stainless steel housing						
E-Stop	Indicator beacon	Contacts	Wiring entry	Order code		
Not included	Not included	1 N/C + 1 N/O	pre-wired, 3 m	XER6022-011C3SS		
Not included	Not included	2 N/C	pre-wired, 3 m	XER6022-020C3SS		



ER-series rope pulls

Accessories

Item	Applicable model	Order code
Replacement Lid	ER 5018	SM06-SL400
	ER 6022	SM06-SL500
	ER6022-SS stainless steel	SM06-SLXER6022SS
Replacement Lid/LED, 24 VDC	ER 1022	EM06-SL710
	ER 1032	SM06-SL711
	ER6022-SS stainless steel	SM06-SLXER622LSS
Replacement Lid/LED	ER 6022	SM06-SL510
Rope kit, 5 m, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	RK5
Rope kit, 10 m, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	RK10
Rope kit, 20 m, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	RK20
Rope kit, 50 m, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	RK50
Rope kit, 80 m, stainless steel	ER 6022, ER1022, ER1032	RK80
Rope kit 100 m, stainless steel	ER6022, ER1022, ER 1032	RK100
Rope kit 126 m, stainless steel	ER 1032	RK126
Rope only, 5 m	ER 5018, ER 6022, ER 1022, ER 1032	R5M
Rope only, 10 m	ER 5018, ER 6022, ER 1022, ER 1032	R10M
Rope only, 20 m	ER 5018, ER 6022, ER 1022, ER 1032	R20M
Rope only, 50 m	ER 5018, ER 6022, ER 1022, ER 1032	R50M
Rope only, 100 m	ER 5018, ER 6022, ER 1022, ER 1032	R100M
Rope only, 126 m	ER 5018, ER 6022, ER 1022, ER 1032	R126M
Tensioner gripper, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	SM06-TG00
Eye bolt stainless steel, 8 per pack	ER 5018, ER 6022, ER 1022, ER 1032	SM06-EB10
Double loop clip, stainless steel, 4 per pack	ER 5018, ER 6022, ER 1022, ER 1032	SM06-DL20
Thimble stainless steel, 4 per pack	ER 5018, ER 6022, ER 1022, ER 1032	SM06-THSS
Turnbuckle, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	SM06-TB30
Spring, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	SM06-SP50
Rope pulley, stainless steel	ER 5018, ER 6022, ER 1022, ER 1032	SM06-RPSS
E-Stop mechanism	ER 5018, ER 6022, ER 1022, ER 1032	SM06-ES60
Yellow E-Stop Background Label	ER5018, ER6022, ER1022, ER1032	SM06-YLES

Specifications

Standard models

Item		Applicable model						
		ER 5018	ER 6022	ER 6022SS	ER 1022	ER 1032		
	Contact configurations	2 N/C + 1 N/O, 3 N/C	2 N/C + 1 N/O, 3N/C + 1N/O	3 N/C+1 N/O, 2 N/C+2 N/O	4 N/C + 2 N/O	4 N/C + 2 N/O		
	Safety contacts	2 N/C, 3 N/C	2 N/C, 3 N/C	4 N/C				
rical	Switching ability	AC: 120 V–6 A, 240 V–3 A, in DC: 24 V–2.5 A, inductive	ductive					
lect	Auxiliary contacts	1 N/O		1 N/0, 2 N/0	2 N/0			
ш	Max. switching current/Volt/Amp	240 V/720 VA						
	Electrical life	1,000,000 minimum						
	LED indicator beacon	-	24 VDC					
	Max. rope span	40 m	80 m	100 m	125 m	125 m each side		
nical	Case material	Die-cast aluminum alloy		Die-cast 316 stainless steel casing	Die-cast aluminum alloy			
scha	Eye nut material	Stainless steel						
Ĕ	Wiring entry	3 x M20			4 x M20			
	Mechanical life	1,000,000 minimum						
늘등	Protection	IP67 (NEMA 6)						
viro	Operating temperature	-25 to 80°C						
문문	Cleaning	Water washdown	Water washdown					
m-	Standards	EN60947-5-1:2004, EN60947	7-5-5:1997+A1:2005; EN6020	4-1; EN ISO 13850:2006				
Col	Approvals/listings	CE marked for all applicable of	lirectives, UL and C-UL					

Explosion proof models

Item			Applicable model				
			XER6022	XER1022	XER1032		
	Contact configurat	tion	1 N/C + 1 N/O, 2 N/C				
	Safety contact		1 N/C, 2 N/C				
	Auxiliary contact		1 N/O				
cal	Rated voltage and current (AC15)		400 VAC/2 A AC, 250 VAC/4 A AC				
otri	B Rated voltage and current (DC)		250 VDC/0,15 A DC				
Ele	ພື້ Switching ability Resistive load		125 VAC/5 A, 250 VAC/5 A				
	AC ratings	Inductive load	125 VAC/3 A, 250 VAC/3 A				
	Switching ability Resistive load 30 VDC/7 A, 250 VDC/0.15 A						
	DC ratings Inductive load 30 VDC/5 A, 250 VDC/0.03 A						
- u-	Ex-classification		II 2 G EEx d II C T6				
Col plia	Certification		PTB00 ATEX 1093X IBExU 01 ATEX 1007X				

ER-series rope pulls

Accessories

RK rope tension kit



The RK rope tension kit comes with all of the required hardware for most installations. A spring is required as shown in the installation example below.

Installation Hardware



Individual hardware items may be purchased for specific installation requirements.



Versatile modular signal tower featuring

LU5 Series - Medium size modular system provides hybrid prism cut lens for enhanced visibility from any direction and distance and two selectable sound patterns up to 85 dB. Main features are the interchangeable LED modules and the color

Two, user - selectable, alarms integrated in the base module with adjustable

easy assembly and wiring designed for every



Ordering information

LED module LU5- <u>E-R</u>	Base module LU5- <u>02UFB</u>
1. E: LED unit 2. Color of LED R: Red Y: Yellow G: Green B: Blue C : Clear/White	 Rated voltage 24 VDC Unit color Blank: Ivory white U: Silver color Type Blank: Continuous light FB: Continuous or flashing light with audible alarm

.

need.

• Diameter: 50 mm

coordinated wiring for easy alignment.

volume up to 85 dB at 1 m

· Base modules available in ivory white or in silver · Up to 5 LED modules can be used on the light tower · Modules of the same color operate from different terminals

Ordering information

LED module						
Module color	Power consumption	Rated voltage	Operation voltage	Operation temperature range	Mass	Order code
Red	52 mA/1.25 W	24 VDC	Rated voltage ±10% (21.6~26.4 V)	-30°C~+60°C	44 g ±10%	LU5-E-R
Yellow						LU5-E-Y
Green	42 mA/1.0 W					LU5-E-G
Blue						LU5-E-B
Clear						LU5-E-C
Base module						

Тур	Alarm/Flash	Power consumption	Rated voltage	Operation voltage	Operation temperature range	Mass	Open collector	Order code
Standard body	Continuous 1.2 W 24 VDC Rated voltage ±10% -30°C~+60°C	-30°C~+60°C	182g ±10%	PNP/ NPN	LU5-02*			
	2 Sounds/Flashlight			(21.6 ~ 26.4 V)		200g ±10%		LU5-02FB*

* Ivory white: black, silver: add "U"

Optional parts

Тур	Material	Order code	Тур	Height	Material	Order code
Wall mount bracket	Aluminum alloy die-cast	SZ-017	Pole	100 mm	Aluminium	Pole-100A21
	ABS resin	SZ-020		300 mm	Aluminium	Pole-300A21
Upper bracket	Metal	SZ-60NPT		800 mm	Aluminium	Pole-800A21
		SZ-60U				
Mount bracket	Aluminum alloy die-cast	SZ-016A				
		SZ-70B				

Features



LED module is stackable and reconfigurable even after installation

IP 65: Implemented o rings seal out liquids so that the tower can be used in wet conditions.





		LED units						
	4	\bigcirc	Model	LU5-E-R	LU5-E-Y	LU5-E-G	LU5-E-B	LU5-E-C
			Unit color					\bigcirc
			Rated voltage			24 VDC		
			Operating voltage range		Rated vo	ltage±10% (2	1.6~26.4 V)	
	4		Current/power consumption	52 mA	/1.25 W		42 mA/1.0 V	V
	Margare 1		Operating temperature range			-30°C~+60	°C	
			Mass			44 g±10%		
	4							
			RED YELLOW		GREEN	BLUE		EAR/WHITE
	¢							
	i	BASE units						
		DAGE UNITS						
		\frown	Model		LU5-02		LU5-0	2FB
			Color			$\bigcirc \bigcirc$		
			Standard body/short body			Standard		
			Rated voltage		Dated vo	24 VDC		
			Buzzer			11age±10%(2	1.0~20.4 V)	**Buzzer 2
			Current consumption		_	5	0±10 mA	24±10 mA
			Power consumption		_	1.	2±0.25 W	0.58±0.25 W
			Sound level		-		Max: 85±5 d	B (at 1 m)
			Flashing cycle				6±12 flashes p	per minutes
			Operating temperature Range			-30°C~+60°	°C	
			Mounting direction		U	pright, indoor	only	
	e		Protection rating			IP65		
			Mass	18	32 g±10%		200 g±	10%
			* Buzzer 1: Continuous sound	**Buzzer 2: I	ntermittent sou	IND PNP/NPN		
				0.1				
, , ,			Vory white	Silver color (L	J)			
1								

OMRON

Optional parts



Specifications

Size	50 mm diameter
Input voltage options	24 VDC
Functions available	Continuous only Continuous, flashing, alarms
Mounting options	Direct mount only, includes 3 mounting nuts
Body styles	Component style, wiring terminals provided Interchangeable and stackable after purchase
Body colours	Beige
Tiers	1-5 modules can be stacked
Module colors	Red / Yellow / Green / Blue / Clear
Alarms (FB style only)	 Alarm 1: selectable, single-tone, continuous alarm, 85 dB (at 1 m) Alarm 2: selectable, single tone, intermittent (slow beep) alarm, 85 dB (at 1 m)
Ratings	 CE UL listed (US) UL listed (Canada) RoHS
Protection	 IP-65 Type 4 / 4X / 13 (indoor only)
Control options	 Dry contact closure such as switches or relay contacts Open-collector transistor (NPN or PNP) for 24 VDC Direct voltage control for 24 VDC, continuous and alarm functions only



Versatile modular signal tower featuring easy assembly and wiring designed for every need.

LU7 presents ultra bright LEDs combined with an innovative prism lens design. 1 to 5 modules can be arranged in tiers.

- Diameter: 70 mm
- Base module in 2 sizes and 3 colors
- · Different modules: standard LED, strobe LED and sound
- Two, user selectable, alarms integrated in the base module with adjustable volume up to 90 dB at 1 m.
- · Color-coordinated and spring-loaded terminal block

Ordering information

LED module							
Тур	Module color	Power consumption	Rated voltage	Operation voltage	Operation temperature range	Mass	Order code
Standard	Red	52 mA/1.25 W	24 VDC	Rated voltage ±10% (21.6~26.4 V)	-30°C~+60°C	60 g ±10%	LU7-E-R
	Yellow						LU7-E-Y
	Green	42 mA/1.0 W					LU7-E-G
	Blue						LU7-E-B
	Clear/White						LU7-E-C
Strobe	Red	290 mA	24 VDC	Rated voltage $\pm 10\%$	-30°C~+60°C	0,07 kg	LU7-XE-R
	Yellow			(21.6~26.4 V)			LU7-XE-Y
	Green	140 mA					LU7-XE-G
	Blue	270 mA					LU7-XE-B
	Clear/White	280 mA					LU7-XE-C

Base module

Тур	Alarm/Flash	Power consumption	Rated voltage	Operation voltage	Operation temperature range	Mass	Open collector	Order code
Short body	Continuous	1.2 W	24 VDC	Rated voltage $\pm 10\%$	-30°C~+60°C	150 g ±10%	PNP/ NPN	LU7-02S*
Standard body	Continuous			(21.6~26.4 V)		250 g ±10%		LU7 - 02*
	2 Sounds/Flashlight					280 g ±10%		LU7 -02FB*

* lvory white: blank, black: add "K", silver: add "U"

Optional parts

Тур	Material	Order code	Тур	Height	Material	Order code		
Wall mount bracket	Aluminum alloy die-cast	SZ-017	Pole	100 mm	Aluminium	Pole-100A21		
	PBT/ ABS resin	SZ-018			Steel	Pole-100S21		
		SZ-018U		300 mm	Aluminium	Pole-300A21		
		SZ-018K			Steel	Pole-300S21		
	ABS resin	SZ-020		800 mm	Aluminium	Pole-800A21		
Upper bracket	Metal	SZ - 50U			Steel	Pole-800S21		
		SZ - 50UU	Voice and sour	d module (uniqu	a sound modula	cound module in all directions)		
		SZ - 50KU		u mouule (umqu	a module (unique sound module in an unec			
		\$7 - 50NPT	Rated voltage	Power consumptio	n Mass	Order code		
Mount brackot	Aluminum allov dia cast	SZ - 30NI 1	24 VDC	3.5 W	0.17 kg	LU7-V1		
WOULL DIAGNEL	Aluminum alloy die-cast	32-010A						
		S7-70B						

Features





How to order

	na moaule					
\bigcirc	Model			LU7-V1		
	Туре		١	/oice synthesize	er	
	Rated voltage			24 VDC		
	Power consumption			3.5 W		
	Weight			0.17 kg		
\smile						
 LED units						
	Model	LU7-E-R	LU7-E-Y	LU7-E-G	LU7-E-B	LU7-E-C
	Unit color					\bigcirc
	Rated voltage			24 VDC		
	Operating voltage range		Rated vo	ltage±10% (21.	6~26.4 V)	
	Current/power consumption	52 mA/	1.25 W		42 mA/1.0 W	
	Operating temperature range			-30°C~+60°C	;	
	Mass			60 g±10%		
LED strobe mo	dule					
	Model	LU7-XE-R	LU7-XE-Y	LU7-XE-G	LU7-XE-B	LU7-XE-C
	Unit color					\bigcirc
	Rated voltage	1		24 VDC		
	Power consumption	290 mA	290 mA	140 mA	270 mA	280 mA
	Mass			0.07 kg		
	RED YELLOW	V 🔵 G	IREEN	BLUE	CLE#	AR/WHITE
BASE units						
BASE units	Model	LU7-02	S	LU7-02		17-02FB
BASE units	Model Color	LU7-02	s	LU7-02		17-02FB
BASE units	Model Color Standard body/short body	LU7-02 Short	S .	LU7-02	LU	17-02FB
BASE units	Model Color Standard body/short body Rated voltage	LU7-02 Short	S	LU7-02 24 VDC	Standard	J7-02FB
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range	LU7-02 Short	S Rated vol	LU7-02	LU Standard 6~26.4 V)	17-02FB
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer	LU7-02 Short	S Rated vol	LU7-02	Standard 6~26.4 V) *Buzzer	17-02FB
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption	LU7-02 Short	S S Rated vol	LU7-02	LU Standard 6~26.4 V) *Buzzer 50±10 m 10.000	17-02FB 1 **Buzzer 2 A 24±10 mA
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Ccnsumption	LU7-02 Short	S Rated vol	LU7-02	LU Standard 6~26.4 V) *Buzzer 1 50±10 m 1.2±0.25	17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58±0.25 W
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Ccnsumption Sound level	LU7-02 Short	S S Rated vol – – – –	LU7-02	Standard 5~26.4 V) 50±10 m 1.2±0.25 Max: 90 Mix: 70 dB	17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58±0.25 W ±5d B (at 1 m)
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Consumption Sound level Elashing cycle	LU7-02 Short	S Rated vol – – – –	LU7-02	Standard 6~26.4 V) *Buzzer 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60+12 fb;	17-02FB 1 **Buzzer 2 A 24±10 mA ₩ 0.58±0.25 W ±5d B (at 1 m) tor Less (at 1 m) shas par minuta
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Ccnsumption Sound level Flashing cycle Operating temperature Range	LU7-02 Short	S Rated vol 	LU7-02 24 VDC tage±10% (21.4 -30°C~±60°C	LU Standard 6~26.4 V) 8Buzzer 1 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60±12 fla	17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58±0.25 W ±5d B (at 1 m) or Less (at 1 m) shes per minute
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Ccnsumption Power Ccnsumption Sound level Flashing cycle Operating temperature Range Mounting direction	LU7-02 Short	S Rated vol - - - - - - - - - - - - - - - - - - -	LU7-02 24 VDC tage±10% (21.4 -30°C~+60°C pright, indoor or	Standard 5~26.4 V) 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60±12 flac	17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58±0.25 W ±5d B (at 1 m) sor Less (at 1 m) shes per minute
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Ccnsumption Power Ccnsumption Sound level Flashing cycle Operating temperature Range Mounting direction Protection rating	LU7-02 Short	S	LU7-02 24 VDC tage±10% (21.4 -30°C~+60°C oright, indoor or IP65	LU Standard 5~26.4 V) *Buzzer 1 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60±12 flat Nhy	17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58 ± 0.25 W ±50 B (at 1 m) tor Less (at 1 m) shes per minute
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Consumption Sound level Flashing cycle Operating temperature Range Mounting direction Protection rating Mass	LU7-02 Short	S	LU7-02 24 VDC tage±10% (21.4 -30°C~+60°C oright, indoor or IP65 250 g±10%	LU Standard 5~26.4 V) 50±10 m 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60±12 fla 10 10 28(17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58±0.25 W ±5d B (at 1 m) shes per minute 0 g±10%
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Ccnsumption Sound level Flashing cycle Operating temperature Range Mounting direction Protection rating Mass Open collector	LU7-02 Short	S	LU7-02 24 VDC tage±10% (21.4 -30°C~+60°C oright, indoor or IP65 250 g±10% PNP/NPN	LU Standard 5~26.4 V) 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60±12 flat 1ly 280	17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58±0.25 W ±5d B (at 1 m) or Less (at 1 m) shes per minute 0 g±10%
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Ccnsumption Sound level Flashing cycle Operating temperature Range Mounting direction Protection rating Mass Open collector * Buzzer 1: Continuous sound	LU7-02 Short	S Rated vol Rated vol Rated vol Rated vol U	LU7-02 24 VDC tage±10% (21.0 -30°C~+60°C pright, indoor or IP65 250 g±10% PNP/NPN ind	LU Standard 5~26.4 V) *Buzzer 1 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60±12 flat Niy 280	17-02FB 1 **Buzzer 2 A 24±10 mA ₩ 0.58±0.25 W ±5d B (at 1 m) or Less (at 1 m) shes per minute 0 g±10%
BASE units	Model Color Standard body/short body Rated voltage Operating voltage range Buzzer Current consumption Power Consumption Sound level Flashing cycle Operating temperature Range Mounting direction Protection rating Mass Open collector * Buzzer 1: Continuous sound Ivory white	LU7-02 Short Short 100 150 g±10 **Buzzer 2: In Silver color (U)	S	LU7-02 24 VDC tage±10% (21.4 -30°C~+60°C oright, indoor or IP65 250 g±10% PNP/NPN ind Black (K)	LU Stardard 5~26.4 V) 50±10 m 50±10 m 1.2±0.25 Max: 90: Min: 70 dB 60±12 fla 1000000000000000000000000000000000000	17-02FB 1 **Buzzer 2 A 24±10 mA W 0.58±0.25 W ±5d B (at 1 m) so Less (at 1 m) shes per minute 0 g±10%

OMRON

Outional name							
	Wall mount brack	ket					
		Model	S7-18	S7-1811	S7-18K		
r and a second		Color	lvorv white	Silver color (U)	Black (K)		
	Upper bracket						
2000							
	SZ	-50NPT(For 1/2" N	PT pole)				
	Upper bracket						
(F)							
		Model	SZ-50-U	SZ-50U-U	SZ-50K-U		
		Color	Ivory white	Sliver color (U)	BIACK (K)		
	Pole						
Π	Pì	Steel p	ole				
		Model	P0LE-800S21	P0LE-300S21	P0LE-100S21		
/	Teigh	Height	800 mm	300 mm	100 mm		
<u> </u>		Alumin	um pole				
	U↓	Model	P0LE-800A21	P0LE-300A21	P0LE-100A21		
	 ↔	Height	800 mm	300 mm	100 mm		
	21 mm						
	Mount bracket		Wall	mount brack	vot		
Ų			wan		NGL		
		ATK.			•		
		(Y)					
		S7-70-B	C				
	SZ-016A (For Ø21.7 mm pole) (Fo	r Ø21.7 mm Alumin	ium S (For Ø2	Z-020 1.7 mm pole) (Fo	SZ-017 or Ø21.7 mm pole)		

Specifications

Size	70 mm diameter
Input voltage options	• 24 VDC
Functions available	Continuous only Continuous, flashing, alarms
Mounting options	Direct mount only: includes three mounting nuts
Body style	Component style, wiring terminals provided Interchangeable and stackable after purchase
Body color	 Beige Black Silver
Tiers	1-5 modules can be stacked
Module colors	 Red / Yellow / Green / Blue / Clear Standard LED modules Strobe-flash LED modules (24 V bases only)
Alarms (FB style only)	 Alarm 1: selectable, single-tone, continuous alarm, 90 dB (at 1 m) Alarm 2: selectable, single tone, intermittent (slow beep) alarm, 90 dB (at 1 m)
Ratings	 CE UL listed (US) UL listed (Canada) RoHS
Protections	IP-65 Type 4/4X/13 (indoor only)
Control options	 Dry contact closure such as switches or relay contacts Open-collector transistor (NPN or PNP for 24 VDC) Direct voltage control for 24 VDC, continuous and alarm functions only



MP/MPS



Ordering information

$\frac{MP}{1} - \frac{502}{2} - \frac{RYGBC - B0738}{4} - \frac{5}{5}$

1. MP: Standard body MPS Short body R:

Patented reflection system increases visibility.

2. Stack 1~5

Features

- 3. Rated voltage
- 24 V AC/DC 02:
- 4. Color of LED Red Y٠ Yellow G Green B: Blue Clear/White C: Top to bottom

Good visibility from any

direction

5. Color of lense Blank: Colored lens B0738: Clear lens

Super slim 30 mm silver body signal tower ideal for small devices

MP/MPS signal towers provide double insulation and superior UV and light translucent AS resin lenses for enhanced durability and reliability in the application environment. The 30mm diameter is ideal for small and mid-sized machines.

Up to 5 colored modules can be combined using a single mounting hole. Modules can be easily added without dismounting the whole signal tower to reduce installation effort.

- · Special pre-wired versatile with 1 connection cable
- NPN/ PNP compactible
- IP65
- · Each color of LED module corresponds to the lead wire color.
- Available colors are Red. Yellow. Green. Blue and Clear/White. All colors as clear-lens modules available

Ordering information

Number of stacks	Rated voltage	Power consumption	Open collector	Order code
1	24 VAC/VDC	0.7 W	NPN/PNP	MP/MPS-102
2		1.4 W		MP/MPS-202
3		2.0 W		MP/MPS-302
4		2.6 W		MP/MPS-402
5		3.2 W		MP/MPS-502





Dimensions

High intensity LED





Wiring diagram



MP/MPS

Specifications

Size	30 mm diameter
Input voltage options	24 VAC/VDC
Functions available	Continuous only
Mounting options	Direct mount only: includes M22 mounting nut and sealing gasket
Body style	pre-assembled, pre-wired Interchangeable and stackable after purchase
Body color	Silver
Tiers	1-5 modules can be stacked
Module colors	Red / Yellow / Green / Blue / Clear-White (for sunlight applications: clear-lense modules in all colors available)
Alarms (FB style only)	 CE UL component recognition (US) UL component recognition (Canada) RoHS
Protection	IP-65
Control options	 Dry contact closure such as switches or relay contacts Open-collector transistor (NPN or PNP) for 24 VDC Direct voltage control

LME

PATLITE



Versatile, cost and energy efficient LED signal tower for every need

The LME series indicating light provides the latest in LED technology. 1 to 5 modules can be arranged in tiers. The original dual reflection system for enhanced light diffusion, creates bright distinctive illumination while saving energy (patent pending).

LME signal towers provide double insulation and superior UV resistant and light translucent AS resin lenses for enhanced durability and reliability in application environment.

Available Colors are Red, Yellow, Green, Blue and Clear/White. All colors as clear-lense modules are available

- Diameter: 60 mm
- 2 selectable built- in alarms with adjustable volume up to 90 dB at 1 m for FB type
- · Special pre-wired versatile and flexible cable connection of 3 m
- NPN/ PNP compatible
- IP 65

Ordering information

LME-502UFBW-C-RYGBC-Z 1 2 3 4 5 6

7 8

- 1. Stack
- 1~5
- 2. Rated voltage 24V AC/DC 02:
- 3. Body color
- Blank: Ivory white Black color N:
- U: Silver color

- 4. Type
 - Blank: Continuous light Continuous light or flashing light with FB:
 - audible alarm

- Blank: Pole mount
- Pole mount (with SZ-020) K: W: Direct mount
- 6. Connection
 - C: pre-wired cable 3 m

- 7. Color of LED R٠ Red Y: Yellow G: Green B: Blue C: Clear/White
- 8. Color of Lens
- Blank: Colored lens
- Z: Clear lens

Ordering information

Number of stacks	Mount	Model	Rated voltage	Power	Open collector	Order code		
				consumption		Continuos light	Continuous light with audible alarm	
1	Pole mount	LME-102	24 VAC/DC	2.2 W	NPN/PNP	LME-102-C	LME-102-FB-C	
	Direct mount		24 VAC/DC			LME-102W-C	LME-102-FBW-C	
2	Pole mount	LME-202	24 VAC/DC	3.4 W		LME-202-C	LME-202-FB-C	
	Direct mount		24 VAC/DC			LME-202W-C	LME-202-FBW-C	
3	Pole mount	LME-302	24 VAC/DC	3.8 W		LME-302-C	LME-302-FB-C	
	Direct mount		24 VAC/DC			LME-302W-C	LME-302-FBW-C	
4	Pole mount	LME-402	24 VAC/DC	4.2 W		LME-402-C	LME-402-FB-C	
	Direct mount		24 VAC/DC		W	LME-402W-C	LME-402-FBW-C	
5	Pole mount	LME-502	24 VAC/DC	4.6 W		LME-502-C	LME-502-FB-C	
	Direct mount		24 VAC/DC			LME-502W-C	LME-502-FBW-C	

Optional parts

Тур	Material	Order code		Тур	Height	Material	Order code
Wall mount bracket	Aluminum alloy die-cast	SZ-017		Pole	100 mm	Aluminium	Pole-100A21
	ABS resin	SZ-020				Steel	Pole-100S21
	PBT/ ABS resin	SZ-028			300 mm	Aluminium	Pole-300A21
Mount bracket	Aluminum alloy die-cast	SZ-016A				Steel	Pole-300S21
	Aluminum alloy die-cast	SZ-010			800 mm	Aluminium	Pole-800A21
						Steel	Pole-800S21

^{5.} Mount

Dimensions



Wiring diagram

LME(-W)/LME(-W)-S·Q/LMS [Continuous type]



* ⊖ ÎPo Fuse Yellow Supply € 1A

Features

Interchangeable LED modules

- Changeable color sequence: Easy to add / remove up to 5 colored modules even after installation.
- Note: LED modules of the same color within a signal tower will light up simultaneously.

The wiring remains the same

Each color of LED module corresponds to the lead wire color.



Easy to add and remove

If the number of LED module is changed, center shaft must be purchased.



PATLITE's original dual reflection system with its exclusive hybrid prism-cut lens and 5 color LED modules create bright, distinctive, even illumination



To bring more attention to certain conditions, two, User-selectable, Alarms integrated in the Base module with adjustable volume up to 85 dB at 1m are available.

Specifications

Size	60 mm diameter
Input voltage options	• 24 VAC/VDC
Functions available	Continuous only Continuous, flashing, alarms
Mounting options	Pole mount: with 300 mm aluminum pole, plastic circular bracket Direct mount: includes 3 mounting nuts
Body style	Pre-assembled, pre-wired Interchangeable and stackable after purchase
Body color	Beige (optional: Black or silver)
Tiers	1-5 modules can be stacked
Module colors	Red / Yellow / Green / Blue / Clear/White (for sunlight applications: clear-lense modules in all colors available)
Alarms (FB style only)	 Alarm 1: selectable, single-tone, intermittent (fast beep) alarm, 85 dB (at 1 m) Alarm 2: selectable, single tone, intermittent (slow beep) alarm, 85 dB (at 1 m)
Ratings	 CE UL component recognition (US) UL component recognition (Canada) RoHS
Protection	 IP-65 (LME, LME-W) IP-54 (LME-FB, LME-FBW) Type 4/4X/13 (indoor, direct-mount only)
Control options	 Dry contact closure such as switches or relay contacts Open-collector transistor (NPN or PNP for 24 VDC) Direct voltage control for 24 VDC, continuous and alarm functions only

SAFETY LIMIT SWITCHES

Precise monitoring of guard position

Guards and covers on machines protect workers. They limit access to the dangerous parts of the machine. Our Safety limit switches guarantee that the guards and covers are in place before the machine is started.



Safety limit switch with plastic housing

D4N-

see page 56

- Wide variety of actuators
- · Gold-plated contacts for micro loads
- Double insulation
- M12 connector
- Direct opening mechanism

SAFE CONTROL SYSTEMS FOR SAFETY LIMIT SWITCHES							
Safety Relay Units		Flexible Safety Units	Safety Co	ntrollers			
G9SB	G9SA	G9SX	G9SP	NE1A			
see page 97	see page 98	see page 103	see page 108	see page 111			

52





metal housing:



small housing:

D4NH page 58

D4N_R page 59

hinge operation:

manual reset:



Limit switch with metal housing

The D4B series of limit switches in a rugged metal housing is suitable for both safety and non-safety applications due to its direct opening mechanism and TÜV approval. Furthermore with the increased temperature range and enhanced mechanical switching lifetime, the D4B is first choice for all applications from standard to demanding environments and for highest flexibility in mounting and connectivity preferences.

- Direct opening mechanism and approval by notified body
- Rugged metal housing and extended mechanical switching lifetime (snap action models)
- Terminal block for direct wiring

Ordering information

D4B

Actuator type		Connection method	Order code ^{*1}		
			1NC/1NO (snap-action)	1NC/1NO (slow-action)	2NC (slow-action)
	Roller lever ^{*2}	Terminal block with M20 conduit	D4B-4111N	D4B-4511N	D4B-4A11N
曲	Adjustable rod lever		D4B-4117N	D4B-4517N	D4B-4A17N
Δ	Plain		D4B-4170N	D4B-4570N	D4B-4A70N
R	Roller		D4B-4171N	D4B-4571N	D4B-4A71N

 \star1 The NC contacts provide the approved direct opening mechanism. (– -

 *2 For models with stainless steel rollers and temperature resistance of -40°C refer to WL-_-TC.

Specifications

Item		Snap-action	Slow-action	
Durability ^{*1}	Mechanical	30,000,000 operations min.	10,000,000 operations min.	
	Electrical	500,000 operations min. (at a 250 VAC, 10 A resistive load)		
Operating speed		1 mm/s to 0.5 m/s		
Operating frequency	Mechanical	120 operations/min		
	Electrical	30 operations/min		
Rated frequency		50/60 Hz		
Contact resistance		25 mΩ max. (initial value)		
Pollution degree (operating en	nvironment)	3 (EN60947-5-1)		
Conditional short-circuit curr	ent	100 A (EN60947-5-1)		
Conventional enclosed thermal current (I _{th})		20 A (EN60947-5-1)		
Protection against electric shock		Class I (with ground terminal)		
Ambient temperature Operating		-40 to 80°C (with no icing) ^{*2}		
Degree of protection		IP67 (EN60947-5-1)		

*1 The values are acquired for an ambient temperature of 5 to 35°C and an ambient humidity of 40 to 70%.
*2 -25 to 80°C for the flexible-rod actuator.

OMRON

1NO/1NC Contact (Snap-action)

If metal deposition between mating contacts occurs on the NC contact side, they can be pulled apart by the shearing force and tensile force generated when part B of the

safety cam or plunger engages part A of the movable contact blade. When the safety cam or plunger is moved in the direction of the arrow, the Limit Switch releases.



When metal deposition occurs, the contacts are separated from each other by the plunger being pushed in.

is marked on the product to indicate approval of direct opening.





Limit switch with plastic housing

The D4N series of limit switches in plastic housing is the ideal switch for all standard mechanical position detection applications both for safety and non-safety applications.

- Direct opening mechanism and approval by notified body
- Rugged plastic housing with double insulation
- Wide range of actuators
- · M12 connectors or terminal block with M20 conduit

Ordering information

Actuator type		Connection method	Order code ^{*1}			
			1NC/1NO (snap-action)	1NC/1NO (slow-action)	2NC (slow-action)	2NC/1NO (slow-action)
			Order code	Order code	Order code	Order code
\sim	Roller lever	M20	D4N-4120	D4N-4A20	D4N-4B20	D4N-4C20
"	(resin lever, resin roller)	M12 connector	D4N-9120	D4N-9A20	D4N-9B20	-
Δ	Plunger	M20	D4N-4131	D4N-4A31	D4N-4B31	-
		M12 connector	D4N-9131	D4N-9A31	D4N-9B31	-
R	Roller plunger	M20	D4N-4132	D4N-4A32	D4N-4B32	D4N-4C32
<u> </u>		M12 connector	D4N-9132	D4N-9A32	D4N-9B32	-
P	One-way roller arm lever (horizontal)	M20	D4N-4162	D4N-4A62	D4N-4B62	D4N-4C62
lía.		M12 connector	D4N-9162	D4N-9A62	D4N-9B62	-
ET	One-way roller arm lever (vertical)	M20	D4N-4172	D4N-4A72	D4N-4B72	-
s/P	Adjustable roller lever, form lock	M20	D4N-412G	D4N-4A2G	D4N-4B2G	-
and the second s	(metal lever, resin roller)	M12 connector	D4N-912G	D4N-9A2G	D4N-9B2G	-
\bigcirc	Adjustable roller lever, form lock	M20	D4N-412H	D4N-4A2H	D4N-4B2H	-
F	ク (metal lever, rubber roller)	M12 connector	D4N-912H	D4N-9A2H	D4N-9B2H	-

Switches with MBB contacts

MBB (Make Before Break) contacts have an overlapping structure, so that before the normally closed (NC) contact opens the normally open (NO) contact closes.

Actuator type		Connection method	Order code ^{^1}			
			1NC/1NO (slow-action)	2NC/1NO (slow-action)		
م	Roller lever (resin lever, resin roller)	M20	D4N-4E20	D4N-4F20		
لکا		M12 connector	D4N-9E20	-		
R	Roller plunger	M20	D4N-4E32	D4N-4F32		
Δ		M12 connector	D4N-9E32	-		
P	One-way roller arm lever (horizontal)	M20	D4N-4E62	D4N-4F62		
lía		M12 connector	D4N-9E62	-		
*1						

Specifications

Durability ^{*1}	Mechanical	15,000,000 operations min.*2		
	Electrical	500,000 operations min. for a resistive load of 3 A at 250 VAC 300,000 operations min. for a resistive load of 10 A at 250 VAC		
Operating speed	Roller lever	1 mm/s to 0.5 m/s		
Operating frequency		30 operations/minute max.		
Minimum applicable load		Resistive load of 1 mA at 5 VDC (N-level reference value)		
Protection against electric shock		Class II (double insulation)		
Pollution degree (operati	ng environment)	3 (EN60947-5-1)		
Contact gap		Snap-action: 2x0.5 mm min Slow-action: 2x2 mm min		
Conditional short-circuit current		100 A (EN60947-5-1)		
Rated open thermal current (I _{th})		10 A (EN60947-5-1)		
Ambient temperature Operating		-30°C to 70°C with no icing		
Degree of protection		IP67 (EN60947-5-1)		

^{*1} The durability is acquired for an ambient temperature of 5°C to 35°C and an ambient humidity of 40 to 70%.

^{*2} 10,000,000 operations min. for fork lever actuator.

1NO/1NC Contact (Snap-action)

If metal deposition between mating contacts occurs on the NC contact side, they can be pulled apart by the shearing force and tensile force generated when part B of the

safety cam or plunger engages part A of the movable contact blade. When the safety cam or plunger is moved in the direction of the arrow, the Limit Switch releases.



NC contacts conform to EN60947-5-1 Direct Opening

When metal deposition occurs, the contacts are separated from each other by the plunger being pushed in.

 \bigcirc is marked on the product to indicate approval of direct opening.



Safety door hinge switch

D4NH safety-door hinge switches are available with one or two built-in contacts, shaft or arm lever actuator and various conduit types, e.g. M20.

- Direct opening mechanism
- Shaft or arm lever actuator
- Wide temperature range
- Metric conduit and M12 connector types are available

Ordering information

Switches						
Actuator	Conduit size		Built-in switch mechanism			
			1NC/1NO (slow-action)	2NC (slow-action)	2NC/1NO (slow-action)	
Shaft	1-conduit	M20	D4NH-4AAS	D4NH-4BAS	D4NH-4CAS	
		M12 connector	D4NH-9AAS	D4NH-9BAS	-	
Arm lever	1-conduit	M20	D4NH-4ABC	D4NH-4BBC	D4NH-4CBC	
		M12 connector	D4NH-9ABC	D4NH-9BBC	-	
Astronom Conduitaire			Ruilt-in switch mechanism			
Actuator	Conduit Size		Dunt-in Switch meenanism			
			3NC (slow-action)	1NC/1NO MBB (slow-action)	2NC/1NO MBB (slow-action)	
Shaft	1-conduit	M20	D4NH-4DAS	D4NH-4EAS	D4NH-4FAS	
		M12 connector	-	D4NH-9EAS	-	
Arm lever	1-conduit	M20	D4NH-4DBC	D4NH-4EBC	D4NH-4FBC	
		M12 connector	-	D4NH-9EBC	-	

Specifications

Degree of protection		IP67 (EN60947-5-1)	
Durability	Mechanical	1,000,000 operations min.	
	Electrical	500,000 operations min. for a resistive load of 3 A at 250 VAC 300,000 operations min. for a resistive load of 10 A at 250 VAC	
Operating speed		2 to 360°/s	
Operating frequency		30 operations/minute max.	
Protection against electric shock		Class II (double insulation)	
Pollution degree (operating environment)		3 (EN60947-5-1)	
Contact gap		Snap-action: 2x9.5 mm min Slow-action: 2x2 mm min	
Conditional short-circuit current		100 A (EN60947-5-1)	
Rated open thermal current (I _{th})		10 A (EN60947-5-1)	
Ambient temperature		Operating: -30°C to 70°C with no icing	





Safety-limit switch with manual reset

The D4NR family is a complete line-up of safety-limit switches with manual reset. They are available with one, two or three built-in contacts and a wide range of actuator types. To set up easy installation and maintenance, various conduit types, e.g. M20 and M12 connector types, are provided.

- Direct opening mechanism
- Various actuators
- · Pull-reset switches
- · Gold-plated contacts for handling micro loads
- Metric conduit types available

Ordering information

Switches		Conduit size		Order code	
				1NC/1NO (slow-action)	2NC/1NO (slow-action)
Q	Roller lever	1-conduit	M20	D4N-4A20R	D4N-4C20R
L)	(resin lever, resin roller)		M12 connector	D4N-9A20R	-
\bigcirc	Adjustable roller lever, form lock (metal lever, rubber roller)	1-conduit	M20	D4N-4A2HR	D4N-4C2HR
F			M12 connector	D4N-9A2HR	-
A	Plunger	1-conduit	M20	D4N-4A31R	D4N-4C31R
			M12 connector	D4N-9A31R	-
R	Roller plunger	1-conduit	M20	D4N-4A32R	D4N-4C32R
Δ			M12 connector	D4N-9A32R	-

Specifications

Degree of protection		IP67 (EN60947-5-1)		
Durability Mechanical 1		1,000,000 operations min.		
	Electrical	500,000 operations min. for a resistive load of 3 A at 250 VAC 300,000 operations min. for a resistive load of 10 A at 250 VAC		
Operating speed		1 mm/s to 0.5 m/s (D4N-1A20R)		
Operating frequency		30 operations/minute max.		
Protection against electric	: shock	Class II (double insulation)		
Pollution degree (operatin	g environment)	3 (EN60947-5-1)		
Contact gap		Snap-action: 2×0.5 mm min Slow-action: 2×2 mm min		
Rated open thermal current (I _{th})		10 A (EN60947-5-1)		
Ambient temperature		Operating: -30°C to 70°C with no icing		



SAFETY DOOR SWITCHES

Reliable Guard Monitoring

Monitoring of the correct position of a door or a guard is a key element in machine safety. Reliable detection of the door position and door locking protects workers. Our range of Non-contact switches is designed for applications in the packaging and food industry, fulfilling the requirement of wear and tear – free operation.



· Stainless steel housing







D4NL



Guard-lock safety door switch

The D4NL guard-lock safety-door switches are available with four or five built-in contacts. When locked, they have a key holding force of up to 1300 N. Mechanical lock/solenoid release types and vice versa set up the complete range.

· Safety-door switch with electromagnetic lock or unlock mechanism

Contact configuration

1NC/1N0 + 1NC/1N0

2NC/1N0 + 1NC/1N0

1NC/1N0 + 2NC

2NC + 1NC/1NO

2NC/1N0 + 2NC

3NC + 1NC/1NO

3NC + 2NC

2NC + 2NC

Conduit opening

M20

M20

M20

M20

M20

M20

M20

M20

Order code

D4NL-4AFG-B

D4NL-4BFG-B

D4NL-4CFG-B

D4NL-4DFG-B

D4NL-4EFG-B

D4NL-4FFG-B

D4NL-4GFG-B

D4NL-4HFG-B

- Models with four or five built-in contacts
- Strong key holding force: 1300 N
- For standard loads and micro loads

Lock and release

types Solenoid lock

mechanical

release

Keys are compatible with D4GL and D4NS

Ordering information

Switches (with approved direct opening contacts)

For 110V and 230V version ask your local Omron representative

	Lock and release types	Contact configuration	Conduit opening	Order code
	Mechanical lock solenoid release	1NC/1N0 + 1NC/1N0	M20	D4NL-4AFA-B
		1NC/1NO + 2NC	M20	D4NL-4BFA-B
		2NC + 1NC/1N0	M20	D4NL-4CFA-B
		2NC + 2NC	M20	D4NL-4DFA-B
		2NC/1N0 + 1NC/1N0	M20	D4NL-4EFA-B
		2NC/1N0 + 2NC	M20	D4NL-4FFA-B
		3NC + 1NC/1N0	M20	D4NL-4GFA-B
		3NC + 2NC	M20	D4NL-4HFA-B

Note: - Conduit sizes of G1/2 and Pg 13,5 are also available. - Solenoid: 24 VDC, Orange LED: 10 to 115 VAC/VDC

Operation keys (order separately)

Туре		Order code	Туре	Order code
Horizontal mounting	2	D4DS-K1	Adjustable mounting (horizontal)	D4DS-K3
Vertical mounting	1	D4DS-K2	Adjustable mounting (horizontal/vertical)	D4DS-K5

Specifications

Degree of protection		IP67 (EN60947-5-1) (This applies for the switch only. The degree of protection for the key hole is IP00.)		
Durability ^{*1} Mechanical		1,000,000 operations min.		
	Electrical	500,000 operations min. for a resistive load of 3 A at 250 VAC		
Operating speed		0.05 to 0.5 m/s		
Operating frequency		30 operations/minute max.		
Rated frequency		50/60 Hz		
Contact gap 2x2 mm min				
Direct opening force *2 60 N min. (EN60947-5-1)				
Direct opening travel *2 10 mm min. (EN60947-5-1)				
Holding force 1,300 N min.				
Minimum applicable load Resistive load of 1 mA at 5 VDC (N-level reference value)				
Thermal current (I _{th})		10 A (EN60947-5-1)		
Conditional short-cire	onditional short-circuit current 100 A (EN60947-5-1)			
Pollution degree (ope	erating environment)	nvironment) 3 (EN60947-5-1)		
Protection against electric shock Class II (double insulation)				
Ambient temperature)	Operating: -10°C to 55°C (with no icing or condensation)		

¹ The durability is for an ambient temperature of 5°C to 35°C and an ambient humidity of 40 to 70%. For more details, consult your Omron representative.

^{*2} These figures are minimum requirements for safe operation.





Guard-lock safety door switch

The D4GL guard-lock safety-door switches are available with four or five built-in contacts. When locked, they have a key holding force of up to 1000 N. Mechanical lock/solenoid release types and vice versa set up the complete range.

- · Slim safety-door switch with electromagnetic lock or unlock mechanism
- Models with four or five built-in contacts
- Strong key holding force: 1000 N
- · For standard loads and micro loads
- Keys are compatible with D4NL and D4NS

Ordering information

Switches (with approved direct opening contacts)

Lock and release types	Contact configuration	Conduit size	Order code
Mechanical lock	1NC/1N0 + 1NC/1N0	M20	D4GL-4AFA-A
solenoid release	1NC/1N0 + 2NC	M20	D4GL-4BFA-A
	2NC + 1NC/1NO M20 D4GL-4CFA-A release		
	2NC + 2NC	M20	D4GL-4DFA-A
	2NC/1N0 + 1NC/1N0	M20	D4GL-4EFA-A
	2NC/1N0 + 2NC	M20	D4GL-4FFA-A
	3NC + 1NC/1NO	M20	D4GL-4GFA-A
	3NC + 2NC	M20	D4GL-4HFA-A

Note: - conduit sizes of G1/2 and Pg13,5 are also available. - solenoid: 24 VDC, orange/green LED: 24 VDC

Operation keys (order separately)

Туре		Order code	Туре		Order code
Horizontal mounting	1	D4DS-K1	Adjustable mounting (horizontal)		D4DS-K3
Vertical mounting	*	D4DS-K2	Adjustable mounting (horizontal/vertical)	i	D4DS-K5

Specifications

Degree of protection		IP67 (EN60947-5-1) (This applies for the switch only. The degree of protection for the key hole is IP00.)			
Durability ^{*1} Mechanical		1,000,000 operations min.			
	Electrical	500,000 operations min. for a resistive load of 4 mA at 24 VDC; 150,000 operations min. for a resistive load of 1 A at 125 VAC in 2 circuits and 4 mA at 24 VDC in 2 circuits			
Operating speed		0.05 to 0.5 m/s			
Operating frequency		30 operations/minute max.			
Rated frequency		50/60 Hz			
Contact gap		2x2 mm min.			
Direct opening force	*2	60 N min. (EN60947-5-1)			
Direct opening travel	*3	10 mm min. (EN60947-5-1)			
Holding force		1,000 N min.			
Minimum applicable	load	Resistive load of 4 mA at 24 VDC (N-level reference value)			
Thermal current (I _{th})		2.5 A (EN60947-5-1)			
Conditional short-cire	cuit current	100 A (EN60947-5-1)			
Pollution degree (ope	erating environment)	3 (EN60947-5-1)			
Protection against el	ectric shock	Class II (double insulation)			
Ambient temperature	1	Operating: -10°C to 55°C with no icing			

^{*1} The durability is for an ambient temperature of 5°C to 35°C and an ambient humidity of 40 to 70%. For more details, consult your Omron representative.

^{*2} These figures are minimum requirements for safe operation.

*3 These figures are minimum requirements for safe operation.



D4NS



Safety door switch with plastic housing

The D4NS line-up includes three-contact models with 2NC/1NC and 3NC contact forms in addition to the previous contact forms, 1NC/1NO and 2NC. All models have a M20 conduit opening.

- Line-up with three contacts: 2NC/1NC and 3NC contact forms
- Line-up with two contacts 1NC/1NO and 2NC
- Standardised gold-clad contacts for high contact reliability
- Applicable for standard loads and micro loads

Ordering information

Switches (with approved direct opening contacts)					
Туре	Contact configuration		Conduit opening/connector		Order code
1-conduit	Slow-action	1NC/1N0	M20		D4NS-4AF
		2NC	M20		D4NS-4BF
		2NC/1N0	M20		D4NS-4CF
S		3NC	M20		D4NS-4DF
	Slow-action MBB contact	1NC/1N0	M20		D4NS-4EF
		2NC/1N0	M20		D4NS-4FF
Operation keys (orde	r separately)				
Туре		Order code	Туре		Order code
Horizontal mounting	2	D4DS-K1	Adjustable mounting (horizontal)		D4DS-K3
Vertical mounting		D4DS-K2	Adjustable mounting (horizontal/vertical)		D4DS-K5

Specifications

Degree of protection		IP67 (EN60947-5-1) (This applies for the switch only. The degree of protection for the key hole is IP00.)		
Durability ^{*1} Mechanical Electrical		1,000,000 operations min.		
		500,000 operations min. for a resistive load of 3 A at 250 VAC 300,000 operations min. for a resistive load of 10 A at 250 VAC		
Operating speed		0.05 to 0.5 m/s		
Operating frequency		30 operations/minute max.		
Direct opening force ^{*2}		30 N min.		
Direct opening travel *2		10 mm min.		
Minimum applicable loa	ad	Resistive load of 1 mA at 5 VDC (N-level reference value)		
Protection against elect	tric shock	Class II (double insulation)		
Pollution degree (opera	ting environment)	3 (EN60947-5-1)		
Contact gap		2×2 mm min		
Conditional short-circui	it current	100 A (EN60947-5-1)		
Rated open thermal cur	rent (I _{th})	10 A (EN60947-5-1)		
Ambient temperature		Operating: -30°C to 70°C with no icing		

¹ The durability is for an ambient temperature of 5°C to 35°C and an ambient humidity of 40 to 70%. For more details, consult your Omron representative.

¹ The durability is for an ambient components of a set operation. ² These figures are minimum requirements for safe operation.



Safety door switch with metal housing

The D4BS line-up includes two-contact models with 1NC/1NO and 2NC in a robust metal housing with 1 PG 13.5 conduit opening.

- · Robust metal housing
- · Line-up with two contacts: 1NC/1NO and 2NC
- · Standardised gold-clad contacts for high contact reliability
- · Applicable for standard loads and micro loads

Ordering information

Switches				
Туре	Mounting direction	Conduit size	Order code	
			1NC/1NO (slow-action)	2NC (slow-action)
1-conduit	Front-side mounting	Pg13.5	D4BS-15FS	D4BS-1AFS
Operation keys (order separately)				
Туре		Order code		
Horizontal mounting		D4BS-K1		
Vertical mounting	200	D4BS-K2		
Adjustable mounting (horizontal)	T	D4BS-K3		

Specifications

Degree of protection ^{*1}	IP67 (EN60947-5-1)				
Durability ^{*2}	Mechanical: 1,000,000 operations min. Electrical: 500,000 operations min. (10 A at 250 VAC, resistive load)				
Operating speed	1 m/s to 0.5 m/s				
Operating frequency	30 operations/min max.				
Rated frequency	50/60 Hz				
Contact gap	2×2 mm min.				
Direct opening force ^{*3}	19.61 N min. (EN60947-5-1)				
Direct opening travel ^{*3}	20 mm min. (EN60947-5-1)				
Full stroke	23 mm min.				
Conventional enclosed thermal current (I _{th})	20 A (EN60947-5-1)				
Conditional short-circuit current	100 A (EN60947-5-1)				
Pollution degree (operating environment)	3 (EN60947-5-1)				
Protection against electric shock	Class I (with ground terminal)				
Ambient temperature	Operating: -40 to 80°C (with no icing)				

*1 Although the switch box is protected from dust, oil, or water penetration, do not use the D4BS in places where dust, oil, water, or chemicals may penetrate through the key hole on the head, otherwise switch damage or malfunctioning may occur. ^{*2} The durability is for an ambient temperature of 5°C to 35°C and an ambient humidity of 40 to 70%. Contact your Omron sales representative for more detailed information on other operating envi-

ronments.

*3 These figures are minimum requirements for safe operation.





Non-contact switches for monitoring the status of guarding doors

Non-contact switches monitor the status of guarding doors. LED for easy diagnosis and stainless steel housing for high hygiene demands in the food industry are available

- Operates with all Omron safety controllers
- Operates behind stainless steel fittings
- Non-contact no abrasion no particles
- Screw-hole covers support hygienic design (NMPC)
- Conforms to safety categories up to 4 acc. EN 954-1, PDF-M acc. EN60947-5-3 and PLe acc. EN ISO13849-1

Ordering information

Elongated sensors					
Cable connection	Contact configuration	Order code			
2 m pre-wired	2NC/1NO	F3S-TGR-NLPC-21-02			
5 m pre-wired	2NC/1NO	F3S-TGR-NLPC-21-05			
10 pre-wired	2NC/1N0	F3S-TGR-NLPC-21-10			
M12, 8-pin	2NC/1N0	F3S-TGR-NLPC-21-M1J8			

Small sensors

Cable Connection	Contact configuration	Order code
2 m pre-wired	2NC/1NO	F3S-TGR-NSMC-21-02
5 m pre-wired	2NC/1N0	F3S-TGR-NSMC-21-05
10 pre-wired	2NC/1N0	F3S-TGR-NSMC-21-10
M12, 8-pin	2NC/1N0	F3S-TGR-NSMC-21-M1J8

Miniature sensors

Cable connection	Contact configuration	Order code
2m pre-wired	2NC/1N0	F3S-TGR-NMPC-21-02
5m pre-wired	2NC/1N0	F3S-TGR-NMPC-21-05
10m pre-wired	2NC/1N0	F3S-TGR-NMPC-21-10
M12, 8-pin	2NC/1N0	F3S-TGR-NMPC-21-M1J8

Specifications

Mechanical data

Item	Model	Elongated sensor	Small sensor	Miniature sensor
Operating distance	OFF → ON (Sao)	12 mm Close		8 mm Close
	ON → OFF (Sar)	17 mm Open		12 mm Open
Actuator approach speed	Min. Max.	4 mm/s 1000 mm/s		
Operating temperature	-	-25°C to +80°C	-25°C to +105°C	-25°C to +80°C
Enclosure protection	Flying lead M12 connector	IP 67		
Material	-	Black Polycarbonate	Stainless steel 316	Black Polyester

F3S-TGR-N_C

Electrical data

Item		Model	Elongated sensor	Small sensor	Miniature sensor
Power supply		-	24 VDC ±15%		
Power consumption		Max.	50 mA		
Switching current		Min.	10 mA, 10 VDC		
Rated loads	NC contacts NO contact	Max.	100 mA, 24 VDC 100 mA, 24 VDC		
Output type		-	Electronic output (potential-fre	e optocoupler output)	

Approved standards

EN standards certified by TÜV Rheinland
EN 954-1, EN ISO13849-1
EN 60204-1
EN/IEC 60947-5-3
UL 508, CSA C22.2
BS 5304
EN 1088-1 conformance

Wiring examples (Single head connection)

G9SA

Single sensor application with G9SA-301 (up to safety category 4 acc. EN954-1 or PLe acc. EN ISO 13849-1)







Non-contact switches for monitoring the status of guarding doors

Non-contact switches monitor the status of guarding doors. LED for easy diagnosis and stainless steel housing for high hygiene demands in the food industry are available.

- Operates with all Omron safety controllers
- Operates behind stainless steel fittings
- Non-contact no abrasion no particles
- Screw-hole covers support hygienic design (NMPR)
- Conforms to safety categories up to 4 acc. EN 954-1, PDF-M acc. EN60947-5-3 and PLe acc. EN ISO13849-1

Ordering information

Elongated sensors				
Cable connection	Contact configuration	Order code		
2 m pre-wired	2NC/1N0	F3S-TGR-NLPR-21-02		
5 m pre-wired	2NC/1N0	F3S-TGR-NLPR-21-05		
10 pre-wired	2NC/1N0	F3S-TGR-NLPR-21-10		
M12, 8-pin	2NC/1N0	F3S-TGR-NLPR-21-M1J8		

Small sensors

Cable connection	Contact configuration	Order code
2 m pre-wired	2NC/1NO	F3S-TGR-NSMR-21-02
5 m pre-wired	2NC/1N0	F3S-TGR-NSMR-21-05
10 pre-wired	2NC/1NO	F3S-TGR-NSMR-21-10
M12, 8-pin	2NC/1NO	F3S-TGR-NSMR-21-M1J8

Miniature sensors

Cable connection	Contact configuration	Order code
2m pre-wired	2NC/1NO	F3S-TGR-NMPR-21-02
5m pre-wired	2NC/1NO	F3S-TGR-NMPR-21-05
10m pre-wired	2NC/1NO	F3S-TGR-NMPR-21-10
M12, 8-pin	2NC/1N0	F3S-TGR-NMPR-21-M1J8

Specifications

Mechanical data

Item	Model	Elongated sensor	Small sensor	Miniature sensor
Operating distance	OFF → ON (Sao)	10 mm Close		12 mm Close
	ON → OFF (Sar)	22 mm Open		20 mm Open
Actuator approach speed	Min. Max.	4 mm/s 1000 mm/s		
Operating temperature	-	-25°C to +80°C	-25°C to +105°C	-25°C to +80°C
Enclosure protection	Flying lead M12 connector	IP 67		
Material	-	Black Polycarbonate	Stainless steel 316	Black Polyester



F3S-TGR-N_R

Electrical data

Item		Model	Elongated sensor	Small sensor	Miniature sensor
Contact release time		Max.	2 ms		
Initial contact resistance		Max.	50 mΩ		500 mΩ
Switching current		Min.	1 mA, 10 VDC		10 mA, 10 VDC
Rated loads	NC contacts NO contact	Max.	1 A, 250 VAC 0.2 A, 24 VDC		0.5 A, 250 VAC 0.2 A, 24 VDC

Approved standards

EN standards certified by TÜV Rheinland
EN 954-1, EN ISO13849-1
EN 60204-1
EN/IEC 60947-5-3
UL 508, CSA C22.2
BS 5304
EN 1088-1 conformance

Wiring examples (Single head connection)

G9SA

Single sensor application with G9SA-301

(up to safety category 4 acc. EN954-1 or PLe acc. EN ISO 13849-1)





SAFETY SENSORS

Total consistency - across the board

Safety Sensors are the first choice in safeguarding workplaces where persons and machines cooperate. Built-in intelligence stops the machine in conditions that are dangerous for the worker. Our F3S-TGR-CL range offers safety light curtains with included safe control functions for Finger-, hand- and body protection, all using the same concept of wiring, installation and setup for simplicity in daily use and maintenance.

000 0000 74
see page 74
t

SAFE CONTROL SYSTEMS FOR SAFETY SENSORS						
Safety R	elay Units	Flexible Safety Units	Safety Co	ntrollers		
G9SB	G9SA	G9SX	G9SP	NE1A		
see page 97	see page 98	see page 103	see page 108	see page 111		




Type 4





robust housing, finger- and hand-protection



slim housing, finger- and hand-protection

OS32C

presence sensing, collission avoidance for AGVs, 270° safety laser scanner





Category 4 / 2 safety light curtain

The MS4800 and MS2800 family of safety light curtain provides simplicity in mounting, configuring, daily use and maintenance by providing a:

- Sensing distance up to 20m for 30mm resolution and 7 m for 14mm resolution
- LED bar for easy alignment and diagnosis
- DIP-switch setup for blanking, muting and optical coding
- Category 4 / 2 sensor complying with EN 61496-1
- All-in-one M12 connection and mounting concept with robust housing
- Multicascadable up to 3 sets

Ordering information

MS2800 Safety Category 2										
Connection features										
Standard Standalone operation										
Master Series connection, muting	Standard				Master			Slave		
Slave Series connection only										
	MS2800S-				MS28	800FS-		MS28	300F-	
Function Set										
Basic Interlock, restart, EDM, 2 optical channels, integrated alignment tool	Ba	sic	Adva	inced	Ва	sic	Adva	inced		
Advanced Muting, blanking (fixed/floating)										
	MS280	0S-EB-	MS280	IOS-EA-	MS280	OFS-EB-	MS280	OFS-EA-	MS280	00F-E-
Resolution	14 mm	30 mm	14 mm	30 mm	14 mm	30 mm	14 mm	30 mm	14 mm	30 mm
14 mm finger protection										
30 mm hand protection	MS2800S-EB-	MS2800S-EB-	MS2800S-EA-	MS2800S-EA-	MS2800FS-EB-	MS2800FS-EB-	MS2800FS-EA-	MS2800FS-EA-	MS2800F-E-	MS2800F-E-
Length	014-	030-	014-	030-	014-	030-	014-	030-	014-	030-
240 mm 2120 mm in	280 1800	280 2120	280 1800	280 2120	280 1800	280 2120	280 1800	280 2120	240 1280	280 2120
40 mm increments										

MS4800 Safety Category 4

Connection features										
Standard Standalone operation										
Master Series connection, muting		Standard			Master			Slave		
Slave Series connection only										
	MS4800S-				MS48	00FS-		MS4800F-		
Function Set										
Basic Interlock, restart, EDM, 2 optical channels, integrated alignment tool	Ba	sic	Adva	nced	Ва	sic	Adva	nced		
Advanced Muting, blanking (fixed/floating)										
	MS480	0S-EB-	MS480	0S-EA-	MS4800FS-EB- MS4800FS-EA-)FS-EA-	MS4800F-E-		
Resolution	14mm	30mm	14mm	30mm	14mm	30mm	14mm	30mm	14mm	30mm
14mm finger protection										
30mm hand protection	MS4800S-EB-	MS4800S-EB-	MS4800S-EA-	MS4800S-EA-	MS4800FS-EB-	MS4800FS-EB-	MS4800FS-EA-	MS4800FS-EA-	MS4800F-E-	MS4800F-E-
Length	014-	030-	014-	030-	014-	030-	014-	030-	014-	030-
240mm 2120mm in	280 1800	280 2120	280 1800	280 2120	280 1800	280 2120	280 1800	280 2120	240 1280	280 2120
40mm increments										

Examples

MS2800S-EB-030-1000 Standalone operation Basic function set 30mm resolution 1000mm protective height MS4800FS-EA-014-1200 Series connection model Advanced function set 14mm resolution 1200mm protective height MS4800F-E-014-600 Slave operation

14mm resolution 600mm protective height



MS4800/2800

Specifications

Model	MS4800E	MS2800E		
Sensor type	Type 4	Type2		
Normal operating range Reduced range (DIP-switch 6)	14 mm resolution: 0.3 - 7 m, 30 mm resolution: 0.3 - 20 m 14 mm resolution: 0.3 - 3 m, 30 mm resolution: 0.3 - 8 m			
Beam pitch	14 mm resolution: 10 mm; 30 mm resolution: 20 mm			
Protective height	14 mm resolution: 280 - 1800 mm; 30 mm resolution: 240 - 212	0 mm		
Detection capability	14 mm resolution: 14 mm non-transparent; 30 mm resolution: 30) mm non-transparent		
Effective aperture angle (EAA)	Within ±2,5°	Within ±5,0°		
	for the emitter and receiver at a detection distance of at least 3m	according to IEC61496-2		
Light source	Infrared LED's (880 nm), Power dissipation: 180 mW, Class 1 per	EN60825-1		
Supply voltage (Vs)	24 VDC \pm 20%, according EN/IEC60204, able to cover a drop of v	oltage of at least 20 msec		
OSSD	Two safety related PNP transistor output, load current 625 mA max.*1, short circuit protection			
Auxiliary output (non safety output)	One PNP output sourcing 100mA @ 24VDC. This output follows the OSSD's			
Output operation mode	OSSD output: Light-ON			
Test functions	Self-test (after power ON and during operation)			
Safety-related functions	All versions: Auto reset/interlock with manual reset, EDM (external device monitoring) advanced versions only: fixed blanking, floating blanking, muting			
Response time	ON to OFF: 14 to 59 ms			
Ambient light intensity	Incandescent lamp: 3000 lx max. (light intensity on the receiver s	urface)		
Ambient temperature	Operating: -10°C to +55°C, storage: -25°C to +70°C (without ici	ng or condensation)		
Degree of protection	IP65 (IEC60529)			
Connection methode	Flexible cable with M 12 connection: receiver: 8 pins, transmitter	: 5 pins		
Materials	Case: Polyurethane powder painted aluminium, cap: polycarbona	te, front window: acrylic, mounting brackets: cold rolled steel		
Size (cross section)	39 x 50 mm			
Receiver indicator lights	Individual Beam Indicator (IBI), interlock, blanking activ, RUN and	STOP state, error codes		
Transmitter indicator lights	ON, OFF, failure			
AOPD (ESPE)	Type4 acc. IEC 61496-1	Type2 acc. IEC 61496-1		
Suitable for safety control systems	Cat. 4 acc. EN954-1, PLe acc. EN ISO 13849-1	Cat. 2 acc. EN954-1, PLc acc. EN ISO 13849-1		
Safety Integrity Level	SIL 3 according IEC 61508			
PFH	5,9 x 10 ⁻⁸			

^{*1} Up to 12 m we recommend to use the F39-JMR cables, to use longer cables and a current of 625 mA the F39-JMR cables are necessary.

Connection example

Using a manual restart and an external device monitoring



F3S-TGR-CL



Multi-beam, finger- and hand protection safety sensor

The multi-beam sensors are available in Type 2 (PL c) and Type 4 (PL e) with integrated muting function. The finger- and hand protection models are available in Type 2 (PL c) and Type 4 (PL e) with integrated safety control functions.

- Type 2/Type 4 sensor complying with EN 61496-1
- Family concept in wiring and mounting

Multi-beam models

- · Sensing distance up to 50 m
- DIP-switch setup for muting, pre-reset, interlock function and optical coding
- Muting function and muting lamp integrated
- Finger- and hand protection models
- Sensing distance up to 0.2 m...6 m (14 mm) and 0.2 m...14 m (35 mm and 70mm)
- DIP-switch setup for blanking, interlock function, muting and optical coding
- · Floating blanking and fixed blanking supported
- Master/Slave models available

Ordering information multi-beam safety sensors

Long-range active/active systems

F3S-TGR-CL2_-K_ (Type 2)

Number of optical axes	Sensing distance	Beam pitch	Feature set ^{*1}	Order code
2	0.5 m 40 m	500	Advanced	F3S-TGR-CL2A-K2-500
2	0.5 m 40 m	500	Basic	F3S-TGR-CL2B-K2-500
3	0.5 m 40 m	400	Advanced	F3S-TGR-CL2A-K3-800
3	0.5 m 40 m	400	Basic	F3S-TGR-CL2B-K3-800
4	0.5 m 40 m	300	Advanced	F3S-TGR-CL2A-K4-900
4	0.5 m 40 m	300	Basic	F3S-TGR-CL2B-K4-900
4	0.5 m 40 m	400	Advanced	F3S-TGR-CL2A-K4-1200
4	0.5 m 40 m	400	Basic	F3S-TGR-CL2B-K4-1200
2	25 m 50 m	500	Advanced	F3S-TGR-CL2A-K2-500-LD
2	25 m 50 m	500	Basic	F3S-TGR-CL2B-K2-500-LD
3	25 m 50 m	400	Advanced	F3S-TGR-CL2A-K3-800-LD
3	25 m 50 m	400	Basic	F3S-TGR-CL2B-K3-800-LD
4	25 m 50 m	300	Advanced	F3S-TGR-CL2A-K4-900-LD
4	25 m 50 m	300	Basic	F3S-TGR-CL2B-K4-900-LD
4	25 m 50 m	400	Advanced	F3S-TGR-CL2A-K4-1200-LD
4	25 m 50 m	400	Basic	F3S-TGR-CL2B-K4-1200-LD

Short-range active/passive systems

F3S-TGR-CL2_-K_C (Type 2)

Number of optical axes	Sensing distance	Beam pitch	Feature set ^{*1}	Order code
2	0.5 m 12 m	500	Advanced	F3S-TGR-CL2A-K2C-500
2	0.5 m 12 m	500	Basic	F3S-TGR-CL2B-K2C-500
3	0.5 m 8 m	400	Advanced	F3S-TGR-CL2A-K3C-800
3	0.5 m 8 m	400	Basic	F3S-TGR-CL2B-K3C-800
4	0.5 m 7 m	300	Advanced	F3S-TGR-CL2A-K4C-900
4	0.5 m 7 m	300	Basic	F3S-TGR-CL2B-K4C-900
4	0.5 m 7 m	400	Advanced	F3S-TGR-CL2A-K4C-1200
4	0.5 m 7 m	400	Basic	F3S-TGR-CL2B-K4C-1200

*1. Feature set: Basic:

 Basic:
 Manual/automatic restart, coding

 Advanced:
 Basic + Muting + integrated Muting lamp + Pre-reset

F3S-TGR-CL4_-K_ (Type 4)

Number of optical axes	Sensing distance	Beam pitch	Feature set ^{*1}	Order code
2	0.5 m 40 m	500	Advanced	F3S-TGR-CL4A-K2-500
2	0.5 m 40 m	500	Basic	F3S-TGR-CL4B-K2-500
3	0.5 m 40 m	400	Advanced	F3S-TGR-CL4A-K3-800
3	0.5 m 40 m	400	Basic	F3S-TGR-CL4B-K3-800
4	0.5 m 40 m	300	Advanced	F3S-TGR-CL4A-K4-900
4	0.5 m 40 m	300	Basic	F3S-TGR-CL4B-K4-900
4	0.5 m 40 m	400	Advanced	F3S-TGR-CL4A-K4-1200
4	0.5 m 40 m	400	Basic	F3S-TGR-CL4B-K4-1200
2	25 m 50 m	500	Advanced	F3S-TGR-CL4A-K2-500-LD
2	25 m 50 m	500	Basic	F3S-TGR-CL4B-K2-500-LD
3	25 m 50 m	400	Advanced	F3S-TGR-CL4A-K3-800-LD
3	25 m 50 m	400	Basic	F3S-TGR-CL4B-K3-800-LD
4	25 m 50 m	300	Advanced	F3S-TGR-CL4A-K4-900-LD
4	25 m 50 m	300	Basic	F3S-TGR-CL4B-K4-900-LD
4	25 m 50 m	400	Advanced	F3S-TGR-CL4A-K4-1200-LD
4	25 m 50 m	400	Basic	F3S-TGR-CL4B-K4-1200-LD

F3S-TGR-CL4_-K_C (Type 4)

Number of optical axes	Sensing distance	Beam pitch	Feature set ^{*1}	Order code
2	0.5 m 12 m	500	Advanced	F3S-TGR-CL4A-K2C-500
2	0.5 m 12 m	500	Basic	F3S-TGR-CL4B-K2C-500
3	0.5 m 8 m	400	Advanced	F3S-TGR-CL4A-K3C-800
3	0.5 m 8 m	400	Basic	F3S-TGR-CL4B-K3C-800
4	0.5 m 7 m	300	Advanced	F3S-TGR-CL4A-K4C-900
4	0.5 m 7 m	300	Basic	F3S-TGR-CL4B-K4C-900
4	0.5 m 7 m	400	Advanced	F3S-TGR-CL4A-K4C-1200
4	0.5 m 7 m	400	Basic	F3S-TGR-CL4B-K4C-1200

Ordering information finger- and hand protection safety sensors

*?				
Feature Set ²	Master/Slave	Resolution	Length	Order code
Basic	Standalone	14 mm	150 mm2400 mm	F3S-TGR-CL2B-014-
		35 mm		F3S-TGR-CL2B-035-
Advanced	Standalone	14 mm		F3S-TGR-CL2A-014-
		35 mm		F3S-TGR-CL2A-035-
	Master	14 mm	300 mm2100 mm	F3S-TGR-CL2A-014M
		35 mm		F3S-TGR-CL2A-035M
	Slave	14 mm		F3S-TGR-CL2A-014S
		35 mm		F3S-TGR-CL2A-035S
		70 mm		F3S-TGR-CL2A-070S
Basic	Standalone	14 mm	150 mm2400 mm	F3S-TGR-CL4B-014-
		35 mm		F3S-TGR-CL4B-035-
Advanced	Standalone	14 mm		F3S-TGR-CL4A-014-
		35 mm		F3S-TGR-CL4A-035-
	Master	14 mm	300 mm2100 mm	F3S-TGR-CL4A-014M
		35 mm		F3S-TGR-CL4A-035M
	Slave	14 mm		F3S-TGR-CL4A-014S
		35 mm		F3S-TGR-CL4A-035S
		70 mm		F3S-TGR-CL4A-070S
	Feature Set ^{*2} Basic Advanced Basic Advanced	Feature Set*2 Master/Slave Basic Standalone Advanced Standalone Master Slave Basic Standalone Advanced Standalone Basic Standalone Basic Standalone Basic Standalone Slave Standalone Standalone Standalone Standalone Standalone Standalone Standalone	Feature Set*2 Master/Slave Resolution Basic Standalone 14 mm Basic Standalone 14 mm Advanced Master 14 mm Master 14 mm 35 mm Master 14 mm 35 mm Master 14 mm 35 mm Slave 14 mm 35 mm Basic Standalone 14 mm So mm 70 mm 14 mm Advanced Standalone 14 mm Master 14 mm 35 mm Advanced Standalone 14 mm Standalone 14 mm 35 mm Advanced Standalone 14 mm Standalone 14 mm 35 mm Advanced Standalone 14 mm Standalone 14 mm 35 mm Master 14 mm 35 mm Standalone 14 mm 35 mm Master 14 mm 35 mm Master 14 mm 35 mm Standalone 14 mm 35 mm Master 35 m	Feature Set*2 Master/Slave Resolution Length Basic Standalone 14 mm 55 mm Advanced Standalone 14 mm

*2. Feature set: Basic: Manual/automatic restart, coding Advanced: Blanking functions + Muting + integrated Muting lamp + pre-reset, Single/ Double Break, Master/Slave



Specifications

Multi-beam safety sensors

	-			
Item	F3S-TGR-CL2K_		F3S-TGR-CL4K_	
Sensor Type	Type 2		Туре 4	
Operating range	F3S-TGR-CLK_ F3S-TGR-CLKLD F3S-TGR-CLK2C-500 F3S-TGR-CLK3C-800 F3S-TGR-CLK4C	0.5 m 40 m 25 m 50 m 0.5 m 12 m 0.5 m 8 m 0.5 m 7 m		
Beam pitch	F3S-TGR-CLK2500: F3S-TGR-CLK3800: F3S-TGR-CLK4900: F3S-TGR-CLK41200:	2 beams, 500 mm 3 beams, 400 mm 4 beams, 300 mm 4 beams, 400 mm		
Effective aperture angle acc. EN 61496-2 (2006) for distances >3 m	Within ±5°		Within $\pm 2.5^{\circ}$	
Light source	Infrared LED (880 nm), power dissipation <3 mW, Class 1 per EN 60825-1			
Supply Voltage	24 VDC±20%, according EN/IEC60204 able to cover a drop of voltage of at least 20 ms			
OSSD	2 PNP transistor outputs, load cr	urrent 2x250 mA max		
Test functions	Self test (after power ON and du	ring operation)		
Safety-related functions	All versions: Auto reset/ interlock with manual reset, EDM (external device monitoring) Advance version only: Muting and pre-reset function			
Response time	< 13 ms			
Ambient temperature	Operating: -10°C+55°C, Stor	age: -25°C+70°C (no icing, no condensation)		
Degree of protection	IP 65 (IEC 60529)			
Materials	Case: Painted aluminium, front window: Acrylic Lexan, Cap: ABS, mounting brackets: cold rolled steel			
Size (cross section)	37x48 mm			
Suitable for safety control systems	Type 2 (EN 61496), PLc (EN ISO	13849-1)	Type 4 (EN 61496), PLe (EN ISO 13849-1)	
MTTFd, DC	MTTFd = 100 years, DC = high,	MTTR = 8 hours		
PFH, Proof test interval	$PFHd = 2,5*10^{-9}$, Proof test inte	rval: every 20 years		

Finger- and hand safety protection sensors

Item	F3S-TGR-CL20	F3S-TGR-CL40		
Sensor type	Type 2	Type 4		
Operating range: short setting	F3S-TGR-CL014: 0.2 m 3 m; F3S-TGR-CL035: 0.2 m 7 m, F3S-TGF	R-CL070: 0,2 m7 m		
Operating range: long setting	F3S-TGR-CL014: 3 m 6 m; F3S-TGR-CL035: 7 m14 m, F3S-TGR-Cl	L070: 7 m14 m		
Beam pitch (center)	14 mm resolution: 7.5 mm 35 mm resolution: 18 mm			
Detection capability	14 mm resolution: 14 mm non-transparent 35 mm resolution: 35 mm non-transparent 70 mm resolution: 70 mm non-transparent			
Effective aperture angle acc. EN 61496-2 (2006) for distances < 3 m	Within ±5°	Within ±2.5°		
Light source	Infrared LED (880 nm), power dissipation <3 mW, Class 1 per EN 60825-1			
Supply voltage	24 VDC $\pm 20\%$, according EN/IEC60204 able to cover a drop of voltage of at least	t 20 ms		
OSSD	2 PNP transistor outputs, load current 2x250 mA max			
Test functions	Self test (after power ON and during operation)			
Safety-related functions	All versions: Auto reset/ interlock with manual reset, EDM (external device monit Advance version only: Blanking, muting and pre-reset function	toring)		
Response time	ON to OFF: 14 ms103 ms			
Ambient temperature	Operating: -10°C+55°C, Storage: -25°C+70°C (no icing, no condensation)			
Detgree of protection	IP 65 (IEC 60529)			
Materials	Case: Painted aluminium, Front window: Acrylic Lexan, Cap: ABS, mounting brackets: cold rolled steel			
Size (cross section)	37x48 mm			
Suitable for safety control systems	Type 2 (EN 61496), PL c (EN ISO 13849-1)	Type 4 (EN 61496), PL e (EN ISO 13849-1)		
MTTFd, DC	MTTFd = 100 years, DC = high, MTTR = 8 hours			
PFH, Proof test interval	$PFHd = 2,5*10^{-9}$, Proof test interval: every 20 years			



F3S-TGR-CL and GSB-301-D in manual reset





Note: This circuit achieves up to PLe according to EN ISO 13849-1 with F3S-TGR-CL4 and up to PLc according to EN ISO 13849-1 with F3S-TGR-CL2.

Standard cables

Receiver cables (M12-8pin, shielded, flying leads)					
Y92E-M12PURSH8S2M-L	F39-TGR-CVL-B-2-R	Receiver cable, 2 m length			
Y92E-M12PURSH8S5M-L	F39-TGR-CVL-B-5-R	Receiver cable, 5 m length			
Y92E-M12PURSH8S10M-L	F39-TGR-CVL-B-10-R	Receiver cable, 10 m length			
Y92E-M12PURSH8S25M-L	F39-TGR-CVL-B-25-R	Receiver cable, 25 m length			
Transmitter cables (M12-4pin, shielded, flving leads)					

Y92E-M12PURSH4S2M-L	F39-TGR-CVL-B-2-T	Transmitter cable, 2 m length
Y92E-M12PURSH4S5M-L	F39-TGR-CVL-B-5-T	Transmitter cable, 5 m length
Y92E-M12PURSH4S10M-L	F39-TGR-CVL-B-10-T	Transmitter cable, 10 m length
Y92E-M12PURSH4S25M-L	F39-TGR-CVL-B-25-T	Transmitter cable, 25 m length

Connector cables F3S-TGR-CL → F39-TGR-CL-W-IBOX

Receiver cables (M12-8pin, male/female connector)

Y92E-M12FSM12MSPURSH82M-L	F39-TGR-CVL-B-2-RR	Receiver cable, 2 m length
Y92E-M12FSM12MSPURSH85M-L	F39-TGR-CVL-B-5-RR	Receiver cable, 5 m length
Y92E-M12FSM12MSPURSH810M-L	F39-TGR-CVL-B-10-RR	Receiver cable, 10 m length

Transmitter cables (M12-4pin, male/female connector)

Y92E-M12FSM12MSPURSH42M-L	F39-TGR-CVL-B-2-EE	Transmitter cable, 2 m length
Y92E-M12FSM12MSPURSH45M-L	F39-TGR-CVL-B-5-EE	Transmitter cable, 5 m length
Y92E-M12FSM12MSPURSH410M-L	F39-TGR-CVL-B-10-EE	Transmitter cable, 10 m length

Connector cables Muting sensors \rightarrow F39-TGR-SB-CMB, F39-TGR-CL-W-IBOX

Interconnect cables (M12-4pin, male/female connector)								
Y92E-M12FSM12MSPURSH42M-L	F39-TGR-CVL-B-2-EE	Connector cable, 2 m length						
Y92E-M12FSM12MSPURSH45M-L	F39-TGR-CVL-B-5-EE	Connector cable, 5 m length						
Y92E-M12FSM12MSPURSH410M-L	F39-TGR-CVL-B-10-EE	Connector cable, 10 m length						

Mounting bracket F39-TGR-ST-ADJ



Wiring accessories (connectors and Y-connector cables)

Туре	
F39-TGR-CT-B-R	Connector M12, 8-pin, female for wiring
F39-TGR-CT-B-E	Connector M12, 4-pin, female for wiring
F39-TGR-CT-W-R	Connector M12, 8-pin, male for wiring
F39-TGR-CT-W-E	Connector M12, 4-pin, male for wiring
F39-TGR-CVL-D-B-5-R	Cable for Sensor system and muting lamp connection "Y" configuration. Receiver cable 5 m length and 2 m to muting lamp



F3S-TGR-CL

Safety Relay Units

Family	Type Name	Configuration
G9SB	G9SB-200-D	DPST-NO
	G9SB-301-D	3PST-NO
G9SA	G9SA-301	3PST-NO
	G9SA-501	5PST-NO
	G9SA-321-T075	3PST-NO, Time del. 7.5 s
	G9SA-321-T15	3PST-NO, Time del. 15 s
	G9SA-321-T30	3PST-NO, Time del. 30 s
G9SX	G9SX-BC202-RT	2 Safe Outputs
	G9SX-BC202-RC	2 Safe Outputs
	G9SX-AD322-T15-RT	3 Safe Outputs, Time del. 15 s
	G9SX-AD322-T15-RC	3 Safe Outputs, Time del. 15 s
	G9SX-AD322-T150-RT	3 Safe Outputs, Time del. 150 s
	G9SX-AD322-T150-RC	3 Safe Outputs, Time del. 150 s
	G9SX-ADA222-T15-RT	2 Safe Outputs, Time del. 15 s
	G9SX-ADA222-T15-RC	2 Safe Outputs, Time del. 15 s
	G9SX-ADA222-T150-RT	2 Safe Outputs, Time del. 150 s
	G9SX-ADA222-T150-RC	2 Safe Outputs, Time del. 150 s
DeviceNet safety	NE1A-SCPU01	16 In, 8 Out, Safety Master
	NE1A-SCPU02	40 In, 8 Out, Safety Master
Safety controller	G9SP-N10S	10 In, 4 Out
	G9SP-N10D	10 In, 16 Out
	G9SP-N20S	20 In, 8 Out
Relay interface	F39-TGR-SB-R	Relay interface for semiconductor OSSDs

Dimensions



F3S-TGR-CL system data with 14 mm, 35 mm and 70 mm resolution

Model code		150	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950	2100	2250	2400
all models	L [mm]	217	364	511	658	805	952	1099	1246	1393	1540	1687	1834	1981	2128	2275	2422
	E [mm]	147	294	441	588	735	882	1029	1176	1323	1470	1617	1764	1911	2058	2205	2352
	A [mm]	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
	Weight [kg]	1.0	1.4	1.9	2.5	3.0	3.6	4.1	4.7	5.3	5.8	6.4	7.0	7.5	8.1	8.6	9.2
14 mm	F [mm]	161	308	455	602	749	896	1043	1190	1337	1484	1631	1778	1925	2072	2219	2366
35 mm	F [mm]	182	329	476	623	770	917	1064	1211	1358	1505	1652	1799	1946	2093	2240	2352
70 mm	F [mm]	n. a.	347	n. a.	641	n. a.	931	n. a.	1229	n. a.	1523	n. a.	1817	n. a.	2111	n. a.	n. a.

F3S-TGR-CL-K system data

Model code	Weight	Dimensions						
		F [mm]	L (mm)	E [mm]	A [mm]			
F3S-TGR-CLK2C-500	2.3 kg	518	682	500	59			
F3S-TGR-CLK3C-800	3.2 kg	818	982	400	59			
F3S-TGR-CLK4C-900	4.1 kg	918	1082	300	59			
F3S-TGR-CLK4C-1200	4.9 kg	1218	1382	400	59			
F3S-TGR-CLK2-500	2.3 kg	518	682	500	59			
F3S-TGR-CLK3-800	3.2 kg	818	982	400	59			
F3S-TGR-CLK4-900	4.1 kg	918	1082	300	59			
F3S-TGR-CLK4-1200	4.9 kg	1218	1382	400	59			
F3S-TGR-CLK2-500-LD	2.3 kg	518	682	500	59			
F3S-TGR-CLK3-800-LD	3.2 kg	818	982	400	59			
F3S-TGR-CLK4-900-LD	4.1 kg	918	1082	300	59			
F3S-TGR-CLK4-1200-LD	4.9 kg	1218	1382	400	59			

F39-TGR-MCL



Muting actuators

The F39-TGR-MCL-_ muting actuators are plug-and-play accessories for the F3S-TGR-CL Safety Sensors. Easy wiring of the entire muting system is provided by connection boxes managing all connections needed.

- Active/active and active/passive systems supported
- T- and L- shape muting by using same parts
- Selectable muting sensor sequence
- · Pre-installed mounting brackets
- Pre-wired connection cables
- Supporting Type 2 and Type 4 applications

Ordering information

Muting actuators (mounting brackets are included)						
		Order code				
Transmitter + Receiver set	active/active	F39-TGR-MCL				
Receiver only	active/active	F39-TGR-MCL-D				
Transmitter only	active/active	F39-TGR-MCL-L				
Transceiver + Reflector set	active/passive	F39-TGR-MCL-R				
Transceiver only	active/passive	F39-TGR-MCL-R-A				
Reflector only	active/passive	F39-TGR-MCL-R-P				
Connection boxes						
		Order code				
Connection box for Receivers and Transceivers	F39-TGR-MCL-CMD					
Connection box for Transmitters	F39-TGR-MCL-CML					
Mounting brookoto						

Mounting brackets

Mounting bracket for one muting actuator

Specifications

Power supply		24 VDC±20%					
Consumption		5 W max (F39-TGR-MCL only)					
Ambient temperature		During operation; -10 to + 55°C (with no dew condensation)					
Cable connector Length		30 cm pre-wired					
	RX	I12 5-pin female					
ТХ		M12 5-pin female					
Degree of protection		IP65					
Distance between muting bea	ms	250mm					
F39-TGR-MCL	Optical data	Through-beam system					
	Operating distance	0 7 m; max. 0 8,4 m					
Light source		Red emitting LEDs, Wavelength 630 nm					
F39-TGR-MCL-R	Optical data	Polarized retro-reflective system					
	Operating distance	0 4 m; max. 0 4,8 m					
	Light source	Red emitting LEDs, Wavelength 660 nm					

Configuration examples

L-muting, active/active

- 1) Safety sensor (e.g. F3S-TGR-CL4A-K2-500)
- 2) Muting actuators F39-TGR-MCL
- 3) Connector box F39-TGR-MCL-CML
- 4) Connector box F39-TGR-MCL-CMD



L-muting, active/passive

1) Safety Sensor (e.g. F3S-TGR-CL4A-K2C-500)

Order code

F39-TGR-MCL-ST

- 2) Muting actuators F39-TGR-MCL-R
- 3) Connection box F39-TGR-MCL-CMD







Adjustable stands family

F39-TGR-AS adjustable stands product family is used to easily install, align and protect multi-beam safety sensors in the F3S-TGR-CL range. Optional mirror kits support perimeter guarding. Adjustable Muting sensor mounting systems support L-, T- and X-muting.

- Robust adjustable stands in 1200 mm and 1600 mm
- Muting accessories for T-, X- and L-muting
- Mirror system for 2-, 3- and 4-beam applications
- Simple installation of the safety sensors
- Easy alignment of the stand by integrated level on top
- Integrated cable support plus optional cable cover

Ordering information

•					
Adjustable stands					
		Order code			
Adjustable stand, 1200 mm high	Safety Sensors, Mirror Systems	F39-TGR-AS-B1200			
Adjustable stand, 1600 mm high	Safety Sensors, Mirror Systems, Muting applications	F39-TGR-AS-B1600			
Mirror system					
		Order code			
Mirror mounting plate	2-, 3- and 4-beam systems	F39-TGR-AS-MM1			
Adjustable mirror kit	Use 1 pcs F39-TGR-AS-AM1 for each beam of the safety sensor	F39-TGR-AS-AM1			
Muting accessories					
		Order code			
Mounting system for muting sensors	For L-Muting	F39-TGR-AS-MA-MBL			
	For X- and T-Muting	F39-TGR-AS-MA-MBXT			
Mounting bracket for muting sensors	For OMRON E3Z and E3G-family	F39-TGR-AS-MA-MSM			
Mounting bracket for reflectors	For OMRON E39-R1S	F39-TGR-AS-MA-MRM			
Cable cover					
		Order code			
Cable cover	For 1200 mm stand	F39-TGR-AS-MA-CC12			
	For 1600 mm stand	F39-TGR-AS-MA-CC16			
Specifications					
Housing	Painted steel				
Ambient temperature	During operation; -25 to + 80°C (with no dew condensation)				
Adjustment range Rotation	+15°				

F3S-TGR-CL-Sensor can be adjusted ±100 mm

±10°

Configuration examples

3-sided guarding, 2-beam system

e.g. F3S-TGR-CL4B-K2-500

1) Adjustable Stand F39-TGR-AS-B1200 (4 x) 2) Mirror Mounting plate F39-TGR-AS-MM1 (2 x) 3) Mirror Kit F39-TGR-AS-AM1 (4 x)

vertical

horizontal



Muting system, X-Muting, active/passive setup e.g. F3S-TGR-CL4A-K2C-500

- 1) Adjustable Stand F39-TGR-AS-B1600 (2 x)
- 2) Muting mounting system F39-TGR-AS-MA-MBXT (2 x)
- 3) Mounting bracket (sensor) F39-TGR-AS-MSM
- 4) Mounting bracket (reflector) F39-TGR-AS-MRM







Single-beam safety sensor in compact housing

The slender M18-sized E3FS is a type 2 safety single beam with an operating range of up to 10 m. Plastic and metal housing, cable and M12-connector offer flexibility in application together with a control unit such as F3SP-U3P or F3SP-U5P.

- Sensing distance up to 10 m
- LEDs for easy alignment and diagnosis
- Cable and M12 plug categories
- Plastic and metal housing
- Type 2 sensor complying with EN 61496-1

Ordering information

Safety single beam sensors (Type 2)				Controller for safety single beam sensors				
Case material	Operation distance	Order code			Sensors	Output contacts	Width	Order code
Plastic	0 to 10 m	Cable type	E3FS-10B4		1 to 2	2 NO 2.5 A	22.5 mm	F3SP-U3P-TGR
		Plug type	ug type E3FS-10B4-P1 S		Safety single beam sensors			
Nickel brass	Cable type E3FS-10B4-M		E3FS-10B4-M		1 to 4 Sefety single beem concern		45 mm	F3SP-U5P-TGR
		Plug type	E3FS-10B4-M1-M	Salety single beam sensors				

Specifications

Sensors							
Sensing method	Through-beam						
Controller	F3SP-U3P-TGR, F3SP-U5P-TGR						
Supply voltage (Vs)	24 VDC ± 10% (ripple p-p 10% max.)						
Effective aperture angle (EAA)	±5° (at 3 m)						
Current consumption	Emitter: 50 mA max. Receiver: 25 mA max.						
Sensing distance	10 m						
Standard sensing object	Opaque object: 11 mm min. in diameter						
Response time	2.0 ms (E3FS only)						
Control output	PNP transistor output, load current: 100 mA max.						
Test input (emitter)	21.5 to 24 VDC: Emitter OFF (source current: 3 mA max.) Open or 0 to 2.5 V: Emitter ON (leakage current: 0.1 mA max.)						
Ambient light intensity	Incandescent lamp: 3.000 lx max. (light intensity on the receiver surface) Sunlight: 10,000 lx max. (light intensity on the receiver surface)						
Ambient temperature	Operating: -20°C +55°C, storage: -30°C +70°C (with no icing or condensation)						
Degree of protection	IP67 (IEC 60529)						
Light source	Infrared LED						
Protection	Protection Output short-circuit protection, reverse polarity protection						
Controllers							
Item	F3SP-U3P	F3SP-U5P					
Number of sensors	1 to 2 safety single beam sensor	1 to 4 safety single beam sensor					
Width	22.5 mm	45 mm					
Muting input	2 Inputs	4 Inputs					
Safety related function	Override function Muting lamp connection Interlock system (automatic and manual reset)						
Power supply voltage	24 VDC ±10%						
Power consumption	420 mA max.						
Output contacts	2 NO 2.5 A (protected by fuse), 115 VAC max.	2 NO 2.5 A (protected by fuse), 250 VAC max.					
Indicators	6 LED for status and diagnostics						
Degree of protection	IP20 (IEC 60529)						
Terminal	16 screw terminals, detachable blocks with '4pin' 32 screw terminals, detachable blocks with '4pin'						
Response time	\leq 30 ms						
Ambient temperature	Operation: -10°C +55°C						
Housing material	Plastic; DIN rail mounting						





Small housing safety light curtain

The F3SJ_A - family is a type 4 safety light curtain with a optical resolution of 14 mm and 30 mm. An operating range of up to 9 m and protective heights up to 2,495 mm are provided with no dead zone.

- Detection heigth = sensor height
- Muting and blanking function available
- LED bar for easy alignment and diagnosis
- Type 4 sensor complying with EN 61496-1 and up to PLe according EN ISO 13849-1

Ordering information

Safety Light Curtain

Application	Detection capability	Beam gap	Operating range	Protective height (mm)	Order code	
					PNP output	
Finger protection	Dia. 14 mm	9 mm	0.2 to 9 m	245 to 1,631	F3SJ-AP14	
Hand/arm protection	Dia. 30 mm	25 mm	0.2 to 9 m	245 to 1,620	F3SJ-AP30	
			0.2 to 7 m	1,745 to 2,495		

Safety Light Curtain Model List

F3SJ-A14 Series (9 mm gap), F3SJ-A14 TS Series (9 mm gap)^{*1}

Number of Beams	Protective Height (mm) ^{*2}	Order code
		PNP Output ^{*1}
26	245	F3SJ-A0245P14
28	263	F3SJ-A0263P14
34	317	F3SJ-A0317P14
42	389	F3SJ-A0389P14
50	461	F3SJ-A0461P14
60	551	F3SJ-A0551P14
68	623	F3SJ-A0623P14
76	695	F3SJ-A0695P14
80	731	F3SJ-A0731P14
88	803	F3SJ-A0803P14
96	875	F3SJ-A0875P14
108	983	F3SJ-A0983P14
116	1,055	F3SJ-A1055P14
124	1,127	F3SJ-A1127P14
132	1,199	F3SJ-A1199P14
140	1,271	F3SJ-A1271P14

*1. The suffix "-TS" is attached to the model number of models with fixed auto reset. (Only for PNP output)
*2. Protective Height (mm) = Total sensor length

F3SJ-A30 Series (25 mm gap)

Number of Beams	Protective Height (mm) ^{*1}	Order code	
		PNP Output	
10	245	F3SJ-A0245P30	
12	295	F3SJ-A0295P30	
16	395	F3SJ-A0395P30	
19	470	F3SJ-A0470P30	
21	520	F3SJ-A0520P30	
22	545	F3SJ-A0545P30	
23	570	F3SJ-A0570P30	
25	620	F3SJ-A0620P30	
29	720	F3SJ-A0720P30	
32	795	F3SJ-A0795P30	
35	870	F3SJ-A0870P30	
37	920	F3SJ-A0920P30	
38	945	F3SJ-A0945P30	
41	1,020	F3SJ-A1020P30	
44	1,095	F3SJ-A1095P30	
45	1,120	F3SJ-A1120P30	
48	1,195	F3SJ-A1195P30	
51	1,270	F3SJ-A1270P30	
56	1,395	F3SJ-A1395P30	
65	1,620	F3SJ-A1620P30	
70	1,745	F3SJ-A1745P30	
75	1,870	F3SJ-A1870P30	
80	1,995	F3SJ-A1995P30	
90	2,245	F3SJ-A2245P30	
95	2,370	F3SJ-A2370P30	
100	2 495	E3S.I-A2495P30	

*1 Protective Height (mm) = Total sensor length

OMRON

F3SJ-A

Accessories (Sold separately)

Single-end Connector Cable (2 cables per set, for emitter and receiver)

For wiring with safety circuit such as single safety relay, safety relay unit, and safety controller.

Appearance	Cable length	Specifications	Order code
	0.5 m	M12 connector (8-pin)	F39-JCR5A
	3 m		F39-JC3A
	7 m		F39-JC7A
	10 m		F39-JC10A
	15 m		F39-JC15A
C -	20 m		F39-JC20A

Sensor Mounting Brackets (Sold separately)

Appearance	Specifications	Application	Remarks	Order code
	Standard mounting bracket (for top/bottom)	(provided with the F3SJ)	2 for an emitter, 2 for a receiver, total of 4 per set	F39-LJ1
	Flat side mounting bracket	Use these small-sized brackets when performing side mounting with standard mounting brackets, so that they do not protrude from the detection surface.	2 for an emitter, 2 for a receiver, total of 4 per set	F39-LJ2
- F . F	Free-location mounting bracket (also used as standard inter- mediate bracket)	Use these brackets for mounting on any place without using standard bracket.	Two brackets per set	F39-LJ3
x x	F3SN Intermediate Bracket Replacement Spacers	When replacing the F3SN with the F3SJ, the mounting hole pitches in the Intermediate Brack- ets are not the same. This Spacer is placed be- tween the mounting holes to mount the F3SJ.	1 set with 2 pieces	F39-LJ3-SN
	Top/bottom bracket B (Mounting hole pitch 19 mm)	Mounting bracket used when replacing existing area sensors (other than F3SN or F3WN) with the F3SJ. For front mounting. Suitable for mounting hole pitch of 18 to 20 mm.	2 for an emitter, 2 for a receiver, total of 4 per set	F39-LJ4
end	Bracket for replacing short-length F3SN	Mounting bracket used when an F3SN with pro- tective height of 300 mm or less is replaced by an F3SJ.	2 for an emitter, 2 for a receiver, total of 4 per set	F39-LJ5
and the second sec	Space-saving mounting bracket	Use these brackets to mount facing inward. Length is 12 mm shorter than the standard F39-LJ1 bracket.	2 for an emitter, 2 for a receiver, total of 4 per set	F39-LJ8
in the second se	Top/bottom bracket C (mounting hole pitch 13 mm)	Mounting bracket used when replacing existing area sensors having a mounting pitch of 13 mm with the F3SJ.	2 for an emitter, 2 for a receiver, total of 4 per set	F39-LJ11



Specifications

Model	PNP Output	F3S I-A P14	F3S I-A P30			
Sensor type	Thi output	Type 4 safety light curtain	1005-A100			
Version		Ver 2				
Setting tool connection		Connectable				
Safety category		Safety purpose of category 4, 3, 2, 1, or B				
Detection capability		Opaque objects 14 mm in diameter	Opaque objects 30 mm in diameter			
Beam gap (P)		9 mm	25 mm			
Number of beams (n)		26 to 180	10 to 100			
Protective height (PH)		245 to 1,631 mm	245 to 2,495 mm			
Lens diameter		Diameter 5 mm				
Operating range		0.2 to 9 m (protective height 1,640 mm max.), 0.2 to (Depending on the setting tool, the detection distance	7 m (protective height 1,655 mm min.) can be shortened to 0.5 m.)			
Response time (under stable light incident	ON to OFF	1 set, 0245 to 983: 11 ms to 17.5 ms max. 1,055 or higher: 20 ms to 25 ms max.	1 set: 10 ms to 17.5 ms max.			
condition)	OFF to ON	1 set, 0245 to 983: 44 ms to 70 ms max. 1,055 or higher: 80 ms to 100 ms max.	1 set: 40 ms to 70 ms max.			
Startup waiting time		2 s max. (2.2 s max. for series connection)	2 s max. (2.2 s max. for series connection)			
Power supply voltage (Vs)		24 VDC±20% (ripple p-p10% max.)	24 VDC±20% (ripple p-p10% max.)			
Current consumption (no load)	Emitter	To 50 beams: 76 mA max., 51 to 100 beams: 106 mA max., 101 to 150 beams: 130 mA max., 151 to 180 beams: 153 mA max., 201 to 234 beams: 165 mA max.				
	Receiver	To 50 beams: 68 mA max., 51 to 100 beams: 90 mA max., 101 to 150 beams: 111 mA max., 151 to 180 beams: 128 mA max., 201 to 234 beams: 142 mA max.				
Light source (emitted wavelength	h)	Infrared LED (870 nm)	Infrared LED (870 nm)			
Effective aperture angle (EAA)	-	Based on IEC 61496-2.Within±2.5° for both emitter a	nd receiver when the detection distance is 3 m or over			
Safety outputs (OSSD)	PNP outputs	Two PNP transistor outputs, load current 300 mA may allowable capacity load 2.2 μ F, leak current 1 mA ma (This can be different from traditional logic (0N/OFF) t	 c., residual voltage 2 V max. (except for voltage drop due to cable extension), x. because safety circuit is used.) 			
Auxiliary output 1 (Non-safety output)	PNP outputs	One PNP transistor output, load current 300 mA max. leak current 1 mA max.	residual voltage 2 V max. (except for voltage drop due to cable extension),			
Auxiliary output 2 (Non-safety output. Function for Basic System.)	PNP outputs	One PNP transistor output, load current 50 mA max., leak current 1 mA max.	residual voltage 2 V max. (except for voltage drop due to cable extension),			
External indicator output (Non-safety output)		Available indicators Incandescent lamp: 24 VDC, 3 to 7 W LED lamp: Load current 10 mA to 300 mA max., leak (To use an external indicator, an F39-JJ3N universal in	current 1 mA max. ndicator cable or an F39-A01P-PAC dedicated external indicator kit is required.)			
Output operation mode	Receiver	Safety output 1, 2: ON when receiving light Auxiliary output 1: Inverse of safety output signals (Op External indicator output 1: Inverse of safety output si tool.), ON when muting/override for a muting system	peration mode can be changed with the setting tool.) gnals for a basic system (Operation mode can be changed with the setting (Operation mode can be changed with the setting tool.)			
	Emitter	Auxiliary output 2: Turns ON when the point of 30,000 operating hours is reached (Operation mode can be changed with the setting tool.) External indicator output 2: ON when lock-out for a basic system (Operation mode can be changed with the setting tool.) ON when muting/override for a muting system (Operation mode can be changed with the setting tool.)				

F3SJ-A

Safety sensors

Model	PNP output	F3SJ-A	_P14	F3SJ-A	P30	
Input voltage	PNP output	Test input, in ON voltage: External dev ON voltage:	nterlock selection input, reset input, and muting inpu 9 to 24 V (Vs) (sink current: 3 mA max.), OFF voltage ice monitoring input 9 to 24 V (Vs) (sink current: 5 mA max.), OFF voltage	t are all : 0 to 1.5 V, : 0 to 1.5 V,	or open or open	
Indicator	Emitter	Light intensi Error mode i Power indica Interlock ind External dev ON/flash acc	ty level indicators (green LED x 2, orange LED x 3): indicators (red LED x 3): Blink to indicate error details ator (green LED x 1): ON while power is on licator (yellow LED x 1): ON while under interlock, bli ice monitoring indicator (muting input 1 indicator), B cording to function	DN based on s nks at lockou lanking/test	the light intensity it. indicator (muting input 2 indicator) (green LED x 2):	
	Receiver	Light intensi Error mode i OFF output i ON output ir Muting error	ty level indicators (green LED x 2, orange LED x 3): C Indicators (red LED x 3): Blink to indicate error details indicator (red LED x 1): ON when safety output is OFF dicator (green LED x 1): ON while safety output is O i indicator, Blanking /test indicator (green LED x 2): C	N based on 5 , blinks at lo N N/flash acco	the light intensity ckout. ording to function	
Mutual interference prevention fu	Inction	Interference	light prevention algorithm, sensing distance change	function		
Series connection		Time divisio Number of c Total numbe Maximum ca	n emission by series connection connections: up to 4 sets (F3SJ-A only) F3SJ-E, F3SJ-I er of beams: up to 400 beams able length for 2 sets: no longer than 15 m	3 and F3SJ-T	S cannot be connected.	
Test function		Self test (at External test	power-ON and at power distribution) t (emission stop function by test input)			
Safety-related functions		Start interloo External dev Muting (Lam Fixed blanki Floating blan	ck, restart interlock (Must be set with a setting tool v ice monitor ip burnout detection, override function included. F39 ng (must be set by a setting tool) iking (must be set by a setting tool)	/hen the mut -CN6 key ca	ing function is used.) p for muting is required.)	
Connection method		Connector m	nethod (M12, 8-pin)			
Protection circuit		Output short	circuit protection, and power supply reverse polarit	/ protection		
Ambient temperature		Operating: -	10 to 55°C (no icing), Storage: -30 to 70°C			
Ambient humidity		Operating: 3	5% to 85% (no condensation), Storage: 35% to 95%			
Operating ambient light intensity		Incandescent lamp: receiving-surface light intensity of 3,000 lx max., Sunlight: receiving-surface light intensity of 10,000 lx max.				
Insulation resistance		20 MΩ min. (at 500 VDC)				
Withstand voltage		1,000 VAC 5	i0/60 Hz, 1 min			
Degree of protection		IP65 (IEC 60	529)			
Vibration resistance		Malfunction	10 to 55 Hz, Multiple amplitude of 0.7 mm, 20 swe	eps in X, Y, a	nd Z directions	
Shock resistance		Malfunction	100 m/s ² , 1,000 times each in X, Y, and Z direction	S .		
Material		Casing (inclu Cap: ABS re	uding metal parts on both ends): Aluminum, zinc die- sin, Optical cover: PMMA resin (acrylic), Cable: Oil re	cast sistant PVC		
Weight (packaged)		Calculate us (1) For F3SJ (2) F3SJ-A_ The values f Protected he Protected he Protected he	ing the following expressions: -A14, weight (g) = (protective height) x 1.7 + α 30, weight (g) = (protective height) x 1.5 + α or α are as follows: sight 245 to 596 mm: = 1,100 protected height 1,66 sight 600 to 1,130 mm: = 1,500 protected height 2, sight 1,136 to 1,658 mm: = 2,000	x 10 to 2,180 n 195 to 2,500	nm: = 2,400) mm: = 2,600	
Accessories		Test rod (*1) (intermediat *1. The F3S. *2. Number For protectiv For protectiv For protectiv For protectiv	h, instruction manual, standard mounting bracket (F3 e) (*2), error mode label, User's Manual (CD-ROM) J-A55 is not included. of intermediate brackets depends on protective heig re height from 600 to 1,130 mm: 1 set for each of th re height from 1,136 to 1,658 mm: 2 sets for each of re height from 1,660 to 2,180 mm: 3 sets for each of re height from 2,195 to 2,500 mm: 4 sets for each of	9-LJ1 brack ht of F3SJ. e emitter and the emitter the emitter the emitter the emitter	et for top/bottom mounting), mounting brackets 1 receiver is included and receiver are included and receiver are included and receiver are included	
Applicable standards		IEC 61496-1 IEC 61496-2 IEC 61508-1 IEC 13849-1 UL 508, UL	, EN 61496-1 UL 61496-1, Type 4 ESPE (Electro-Se 2, CLC/TS 61496-2, UL 61496-2, Type 4 AOPD (Activ to -3, EN 61508-1 to -3 SIL3 : 2006, EN ISO 13849-1: 2008 (PLe, Cat.4) 1998, CAN/CSA C22.2 No.14, CAN/CSA C22.2 No.0.8	nsitive Protec e Opto-elect	ctive Equipment) ronic Protective Devices)	



Response Time

Model	Protected Height (mm)	Number of Beams	Response time ms (ON to OFF)	Response time ms (OFF to ON)
F3SJ-A14 Series	245 to 263	26 to 28	11	44
	281 to 389	30 to 42	12	48
	407 to 497	44 to 54	13	52
	515 to 605	56 to 66	14	56
	623 to 731	68 to 80	15	60
	767 to 983	84 to 108	17.5	70
	1,055 to 1,271	116 to 140	20	80
	1,343 to 1,559	148 to 172	22.5	90
	1,631	180	25	100
F3SJ-A30 Series	245 to 395	10 to 16	10	40
	420 to 720	17 to 29	11	44
	745 to 1,045	30 to 42	12	48
	1,070 to 1,295	43 to 52	13	52
	1,395 to 1,620	56 to 65	14	56
	1,745 to 1,995	70 to 80	15	60
	2,120 to 2,495	85 to 100	17.5	70

Note: Use the following expressions for series connection.

For 2-set series connection:

Response time (ON to OFF): Response time of the 1st unit + Response time of the 2nd unit - 1 (ms), Response time (OFF to ON): Response time calculated by the above x 4 (ms) - For 3-set series connection:

Response time (ON to OFF): Response time of the 1st unit + Response time of the 2nd unit + Response time of 3rd unit - 5 (ms), Response time (OFF to ON): Response time calculated by the above x 5 (ms) For models with the "-TS" suffix, multiply the response time obtained by the above x 5 (ms), or use 200 ms, whichever is less.)

- For 4-set series connection: Response time (ON to OFF): Response time of the 1st unit + Response time of the 2nd unit + Response time of the 3rd unit + Response time of the 4th unit - 8 (ms) Response time (OFF to ON): Response time calculated by the above x 5 (ms)

Cable Extension Length

Total cable extension length must be no greater than the lengths described below.

When the F3SJ and an external power supply are directly connected, or when the F3SJ is connected to a G9SA-300-SC.

Condition	1 set	2 sets	3 sets	4 sets
Using incandescent lamp for auxiliary output and external indicator output	45 m	40 m	30 m	20 m
Not using incandescent lamp	100 m	60 m	45 m	30 m

When connected to the F3SP-B1P

Condition	1 set	2 sets	3 sets	4 sets
Using incandescent lamp for external indicator output 2	40 m	30 m	25 m	20 m
Using incandescent lamp for external indicator output 1	60 m	45 m	30 m	20 m
Using incandescent lamp for auxiliary output 1				
Not using incandescent lamp	100 m	60 m	45 m	30 m

Note: Keep the cable length within the rated length. Failure to do so is dangerous as it may prevent safety functions from operating normally.



Accessories

Control Unit			
Item	Model	F3SP-B1P	
Applicable sensor		F3SJ-B/A (Only for PNP output type) ^{*1}	
Power supply voltage		24 VDC±10%	
Power consumption		DC1.7 W max. (not including sensor's current consumption)	
Operation time		100 ms max. (not including sensor's response time)	
Response time		10 ms max. (not including sensor's response time)	
Relay output	Number of contacts	3N0+1NC	
	Rated load	250 VAC 5 A (cos ϕ = 1), 30 VDC 5 A L/R = 0 ms	
	Rated current	5 A	
Connection type	Between sensors	M12 connector (8-pin)	
	Others	Terminal block	
Weight (packed state)		Approx. 280 g	
Accessories		Instruction manual	

 $^{\star1}\,$ NPN output type cannot be connected. Also, the system cannot be used as a muting system.

Laser Pointer

Item	F39-PTJ
Applicable sensor	F3SJ Series
Power supply voltage	4.65 or 4.5 VDC
Battery	Three button batteries (SR44 or LR44)
Battery life ^{*1}	SR44: 10 hours of continuous operation, LR44: 6 hours of continuous operation
Light source	Red semiconductor laser (wavelength: 650 nm, 1 mW max. JIS class 2, EN/IEC class 2, FDA class II)
Spot diameter (typical value)	6.5 mm at 10 m
Ambient temperature	Operating: 0 to 40°C Storage: -15 to 60°C (with no icing or condensation)
Ambient humidity	Operating and storage: 35% to 85% (with no condensation)
Material	Laser module case: aluminum Mounting bracket: aluminum and stainless
Weight	Approx. 220 g (packed)
Accessories	Laser safety standard labels (EN: 1, FDA: 3) Button batteries (SR44: 3), instruction manual

*1 Battery life varies depending on a battery used.



Connections

Basic Wiring Diagram

PNP Output

Wiring when using manual reset mode, external device monitoring.



Wiring when the external device monitoring function will not be used

- Use a setting tool to set the external device monitoring function to "Disabled."
- When using an auxiliary output 1 that has not been changed (output operation mode is "control output data," and inverse of safety output signals is "Enabled), the external device monitoring function will be disabled when auxiliary output 1 and the external device monitoring input are connected as shown below.





Input/Output Circuit Diagram

Entire Circuit Diagram

PNP Output

The numbers in circles indicate the connectors' pin numbers. The black circles indicate connectors for series connection. The words in brackets ([]) indicate the signal name for muting system.



OMRON

Safety sensors

Connection Circuit Examples

Wiring for single F3SJ application (Category 4 acc. EN 954-1 and PLe acc. EN ISO 13849-1)

PNP Output

· Use of relay contact welding detection and interlock is possible without a controller or relay unit



OS32C



OS32C Safety Laser Scanner

- Type 3 Safety laser scanner complies with IEC61496-1/-3.
- 70 sets of safety zone and warning zone combinations are available, supporting complicated changes in working environments.
- A safety radius up to 3 m and warning zone(s) radius up to 10 m can be set.
- 8 Individual sector indicators and various LED indications allow the user to • determine scanner status at a glance.
- Reference boundary monitoring function prevents unauthorized changes in the scanner position.
- Configurable minimum object resolution of 30, 40, 50 or 70 mm, for hand and arm detection applications

Ordering information

OS32C (Power cable is sold separately.)				
Description	Order code			
Back location cable entry	OS32C-BP			
Side location cable entry ^{*1}	0S32C-SP1			
*1 For OC200 CD1, each composter is leasted on the left or viewed from th	a haali of tha 1/0 blaali			

For OS32C-SP1, each connector is located on the left as viewed from the back of the I/O block

Description	Remarks	Order code
Configuration tool	CD-ROM OS supported: Windows 2000/XP/Vista Windows 7	included

Note: The OS32C laser scanner may not be sold or imported into or used in the Federal Republic of Germany prior to December 1, 2013.

Mounting brackets					
Туре	Remarks	Order code			
Bottom/side mounting bracket	Bottom/side mounting bracket x 1, unit mounting screws x 4 sets	0S32C-BKT1			
XY axis rotation mounting bracket	XY axis rotation mounting bracket x 1, unit mounting screws x 6 sets, bracket mounting screws x 1 set (must be used with OS32C-BKT1)	OS32C-BKT2			

Note: For a full line-up of accessories and spare parts, please refer to the Z298-E1... datasheet.

Specifications

Sensors					
Sensor ty	pe	Type 3 Safety laser scanner			
Safety ca	tegory	Category 3, performance level d (ISO13849-1: 2006)			
Detection	capability	Configurable; Non-transparent with a diameter of 30, 40, 50 or 70 mm (1.8% reflectivity or greater)			
Monitorin	g zone	Monitoring zone set count: (Safety zone + 2 warning zones) x 70 sets			
Operating	range	Safety Zone: 3.0 m (min. obj. resolution of 50 mm or 70 mm) 2.5 m (min. obj. resolution of 40 mm) 1.75 m (min. obj. resolution of 30 mm) Warning Zone: 10.0 m			
Detection	angle	270°			
Response	time	Response time from ON to OFF: From 80 ms (2 scans) to 680 ms (up to 17 scans) Response time from OFF to ON: Response time from ON to OFF + 100 ms to 60 s (configurable)			
Line volta	ige	24 VDC +25%/-30% (ripple p-p 2.5 V max.)			
Power consumption Normal operation: 5 W max., 4 W typical (without output load) ^{*1} Standby mode: 3.75 W (without output load)					
Safety ou	tput (OSSD)	PNP transistor x 2, load current of 250mA max., residual voltage of 2 V max., load capacity of 2.2 µf max., leak current of 1 mA max.*1.*2.*3			
Auxiliary output (Non-Safety)		NPN/PNP transistor x 1, load current of 100 mA max., residual voltage of 2 V max., leak current of 1 mA max.*2.*3.*4			
Warning output (Non-Safety)		NPN/PNP transistor x 1, load current of 100 mA max., residual voltage of 2 V max., leak current of 1 mA max.*2.*3.*4			
Output op	eration mode	Auto start, start interlock, start/restart interlock			
Input	External Device Monitoring (EDM)	ON: 0 V short (input current of 50 mA), OFF: Open			
	Start	ON: 0 V short (input current of 20 mA), OFF: Open			
	Zone select	ON: 24 V short (input current of 5 mA), OFF: Open			
	Stand-by	ON: 24 V short (input current of 5 mA), OFF: Open			
Connectio	on type	Power cable: 18-pin mini-connector (pigtail) Communication cable: M12, 4-pin connector			
Connectio	on with PC	Communication: Ethernet			
Indicators	3	RUN indicator: Green, STOP indicator: Red, Interlock indicator: Yellow, Warning output indicator: Orange, Status/diagnostic display: 2 x 7-segment LEDs, Intrusion indicators: Red LED x 8			
Enclosure	e rating	IP65 (IEC60529)			
Dimensions (WxHxD)		133.0 x 104.5 x 142.7 mm (except cable)			
Weight (N	lain Unit only)	1.3 kg			
Approvals	3	Certified by: TÜV Rheinland, UL Major Standards: IEC61496-1/-3 (Type 3), IEC61508 (SIL2), ISO13849-1:2008 (Category 3, Performance Level d), UL508, UL1998			

Rated current of OS32C is 1.025 A max. (OS32C 210 mA + OSSD A load + OSSD B load + auxiliary output load + warning output load + functional Inputs). Where functional inputs are: EDM input ... 50 mA Start input ... 20 mA Standby input ... 5 mA Zone X input ... 5 mA x 8 (eight zone set select inputs) Output voltage is input voltage - 2.0 VDC. Total consumption current of 2 OSSDs, auxiliary output, and warning output must not exceed 700 mA. *1

*2 *3

^{*4} Output polarity (NPN/PNP) is configurable via the configuration tool.

Connection

Basic connection with single OS32C unit Category 3, performance level d (ISO13849-1)



Dimensions

OS32C with back location cable entry - OS32C-BP



OS32C with side Llcation cable entry - OS32C-SP1



SAFE CONTROL SYSTEMS

Configurable, flexible and simple

Omron safety controllers offer transparent standalone operation and scalability in safety networking applications for all sizes of machine safety control systems. The G9SP safety controller is simple to configure and setup and overcomes limitations of hard-wired solutions by adding flexibility of a software-based solution. Total cost of ownership is reduced by having user-defined function blocks and an integrated simulation tool for debugging of the application program.







	G9SB	G9SA	G9SX
Emergency stop up to Cat. 4/PLe	Slim size	Expandable more	Elavible sofaty
	17,5m, 22.5 mm	contacts / time	unit solid state
		delay	outputs
	G9SB	G9SA	G9SX
Door monitoring up to Cat. 4/PLe			
	Slim size 17,5m, 22.5 mm	Expandable more contacts / time delay	Flexible safety unit solid state outputs
	COSP	6754	C057
Expansion of contacts	Expansion unit	Safety relay	Flexible safety
		<u>-</u>	unit
	G9SA-TH301	G9SX-NS	G9SX-GS
Dedicated Safety Function			
	Two-hand control unit type IIIC	Monitoring of D40A non-contact switches	Monitoring of Enabling devices
	G9SX-LM	G9SX-SM	
Speed monitoring up to Cat. 4/PLe		Ctandatill	
	monitoring	monitoring	







Slim-size safety unit

G9SB is a family of slender safety relay units, providing two safety contacts in a 17.5 mm- and three safety contacts in a 22.5mm-wide housing.

- 17.5 mm- and 22.5 mm-wide housing
- 1- and 2-input channel units
- Manual and automatic reset units
- Certification up to PLe according to EN ISO 13849-1 depending on the application

Ordering information

Main contacts	Auxiliary contact	Number of input channels	Reset mode	Input type	Rated voltage	Size (HxWxD)	Order code
DPST-NO Non 2 safety contacts	None	2 channels	Auto-reset	Inverse	24 VAC/VDC	100 mmx17.5 mmx112 mm	G9SB-2002-A
		1 channel or 2 channels		+ common			G9SB-200-B
		2 channels	Manual-reset	Inverse			G9SB-2002-C
		1 channel or 2 channels		+ common			G9SB-200-D
3PST-NO 3 safety	SPST-NC	None (direct breaking)	Auto-reset	-	24 VDC	100 mmx17.5 mmx112 mm	G9SB-3010
contacts		2 channels		Inverse	24 VAC/VDC	100 mmx22.5 mmx112 mm	G9SB-3012-A
		1 channel or 2 channels		+ common			G9SB-301-B
		2 channels	Manual-reset	Inverse			G9SB-3012-C
		1 channel or 2 channels		+ common			G9SB-301-D

Specifications

Power input						
Item		G9SB-200	G9SB-3010	G9SB-301		
Power supply voltage		24 VAC/VDC: 24 VAC, 50/60 Hz, or 24VDC 24 VDC: 24 VDC				
Operating voltage range		85 to 110% of rated power supply voltage				
Power consumption		1.4 VA/1.4 W max.	1.7 W max.	1.7 VA/1.7 W max.		
Inputs						
Item		G9SB-200	G9SB-3010	G9SB-301		
Input current		25 mA max.	60 mA max. (See note.)	30 mA max.		
Note: Indicates the current l	between terminals A1 and A2					
Contacts						
Item		G9SB-200	G9SB-3010	G9SB-301		
		Resistive load ($\cos\phi$ = 1)				
Rated load		250 VAC, 5 A				
Rated carry current		5A				
Characteristics						
Item		G9SB-200	G9SB-3010	G9SB-301		
Response time *1		10 ms max.				
Durability	Mechanical	5,000,000 operations min. (at approx. 7,200 operations/hr)				
	Electrical	100,000 operations min. (at approx. 1,800 operations/hr)				
Minimum permissable load	(reference value)	5 VDC, 1 mA				
Ambient operating tempera	iture	-25°C +55°C (with no icing or condensation)				

 $^{\star1}\,$ The response time is the time it takes for the main contact to open after the input is turned OFF.





Expandable safety relay unit

G9SA-family offers a complete line-up of compact and expandable safety relay units. Modules with safe OFF-delay timing are available as well as a two-hand controller. Simple multiplication of safety contacts is possible by using the connection on the front.

- 45 mm-wide housing, expansion units are 17.5 mm wide
- · Safe OFF-delay timer
- Simple expansion connection
- Certification up to PLe according to EN ISO 13849-1 depending on the application

Ordering information

Emergency-stop units					
Main contacts	Auxiliary contact	Number of input channels	Rated voltage	Order code	
3PST-NO	SPST-NC	NC 1 channel or 2 channels possible	24 VAC/VDC	G9SA-301	
			100 to 240 VAC		
5PST-NO	SPST-NC	1 channel or 2 channels possible	24 VAC/VDC	G9SA-501	
			100 to 240 VAC		

Emergency-stop OFF-delay units

Main contacts	OFF-delay contacts	Auxiliary contact	Number of input channels	OFF-delay time	Rated voltage	Order code
3PST-N0	DPST-NO SPST-NC	SPST-NC	1 channel or	7.5 s	24 VAC/VDC	G9SA-321-T075
		2 channels possible		100 to 240 VAC		
			15 s	24 VAC/VDC	G9SA-321-T15	
					100 to 240 VAC	
			30 s	24 VAC/VDC	G9SA-321-T30	
				100 to 240 VAC		

Two-hand controller

The nume control								
Main contacts	Auxiliary contact	Number of input of	Number of input channels		Rated voltage			
3PST-NO	SPST-NC	2 channels		24 VAC/VDC	24 VAC/VDC			
					100 to 240 VAC			
Expansion unit The expansion unit connects to a G9SA-301, G9SA-501, G9SA-321, or G9SA-TH301.			Expansion units The expansion un	Expansion units with OFF-delay outputs The expansion unit connects to a G9SA-301, G9SA-501, G9SA-321, or G9SA-TH3				
Main contacts	Auxiliary contact	Category	Order code	Main contact form	Auxiliary contact	OFF-delay time	Order code	
3PST-NO	SPST-NC	4	G9SA-EX301	3PST-NO	SPST-NC	7.5 s	G9SA-EX031-T075	
					15 s	G9SA-EX031-T15		
						30 s	G9SA-EX031-T30	

Specifications

Power input		Inputs				
Item	G9SA-301/TH301 / G9SA-501 / G9SA-321-T_	Item		G9SA-301/321-T_/TH301	G9SA-501	
Power supply	24 VAC/VDC: 24 VAC, 50/60 Hz, or 24 VDC	Input current		40 mA max.	60 mA max.	
voltage	a 100 to 240 VAC:100 to 240 VAC, 50/60 Hz	Contacts				
Operating voltage	5 to 110% of rated power supply voltage	ltom		COCA 201/E01/221 T /TH201/EV201/EV021 T		
range		item		u93A-301/301/321-1_/16	DU1/EA3U1/EAU31-1_	
				Resistive load ($\cos\phi = 1$)		
		Rated load		250 VAC, 5 A		

Rated load Rated carry current

5 A

Characteristics

Item		G9SA-301/TH301 / G9SA-501/321-T_ / G9SA-EX301/EX031-T_					
Operating time		30 ms max. (not including bounce time)					
Response time *1		10 ms max. (not including bounce time)					
Durability	Mechanical	5,000,000 operations min. (at approx. 7,200 operations/hr)					
	Electrical	100,000 operat	00,000 operations min. (at approx. 1,800 operations/hr)				
Minimum permissib (reference value)	ole load	5 VDC, 1 mA					
Ambient temperature		Operating: Storage:	-25 to 55°C (with no icing or condensation) -25 to 85°C (with no icing or condensation)				

 $^{\star1}\,$ The response time is the time it takes for the main contact to open after the input is turned OFF.



Compact non-contact door switch/ flexible safety unit

Electronic detection mechanism for better stability in non-contact door switch operation.

- Stable operation reduces controller errors caused by unstable doors.
- Connect up to 30 non-contact door switches with LED indicators to one controller.
- Reversible switch provides flexibility in installation.
- Two-colour LED indicator enables easier maintenance by identification of door status and cable disconnections.

Ordering information

Non-contact door switches (switch/actuator)								
Classification	Auxiliary outputs	Cable length	Order code					
Standard models	Semiconductor outputs *1	2 m	D40A-1C2					
		5 m	D40A-1C5					
		Pigtail with M12 connector 4-pole	D40A-1C015-F					

*1 PNP open-collector semiconductor output.

 $\label{eq:Note:Must} \textbf{Note:} \ \textbf{Must} \ be \ used \ in \ combination \ with \ a \ G9SX-NS_ \ non-contactdoor \ switch \ controller.$

Non-contact door switch controllers (Controllers for D40A)

Safety outputs *1		Auxiliary	Logical AND	Logical AND	Max. OFF	Rated	Terminal block type	Order code
Instantaneous	OFF-delayed *4	outputs ^{~2}	connection input	connection output	delay time ³	voltage		
2 (Semi-	2 (Semi- 0	2 (Semi- conductors) ni- ictors)	1	1	-	24 VDC	Screw terminals	G9SX-NS202-RT
conductors) 2 (Semi- conductors)							Spring-cage terminals	G9SX-NS202-RC
	2 (Semi- conductors)				3.0 s		Screw terminals	G9SX-NSA222-T03-RT
							Spring-cage terminals	G9SX-NSA222-T03-RC

^{*1} P channel MOS FET transistor output

*2 PNP transistor output

^{*3} The OFF-delay time can be set in 16 steps as follows:

0/0.2/0.3/0.4/0.5/0.6/0.7/0.8/0.9/1.0/1.2/1.4/1.8/2.0/2.5/3.0 s

⁴⁴ The OFF-delayed output becomes an instantaneous output by setting the OFF-delay time to 0 s.

Specifications

Ratings/characteristics of non-contact door switches

tallige of all of the o					
Item	Model	D40A-1C_			
Operating	Operating distance OFF $ ightarrow$ ON	5 mm min.			
characteristics *1	Operating distance ON $ ightarrow$ OFF	15 mm max.			
	Differential travel (max.)	20% of operating distance			
Ambient operating temp	erature	-10 to 55°C (no icing or condensation)			
Vibration resistance		10 to 55 to 10 Hz (single amplitude: 0.75 mm, double amplitude: 1.5 mm)			
Shock resistance		300 m/s ² min.			
Degree of protection		IP67			
Material		PBT resin			
Mounting method		M4 screws			
Power consumption		0.6 W max.			
Auxiliary outputs *2		24 VDC, 10 mA (PNP open-collector outputs)			
LED indicators		Actuator not detected (red); actuator detected (yellow)			
Connection cables		2 m, 5 m			
Number of connectable	switches	30 max. (wiring length: 100 m max.)			

^{*1} This is the distance where the switch operates from 0FF to 0N when approaching and the distance where the switch operates from 0N to 0FF when separating when the switch and actuator target marks are on the same axis, and the sensing surfaces coincide.

^{*2} Turns ON when the actuator is approaching.



Ratings of non-contact door switch controllers

rower input						
Item	G9SX-NS202	G9SX-NSA222-T03	G9SX-EX			
Rated supply voltage	24 VDC					
Inputs						
Item	G9SX-NS202/G9SX-NSA222-T03					
Safety input ^{*1}	Operating voltage: 20.4 VDC to 26.4 VDC, internal impedance: approx. 2.8 k Ω					
Feedback/reset input						
¹¹ Only applies to the G9SX-NSA222-T03 Refers to input other than that from the non-contact door switch.						

Outputs

Item	G9SX-NS202/G9SX-NSA222-T03
Instantaneous safety output OFF-delayed safety output	P channel MOS FET transistor output Load current: 0.8 A DC max.
Auxiliary output	PNP transistor output Load current: 100 mA max.

Non-contact door switch and non-contact door switch controller wiring **Example: Wiring a single switch**



Note: The auxiliary output load current must be 10 mA max.

Example: Wiring multiple switches Connect up to 30 Non-contact door switches





Safety guard switchting unit

The safety controller to support maintenance mode of machinery in the safe way.

- Two operation modes to support: • Auto switching for applications where machine and worker co-operate.
 - Manual switching for applications with limitation in operation like maintenance. Clear and transparent segmentation of safety functions by use of unique "AND" connection
- Clear LED diagnosis of all in- and output signals for easy maintenance
- PLe according to EN ISO 13849-1 and SIL 3 according to EN 61508. •

Ordering information

Enabling grip switches							
Contact form							Order code
Enabling switch	Monitor switc	h		Pushbutton swi	tch		
Two contacts	1NC (grip output	1NC (grip output)				A4EG-C000041	
Two contacts	None	None			switch (2NC)	A4EG-BE2R041	
Two contacts	None	None			ation switch (A4EG-BM2B041	
Safety guard switching units							
Outota autouta *1	Accelling	Levies LAND	Lesies AND	Man OFF	Detect	Townshing I block have	Ouden ande

Safety outputs		Auxiliary	Logical AND	Logical AND	Max. OFF	Rated	Terminal block type	Order code
Instantaneous	OFF-delayed *4	outputs *2	connection input	connection output	delay time ^{^3}	voltage		
2 (Semi-	2 (Semi-	Semi- 6 (Semi- 1	1 1	1	15 s	24 VDC	Screw terminals	G9SX-GS226-T15-RT
conductors) conductors)		conductors)					Spring-cage terminals	G9SX-GS226-T15-RC

*1 P channel MOS FET transistor output

*2 PNP transistor output

*3 The OFF-delay time can be set in 16 steps as follows: T15: 0, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 1, 1.5, 2, 3, 4, 5, 7, 10 or 15 s
 *4 The OFF-delayed output becomes an instantaneous output by setting the OFF-delay time to 0 s.

Specifications

Ratings of guard switching unit Power input G9SX-GS226-T15-Item G9SX-EX-Rated supply voltage 24 VDC Inputs G9SX-GS226-T15-Item Operating voltage: 20.4 VDC to 26.4 VDC, internal impedance: approx. 2.8 $k\Omega$ Safety input Feedback/reset input Mode selector input Outputs G9SX-G9SX-GS226-T15-Item Instantaneous safety output P channel MOS FET transistor output **OFF-delayed safety output** Load current: 0.8 A DC max. Auxiliary output PNP transistor output Load current: 100 mA max. External indicator outputs P channel MOS FET transistor outputs Connectable indicators • Incandescent lamp: 24 VDC, 3 W to 7 W 10 to 300 mA DC · LED lamp:



Application example

Automatic switching mode

Worker is loading and unloading the machine manually. When loading is finished, robot cycle is started manually by the worker. When robots return to their home position, loading cycle is selected automatically.

Loading condition: Safety sensor B is not active, safety sensor A is active because the robots are not allowed to move to the loading area while the worker loads the machine. So the worker is safe because safety sensor A is active.

Robot work condition: Safety sensor B is active, safety sensor A is not active because the worker is not allowed to move to the loading area when the robots work. So the worker is safe because safety sensor B stops the machine if he moves to the loading area.



Manual switching mode

Worker has to do maintenance in this machine. While maintenance, it is necessary to move the machine in a limited way. The worker has to select automatic mode or manual mode manually by using the mode selector switch.

Operation steps:

- 1) Select maintenance mode by using the mode selector
- 2) Open the door to do the maintenance while the machine still is able to operate in a limited way (monitoring of limited movement by using the safety limit switch).
- 3) Close the cover after finishing maintenance
- 4) Select automatic mode by using the mode selector
- E-Stop conditions:
- a) open the door while not in maintenance mode
- b) the machine actuates the limit switch (breaks the limit).
- c) the Enabling grip switch A4EG is actuated to stop the machine in emergency condition.





Flexible safety unit

G9SX-family modules can be connected by a logical "AND" function to implement partial/global stopping of a machine. Solid-state outputs, detailed LED diagnosis and clever feedback signals help to keep maintenance easy. The line-up is completed by expansion units with safe timing functions.

- Clear and transparent segmentation of safety functions by use of unique "AND" connection
- · Solid-state outputs for long life and relay outputs in extension box available
- Detailed LED indications enable easy diagnosis
- Clever feedback signals for easy maintenance
- PLe according to EN ISO 13849-1 and SIL 3 according to EN 61508

Ordering information

Advanced unit								
Safety outputs		Auxiliary outputs	No. of input	Max. OFF-delay	Rated	Terminal block type	Order code	
Instantaneous	OFF-delayed		channels	time	voltage			
3 P channel MOS-FET	2 P channel MOS-FET	2 PNP transistor	1 or 2 channels	0 to 15 sec in 16 steps	24 VDC	Screw terminals	G9SX-AD322-T15-RT	
transistor output transistor output	transistor output	outputs				Cage clamp terminals	G9SX-AD322-T15-RC	
2 P channel MOS-FET transistor output	2 P channel MOS-FET transistor output	2 PNP transistor outputs	1 or 2 channels	0 to 150 sec in 16 steps	24 VDC	Screw terminals	G9SX-AD-322-T150-RT	
						Cage clamp terminals	G9SX-AD-322-T150-RC	
				0 to 15 sec in	24 VDC	Screw terminals	G9SX-ADA-222-T15-RT	
				16 steps		Cage clamp terminals	G9SX-ADA-222-T15-RC	
				0 to 150 sec in	24 VDC	Screw terminals	G9SX-ADA-222-T150-RT	
				16 steps		Cage clamp terminals	G9SX-ADA-222-T150-RC	

^{*1} The OFF-delay time can be set in 16 steps as follows: T15: 0/0.2/0.3/0.4/0.5/0.6/0.7/1/1.5/2/3/4/5/7/10/15 s, T150: 0/10/20/30/40/50/60/70/80/90/100/110/120/130/140/150 s.

Basic unit

Safety outputs		Auxiliary outputs	No. of input	Rated voltage	Terminal block type	Order code		
Instantaneous	OFF-delayed		channels					
2 P channel MOS FET	-	2 PNP transistor	1 or 2 channels	24 VDC	Screw terminals	G9SX-BC202-RT		
transistor output		output			Cage clamp terminals	G9SX-BC202-RC		
Expansion unit								
Safety outputs		Auxiliary outputs	OFF-delay time	Rated voltage	Terminal block type	Order code		
Instantaneous	OFF-delayed							
4 PST-NO (contact)	-	2 (solid state) PNP transistor outputs PST-NO (contact)	-	24 VDC	Screw terminals	G9SX-EX401-RT		
					Cage clamp terminals	G9SX-EX401-RC		
-	4 PST-N0 (contact)		Synchronized with G9S-X-AD - unit		Screw terminals	G9SX-EX041-T-RT		
					Cage clamp terminals	G9SX-EX041-T-RC		

Specifications

Power input				Inputs				
Item	G9SX-AD_	G9SX-BC202	G9SX-EX	Item	G9SX-AD_	G9SX-BC202		
Rated supply voltage	20.4 to 26.4 VDC (24 VDC -15% +10%)			Safety input	Operating voltage: 20.4 VDC to 26.4 VDC,			
				Feedback/reset input	internal impedance: Approx. 2.8 k Ω			

Outputs

Item		G9SX-AD_		G9SX-BC202		
Instantaneous safety output OFF-delayed safety output		P channel MOS FET transistor output Load current: Using 2 outputs or less: 1 A DC max. Using 3 outputs or more: 0.8 A DC max.		P channel MOS FET transistor output Load current: Using 1 output: 1 A DC max. Using 2 outputs: 0.8 A DC max.		
Auxiliary output		PNP transistor output Load current: 100 mA max.	PNP transistor output Load current: 100 mA max.			
Expansion unit						
Item		G9SX-EX				
Rated load 250 VAC, 3A/30 VDC, 3A (resistive load)						
Rated carry current		3A				
Maximum switching vol	Itage	250 VAC, 125 VDC				
Characteristics						
Item		G9SX-AD_	G9SX-BC202		G9SX-EX	
Operating time (OFF to ON state)		50 ms max. (Safety input: ON) 50 ms max. (Safety input: ON) 100 ms max. (Logical AND connection input: ON)			30 ms max.	
Response time (ON to OFF state)		15 ms max.		10 ms max.		
Durability Electrical		-			100,000 cycles min.	
	Mechanical	-			5,000,000 cycles min.	
Ambient temperature		-10°C +55°C (with no icing or condensation)				





Standstill monitoring unit

Safe standstill monitoring unit based on Back-EMF operation for two- and three-phase systems.

- Ready to use covering all standard applications without additional setup
- Easy integration in star- and delta wiring
- Clear LED diagnosis of all in- and output signals for easy maintenance
- Applicable up to PLe according to EN ISO 13849-1

Ordering information

Safety standstill monitoring unit					
Safety outputs *1	Auxiliary outputs *1	Power input	Terminal block type	Order code	
Instantaneous		Rated supply voltage			
3 (Semi-conductors)	2 (Semi-conductors)	24 VDC	Screw terminals	G9SX-SM032-RT	
			Spring-cage terminals	G9SX-SM032-RC	
^{*1} PNP transistor output					

Specifications

Ratings of standstill monitoring unit

Power input	
Item	G9SX-SM032
Rated supply voltage	24 VDC
Inputs	
Item	G9SX-SM032
Input voltage	Standstill detection input (Z1-Z2/Z3-Z4) AC 415 Vrms + 10% max.
Maximum power supply frequency for AC induction motor	60 Hz max.
Internal impedance	Standstill detection input: approx, 660 k Ω EDM input: approx. 2.8 k Ω
Outputs	
Item	G9SX-SM032
Safety standstill detection output	Sourcing output (PNP) Load current: 300 mA DC max.
Auxiliary output	Sourcing output (PNP) Load current: 100 mA DC max.

Application example







Standstill detected

Standstill detected



G9SX-SM

Wiring of inputs and outputs

Signal Name	Terminal Name	Description of operation	Wiring		
Power supply input	A1,A2	Power supply input for G9SX-SM . Connect the power source to the A1 and A2 terminals.	Connect the power supply Connect the power supply	plus to the A1 terminal. minus to the A2 terminal.	
Standstill detection input 1	Z1,Z2	To turn on the Safety standstill detection outputs, both standstill detec- tion inputs must be below the threshold voltage. Otherwise, Safety	Connect Z1 and Z2 to the motor lines respectively.		
Standstill detection input 2	Z3,Z4	standstill detection outputs will NOT be turned ON.	Connect Z3 and Z4 to the motor lines respectively.		
EDM input T31,T32		1,T32 To turn on safety standstill detection outputs, ON-state signals should be input to T32. Otherwise, Safety standstill detection outputs will not be turned ON.	Corresponds to category 3		
			Corresponds to category 4	EDM input	





Limited speed monitoring unit

Safe limited speed monitoring unit for complete support of maintenance mode in machinery.

- · Preset of limited speed frequency by using integrated preset switches
- Easy integration in G9SX-Systems by using unique logical "AND" connection
- Clear LED diagnosis of all in- and output signals for easy maintenance
- Applicable up to PLd according to EN ISO 13849-1 using Omron proximity sensors

Ordering information

Proximity sensors			
Classification			Order code
Proximity sensor	Shielded	M8	E2E-X1R5F1
		M12	E2E-X2F1
		M18	E2E-X5F1
	Unshielded	M8	E2E-X2MF1
		M12	E2E-X5MF1
		M18	F2F-X10MF1

Ratings of limited speed monitoring unit

Safety outputs ^{*1} Instantaneous	Auxiliary outputs ^{*2}	Logical AND connection input	Rated voltage	Sensor power supply terminals	Terminal block type	Order code
4 (Semi-conductors)	4 (Semi-conductors)	1	24 VDC	2	Screw terminals	G9SX-LM224-F10-RT
					Spring-cage terminals	G9SX-LM224-F10-RC

*1 P channel MOS FET output

*2 PNP transistor output

Specifications

Ratings of limited speed monitoring unit

Power input			
Item	G9SX-LM224-F10		
Rated supply voltage	24 VDC		
Inputs			
Item	G9SX-LM224-F10		
Safety input	Operating voltage: 20.4 VDC to 26.4 VDC		
Feedback/reset input	Internal impedance: approx. 2.8 k Ω		
Mode selector input			
Rotation detection input	Operating voltage 20.4 VDC to 26.4 VDC Internal impedance: approx. 2.8 k Ω Input frequency: 1 kHz max.		
Outputs			
Item	G9SX-LM224-F10		
Safety solid state output	P channel MOS FET transistor output Load current: 0.8 A DC max.		
Safety speed detection output	P channel MOS FET transistor output Load current: 0.3 A DC max.		
External indicator output	PNP transistor output Load current: 100 mA max.		


G9SX-LM

Application example

Safe limited speed





Standalone safety controller

The G9SP safety controller provides all local safety based in- and outputs and controls the safety application.

- Three CPU-types to suit different applications
- · Clear diagnosis and monitring via Ethernet or serial connection
- Memory cassette for easy duplication of configuration
- Unique programming software to support easy design, verfication, standardization and reusage of the program.
- Certified according to PLe (EN ISO 13849-1) and SIL 3 (IEC 61508)

Ordering information

Appearance	Appearance description 0		Order code
Standalone safety controller	10 PNP safety inputs 4 PNP safety outputs 4 test outputs 4 PNP standard outputs		G9SP-N10S
	10 PNP safety inputs 16 PNP safety outputs 6 test outputs		G9SP-N10D
	20 PNP safety inputs 8 PNP safety outputs 6 test outputs		G9SP-N20S
Software			
Appearance	Media	Applicable OS	Order code
G9SP	Setup disk 1 license	Windows 2000	WS02-G9SP01-V1
configurator	Setup disk 10 licenses	Windows XP	WS02-G9SP10-V1
	Setup disk 50 licenses	WS02-G9SP50-V1	
	Setup disk Site license		WS02-G9SPXX-V1
Expansion unit	s (standard I/O)		

	Appearance	Туре	Number of I/O		Model
			In	Out	
Expansion I/O unit	Sinking	12	8 (solid state)	CP1W-20EDT	
	Sourcing	12	8 (solid state)	CP1W-20EDT1	
	Sinking	-	32 (solid state)	CP1W-32ET	
	Sourcing	-	32 (solid state)	CP1W-32ET1	
	I/O Connecting cable, 80 cm long			CP1W-CN811	

Safety controller G9SP Expansion I/O units

- Memory cassette
- O Ethernet option board
- SRS-232C option board
- Ompact non-contact door switch

G9SP configuration

- Safety mats 6 CJ1/PLC



Option units	
Appearance	Order code
RS-232 option board	CP1W-CIF01
Ethernet option board (Ver. 2.0 or later)	CP1W-CIF41
Memory cassette	CP1W-ME05M
G9SP Status Display Touchscreen with 1.8 m cable	82614-0010 H-T40M-P
G9SP-N10S Display Kit (G9SP, Touchscreen, cable, CP1W-CIF01)	82612-0010 G9SP-N10S-SDK
G9SP-N10D Display Kit (G9SP, Touchscreen, cable, CP1W-CIF01)	82612-0020 G9SP-N10D-SDK
G9SP-N20S Display Kit (G9SP, Touchscreen, cable, CP1W-CIF01)	82612-0030 G9SP-N20S-SDK
G9SP-N10S kit with EtherNet/IP module	82608-0010 G9SP-N10S-EIP
G9SP-N10D kit with EtherNet/IP module	82608-0020 G9SP-N10D-EIP
G9SP-N20S kit with EtherNet/IP module	82608-0030 G9SP-N20S-EIP

OMRON

Specifications

General specifications				
Power supply voltage		20.4 to 26.4 VDC (24 VDC -15% +10%)		
Consumption current	G9SP-N10S	400 mA (V1: 300 mA, V2: 100 mA)		
	G9SP-N10D	500 mA (V1: 300 mA, V2: 200 mA)		
	G9SP-N2OS	500 mA (V1: 400 mA, V2: 100 mA)		
Mounting method		35-mm DIN track		
Ambient operating temperature		0°C +55°C		
Ambient storagetemperature		-20°C +75°C		
Degree of protection		IP20 (IEC 60529)		

Safety input specifications

Sinking inputs (PNP)
11 VDC min. between each input terminal and G1
5 VDC max. between each input terminal and G1
1 mA max.
6 mA

Safety output specifications		
Output type	Sourcing outputs (PNP)	
Rated output current	0.8 A max. per output*	
Residual voltage	1.2 V max. between each output terminal and V2	
Test output specifications		
Output type	Sourcing outputs (PNP)	
Rated output current	0.3 A max. per output*	
Residual voltage	1.2 V max. between each output terminal and V1	
Standard output specifications (G9SP-N10S)		
Output type	Sourcing outputs (PNP)	
ON Residual voltage	1.5 V max. (between each output terminal and V2)	
Rated output current	100 mA max.*	

*For details on the rated output current, please refer to the user manual of G9SP.

Control system integration

Safety - I/O-status becomes transparent

The standalone safety controller offers diagnosis information in 3 ways:

1) via parallel wiring

2) via serial RS232C interface (option)

3) via Ethernet interface (option).

Information of all safety in- and outputs on the standard control system ensure minimum downtime of the machine.







G9SP-N

G9SP configuration tool



Easy setup and configuration is provided by a setup wizard supporting the hardware selection.





Programmable safety system



User-defined function blocks Approved configuration elements such as a tested door monitoring solution can be easily stored as a user defined function block and re-used in future projects. This minimises the time it takes to create a new system configuration.



Knowledge-building Existing configurations are the basis for new projects. The G9SP configuration tool supports re-use of existing and proven know-how in safety control, as well as user-defined function blocks. Which means no more repetition of effort, instead a growing library of safety solutions.

Integrated Simulator

All functions can be tested and simulated in the configuration tool, so there's no unnecessary additional workload for the engineer. In addition, on-line diagnosis reduces debug time to a minimum during implementation in the machine control system.





Safety network controller NE1A

The NE1A hosts the safety application program. All local and DeviceNet safety-based in- and outputs are monitored and controlled by the NE1A. It manages up to 32 DeviceNet safety slaves and can be seamlessly integrated in a standard DeviceNet system.

- · Removable cage-clamp terminals for easy installation
- Predefined and certified function blocks for easy programming
- LED display and status LEDs for advanced diagnostics
- · System status on DeviceNet for easy troubleshooting and predictive maintenance
- · Easy scalability through the addition of DeviceNet safety devices

Ordering information

Appearance	Appearance description		Interface			Order code
Safety network 16 PNP inputs controler 8 PNP outputs 4 test outputs 254 function block programming removable cage clamp terminals 40 PNP inputs 8 PNP outputs 9 tot outputs		USB and DeviceNet safety			NE1A-SCPU01-V1	
			Ethernet/IP and DeviceNet safety			NE1A-SCPU01-EIP
				and ceNet safety	NE1A-SCPU02	
	254 function block programming removable cage clamp terminals		Ethernet/IP and DeviceNet safety			NE1A-SCPU02-EIP
Software				Accessories		
Appearance	Appearance description	Order code		Appearance	Appearance description	Order code
Safety network In configurator II V	Installation disk (CD-ROM)	WS02-CFSC1-E		Network router	Ethernet/IP - DeviceNet router	NE1A-EDR01
	IBM PC/AT compatible Windows 2000, Windows XP, Windows 7			Programming console	CF-Card slot to store configuration USB-Interface for maintenance	NE1A-HDY

Specifications

General specifications			Safety ir	
DeviceNet comm	nunications power supply voltage	11 to 25 VDC (supplied from communications connector)	Input typ ON voltag OFF volta	
Unit power supp	oly voltage	20.4 to 26.4 VDC	OFF curre	
I/O power suppl	I/O power supply voltage		Input cur	
Consumption	Communications power supply	24 VDC, 15 mA	Cofoty o	
current	Internal circuit power supply	24 VDC, 230 mA	Salety U	
Mounting method		35-mm DIN track	Output ty	
Ambient operati	ing	-10°C +55°C	Rated ou	
temperature			Residual	
Ambient storage		-40°C +70°C		
temperature			Test out	
Degree of prote	ction	IP20 (IEC 60529)	Output ty	

Safety input specifications		
Input type	Sinking inputs (PNP)	
ON voltage	11 VDC min. between each input terminal and G1	
OFF voltage	5 VDC max. between each input terminal and G1	
OFF current	1 mA max.	
Input current	4.5 mA	
Safety output specifications		
Safety output spec	ifications	
Safety output spec Output type	ifications Sourcing outputs (PNP)	
Safety output spec <mark>Output type</mark> Rated output current	ifications Sourcing outputs (PNP) 0.5 A max. per output	
Safety output spec Output type Rated output current Residual voltage	ifications Sourcing outputs (PNP) 0.5 A max. per output 1.2 V max. between each output terminal and V2	
Safety output spec Output type Rated output current Residual voltage Test output specifi	ifications Sourcing outputs (PNP) 0.5 A max. per output 1.2 V max. between each output terminal and V2 cations	
Safety output spec Output type Rated output current Residual voltage Test output specifi Output type	ifications Sourcing outputs (PNP) 0.5 A max. per output 1.2 V max. between each output terminal and V2 cations Sourcing outputs (PNP)	
Safety output spec Output type Rated output current Residual voltage Test output specifi Output type Rated output current	ifications Sourcing outputs (PNP) 0.5 A max. per output 1.2 V max. between each output terminal and V2 cations Sourcing outputs (PNP) 0.7 A max. per output (see note.)	



DST1-ID/-MD/-MRD



DeviceNet safety I/O terminal block family

- Removable cage clamp terminals for easy installation
- Up to 12 inputs for safety signals
- · 4 test pulse outputs to ensure crosstalk and short circuit detection
- Up to 8 safety outputs (solid state or relay)
- Status LEDs for advanced diagnostics
- · Mixed mode operation (safety and standard) for all in- and outputs

Ordering information

Safety network Expand safety I/O through networks Safety components distributed over many different installation locations required long and complicated wiring. Replacing the wiring with a network between safety components greatly improves productivity. Ethernet/IP Machine control Safety control NE1A-SCPU01-V1 NE1A-SCPU02 NE1A-SCPU01-EIP Safety network Safety network Safety network controller controller controller C.I1 series PLC DeviceNet master DeviceNet Г DST1-ID12SL-1 DST1-MRD08SL-1 DST1-MD16SL-1 Safety I/O terminal Safety I/O terminal Safety I/O terminal DeviceNet slave DeviceNet slave DeviceNet slave Analog I/O terminal Remote I/O terminal DeviceNet slave DeviceNet slave Safety door switch Safety light Contactor Emergency Contacto curtain stop Appearance description Order code Appearance 12 PNP inputs DST1-ID12SL-1 Input terminal 4 Test outputs Removable cage clamp terminals Mixed I/O terminal 8 PNP inputs DST1-MD16SL-1 8 PNP outputs 4 Test outputs Removable cage clamp terminals Mixed I/O terminal 4 PNP inputs DST1-MRD08SL-1 4 relay outputs (4×2-single pole) 4 Test outputs Removable cage clamp terminals



DST1-ID/-MD/-MRD

Programmable safety system

Specifications

General specifications				
DeviceNet communications power supply voltage		11 to 25 VDC (supplied from communications connector)		
Unit power supp	oly voltage	20.4 to 26.4 VDC (24 VDC -15% +10%)		
I/O power supp	ly voltage			
Consumption current	Communications power supply	DST1-ID12SL-1/MD16SL-1: 100 mA DST1-MRD08SL-1: 110 mA		
Mounting method		35-mm DIN track		
Ambient operating temperature		-10°C +55°C		
Ambient storage temperature		-40°C +70°C		
Degree of protection		IP20 (IEC 60529)		
Weight		DST1-ID12SL-1/MD16SL-1: 420 g DST1-MRD08SL-1: 600 g		
Safety input specifications				
Input type		Sinking inputs (PNP)		

	-
Safety input specifications	
Input type	Sinking inputs (PNP)
ON voltage	11 VDC min. between each input terminal and G1
OFF voltage	5 VDC max. between each input terminal and G1
OFF current	1 mA max.
Input current	6 mA

Safety output specifications		
Output type	Sourcing outputs (PNP)	
Rated output current	0.5 A max. per output	
Residual voltage	1.2 V max. between each output terminal and V1	
Test output specifications		
Output type	Sourcing outputs (PNP)	
Rated output current	0.7 A max. per point	
Residual voltage	1.2 V max. between each output terminal and V0	
Safety output specifications for relay outputs		
Relays	G7SA-2A2B, EN 50205 class A	
Minimum applicable load	1 mA at 5 VDC	
Rated load for a resistive load	240 VAC: 2 A, 30 VDC: 2 A	
Rated load for an inductive load	2 A at 240 VAC ($\cos\phi$ = 0.3), 1 A at 24 VDC	
Mechanical life expectancy	5,000,000 operations min. (switching frequency of 7,200 operations/h)	
Electrical life expectancy	100,000 operations min. (at rated load and switching frequency of 1,800 operations/h)	

Safety I/O terminals

Inp



DST1-MD16SL-1



DST1-MRD08SL-1



SAFE ACTUATING

Safe and reliable shutdown

Protection of workers is finally achieved when the dangerous condition or movement in the machine is stopped. Omron's relays and contactors with integrated safety function are designed to shutdown the machine reliably and safely.

Quickest and most reliable shutdown as a next step in safety integration is provided by inverters and servo drives with embedded safety function to limit external wiring and effort, maximizing transparency in diagnosis.

Relays and contactors with Safety function





Inverters with embedded safety function

- Embedded safety stop function (STO)
- Up to 15kW/18.5kW
- IM and PM motor control

- Speed range up to 1000Hz
- Positioning functionality
- USB interface for PC programming
- Fieldbus communication via Modbus, DeviceNet, Profibus, CompoNet, Ethercat, ML-II and CanOpen
- Built-in filter
- Current vector control
- USB interface for PC programming
- Fieldbus communication via DeviceNet, Profibus, CompopNet and DeviceNet



MX2



Servo Drive systems with embedded safety function

- Embedded safety stop function (STO)
- Vibration suppression
- MECHATROLINK-II Motion Network

- Frequency response of 2kHz
- High accuracy provided by built-in 20bit encoder
- Side by side mounting of drives

• Frequency response of 1.6kHz Quick positioning and smooth control

 Configuration and commissioning using CX-Drive software



Sigma 5 see page 125

Traditional safety circuit Safety circuir with safety drive Safet Safety Inverte Low voltage Motor





Convenient on-line tuning

Space-saving side-by-side mounting

Benefits of safety drives:

- Faster reaction times contactors are not necessary any longer
- Reduction of total cost of ownership design of the circuit is made more simple,
- wearing elements are removed, wiring is made more simple
- · Machine certification is made simpler as all elements have a declaration of conformity

Save actuating







Relays with forcibly guided contacts

The slim G7SA relay family with forcibly guided contacts is available as a fouror six-pole type in various contact combinations and offers reinforced insulation. Terminals are arranged for easy PCB layout. It can be soldered directly to a PCB or used together with the P7SA sockets.

- · Forcibly guided contacts
- Conforms to EN 50205
- · 6 A at 240 VAC and 6A at 24 VDC for resistive loads
- · Reinforced insulation between inputs and outputs and poles
- 4- and 6-pole relays available

Ordering information

Relays with forcibly guided contacts						Sockets					
Туре	Sealing	Poles	Contacts	Rated voltage	Order code	Туре		LED indicator	licator Poles	Rated	Order code
Standard	Flux-tight	4 poles	3PST-NO,	24 VDC ^{*1}	G7SA-3A1B					voltage	
			SPST-NC			Track-mount-	Track mounting	Yes	4 poles	24 VDC	P7SA-10F-ND
			DPST-NO, DPST-NC		G7SA-2A2B	ing	and screw mounting		6 poles		P7SA-14F-ND
		6 poles	5PST-NO,		G7SA-5A1B	Deal and all a	PCB terminals	No	4		D704 10D
			SPST-NC			Back-mounting			4 poles	-	P75A-TUP
			4PST-NO.		G7SA-4A2B				6 poles		P7SA-14P
			DPST-NC								
			3PST-NO, 3PST-NC		G7SA-3A3B						

 $^{\star1}\,$ 12 VDC, 21 VDC, 48 VDC are available on request.

Specifications

Contacts

oil										
Rated voltage	Rated current	Coil resistance	Must-operate voltage	Must-release voltage	Max. voltage	Power consumption				
24 VDC	4 poles: 15 mA 6 poles: 20.8 mA	4 poles: 1,600 Ω 6 poles: 1,152 Ω	75% max. (V)	10% min. (V)	110% (V)	4 poles: Approx. 360 mW 6 poles: Approx. 500 mW				

Note: Refer to datasheet for details

oontaoto			
Load	Resistive load ($\cos \phi = 1$)	Load	Resistive load ($\cos\phi = 1$)
Rated load	6 A at 250 VAC, 6 A at 30 VDC	Max. switching current	6 A
Rated carry current	6 A	Max. switching capacity	1,500 VA, 180 W
Max. switching voltage	250 VAC, 125 VDC	(reference value)	

Relays with forcibly guided contacts

	gainen eennaene				
Contact resistance		100 mΩ max. (The contact resistance was measured with 1 A at 5 VDC using the voltage-drop method.)			
Operating time *1		20 ms max.			
Response time ^{*1}		10 ms max. (The response time is the time it takes for the normally open contacts to open after the coil voltage is turned OFF.)			
Release time *1		20 ms max.			
Insulation resistance		00 MΩ min. (at 500 VDC) (The insulation resistance was measured with a 500 VDC megger at the same places that the dielectric strength was neasured.)			
Dielectric strength ^{*2 *3}		Between coil contacts/different poles: 4,000 VAC, 50/60 Hz for 1 min (2,500 VAC between poles 3-4 in 4-pole Relays or poles 3-5, 4-6, and 5-6 in 6-pole Relays.) Between contacts of same polarity: 1,500 VAC, 50/60 Hz for 1 min			
Durability	Mechanical	10,000,000 operations min. (at approx. 36,000 operations/hr)			
	Electrical	100,000 operations min. (at the rated load and approx. 1,800 operations/hr)			
Min. permissible load	*4	5 VDC, 1 mA (reference value)			
Ambient temperature *5		Operating: -40 to 85°C (with no icing or condensation)			
Ambient humidity		Operating: 35 to 85%			
Approved standards		EN61810-1 (IEC61810-1), EN50205, UL508, CSA22.2 No. 14			

¹ These times were measured at the rated voltage and an ambient temperature of 23°C. Contact bounce time is not included.

⁴ Pole 3 refers to terminals 31-32 or 33-34, pole 4 refers to terminals 43-44, pole 5 refers to terminals 53-54, and pole 6 refers to terminals 63-64.
 ³ When using a P7SA socket, the dielectric strength between coil contacts/different poles is 2,500 VAC, 50/60 Hz for 1 min.
 ⁴ Min. permissible load is for a switching frequency of 300 operations/min.

^{*5} When operating at a temperature between 70°C and 85°C, reduce the rated carry current (6 A at 70°C or less) by 0.1 A for each degree above 70°C.

Note: The values listed above are initial values.





Compact 160 Amp Power Relay

G7Z series provides a compact, cost efficient solution for applications such as inverters, UPS, solar and fuel-cell battery circuits. Relay in combination with auxiliary contact block meets EN 60947-4-1. Coil ratings are available in 12 and 24 VDC. Power consumption is less than 4 watts.

- Switching current 160 A (40 A rating / 4-pole / IEC-AC1)
- Switching voltage 440 VAC
- Safety function with mirror contacts in various configurations
- Power consumption less than 4 Watts
- Low switching noise (70 dB)

Ordering information

Relay with auxiliary contact block (for screw terminals)							
Contact configuration		Rated voltage	Order code				
Relay	Auxiliary contact block						
4PST-N0	DPST-NO	12, 24 VDC	G7Z-4A-20Z				
	SPST-NO/SPST-NC		G7Z-4A-11Z				
	DPST-NC		G7Z-4A-02Z				
3PST-N0/SPST-NC	DPST-NO		G7Z-3A1B-20Z				
	SPST-NO/SPST-NC		G7Z-3A1B-11Z				
	DPST-NC		G7Z-3A1B-02Z				
DPST-NO/DPST-NC	DPST-NO		G7Z-2A2B-20Z				
	SPST-NO/SPST-NC		G7Z-2A2B-11Z				
	DPST-NC		G7Z-2A2B-02Z				

Specifications

Coil ratings									
Rated voltage	Rated current	Coil resistance	Must operate voltage Must release voltage Max. voltage			Power consumption (approx.)			
			% of rated voltage						
12 VDC	333 mA	39 Ω	75% max.	10% min.	110%	Approx. 3.7 W			
24 VDC	154 mA	156 Ω							

Note: - Rated current and coil resistance were measured at a coil temperature of 23°C with coil resistance of ±15%.

- Operating characteristics were measured at a coil temperature of 23°C.

- The maximum allowable voltage is the maximum value of the fluctuation range for the relay coil operating power supply and was measured at an ambient temperature of 23°C.

Contact ratings - relay

Item		G7Z-4AZ, G7Z-3A1BZ, G7Z-2A2BZ					
		Resistive load	Inductive load cos phi = 0.3	Resistive load L/R = 1 ms			
Contact structure		Double break					
Contact material		Ag alloy					
Rated load	NO	40 A at 440 VAC	22 A at 440 VAC	5 A at 110 VDC			
	NC	25 A at 440 VAC	10 A at 440 VAC	5 A at 110 VDC			
Rated carry current	NO	40 A	22 A	5 A			
	NC	25 A	10 A	5 A			
Maximum contact voltage		480 VAC		125 VDC			
Maximum contact current	NO	40 A	40 A				
		25 A					
Maximum switching capacity	NO	17,600 VA	9,680 VA	550 W			
		11,000 VA	4,400 VA	550 W			
Failure rate P value (reference value)		2 A at 24 VDC					

Note: The ratings for the auxiliary contact block mounted on the G7Z are the same as those for the G73Z auxiliary contact block.

Contact ratings - auxiliary contact block

Item	G7Z-4AZ, G7Z-3A1BZ, G7Z-2A2BZ						
	Resistive load	Inductive load cos phi = 0.3	Resistive load L/R = 1 ms				
Contact structure	Double break						
Contact material	Au clad + Ag						
Rated load	1 A at 440 VAC	0.5 A at 440 VAC	5 A at 110 VDC				
Rated carry current	1 A						
Maximum contact voltage	480 VAC		125 VDC				
Maximum contact current	1 A						
Maximum switching capacity	440 VA	220 VA	110 W				
Failure rate P value (reference value)	1 mA at 5 VDC						





$10 \times 100 = 1 - Quality$ has a new formula

Thanks to the patented design of the V1000 series and modern manufacturing, it is built for a 10 year life-time without maintenance. The new features guarantee a 100% expectation match. And with a field failure rate of less than 1 in 10.000, the new V1000 series inverter will outperform all other inverters long after it has been implemented.

- Up to 15 kW / 18.5 kW
- Built-in filter
- Current vector control
- IM and PM motor control
- Embedded safety stop function category 3 (EN954-1)



V1000

1000						
Specifications					Order code	
Voltage	Heavy duty		Normal duty		Standard	Built-in filter
1x200 V	0.12 kW	0.8 A	0.18 kW	0.8 A	VZAB0P1BAA	VZAB0P1HAA
	0.25 kW	1.6 A	0.37 kW	1.6 A	VZAB0P2BAA	VZAB0P2HAA
	0.55 kW	3.0 A	0.75 kW	3.5 A	VZAB0P4BAA	VZAB0P4HAA
	1.1 kW	5.0 A	1.1 kW	6.0 A	VZAB0P7BAA	VZAB0P7HAA
	1.5 kW	8.0 A	2.2 kW	9.6 A	VZAB1P5BAA	VZAB1P5HAA
	2.2 kW	11.0 A	3.0 kW	12.0 A	VZAB2P2BAA	VZAB2P2HAA
	4.0 kW	17.5 A	5.5 kW	21.0 A	VZAB4P0BAA	VZAB4P0HAA
3x200 V	0.12 kW	0.8 A	0.18 kW	0.8 A	VZA20P1BAA	VZA20P1HAA
	0.25 kW	1.6 A	0.37 kW	1.6 A	VZA20P2BAA	VZA20P2HAA
	0.55 kW	3.0 A	0.75 kW	3.5 A	VZA20P4BAA	VZA20P4HAA
	1.1 kW	5.0 A	1.1 kW	6.0 A	VZA20P7BAA	VZA20P7HAA
	1.5 kW	8.0 A	2.2 kW	9.6 A	VZA21P5BAA	VZA21P5HAA
	2.2 kW	11.0 A	3.0 kW	12.0 A	VZA22P2BAA	VZA22P2HAA
	4.0 kW	17.5 A	5.5 kW	21.0 A	VZA24P0BAA	VZA24P0HAA
	5.5 kW	25.0 A	7.5 kW	30.0 A	VZA25P5FAA	VZA25P5HAA
	7.5 kW	33.0 A	11.0 kW	40.0 A	VZA27P5FAA	VZA27P5HAA
	11 kW	47.0 A	15.0 kW	56.0 A	VZA2011FAA	VZA2011HAA
	15 kW	60.0 A	18.5 kW	69.0 A	VZA2015FAA	VZA2015HAA





V1000

Safe actuating

Specifications		Order code				
Voltage	Heavy duty		Normal duty		Standard	Built-in filter
3x400 V	0.37 kW	1.2 A	0.18 kW	1.2 A	VZA40P2BAA	VZA40P2HAA
	0.55 kW	1.8 A	0.37 kW	2.1 A	VZA40P4BAA	VZA40P4HAA
	1.1 kW	3.4 A	0.75 kW	4.1 A	VZA40P7BAA	VZA40P7HAA
	1.5 kW	4.8 A	1.1 kW	5.4 A	VZA41P5BAA	VZA41P5HAA
	2.2 kW	5.5 A	2.2 kW	6.9 A	VZA42P2BAA	VZA42P2HAA
	3.0 kW	7.2 A	3.0 kW	8.8 A	VZA43P0BAA	VZA43P0HAA
	4.0 kW	9.2 A	5.5 kW	11.1 A	VZA44P0BAA	VZA44P0HAA
	5.5 kW	14.8 A	7.5 kW	17.5 A	VZA45P5FAA	VZA45P5HAA
	7.5 kW	18.0 A	11.0 kW	23.0 A	VZA47P5FAA	VZA47P5HAA
	11 kW	24.0 A	15.0 kW	31.0 A	VZA4011FAA	VZA4011HAA
	15 kW	31.0 A	18.5 kW	38.0 A	VZA4015FAA	VZA4015HAA

1 Line filters

Specifications					Order code		
Power supply	Inverter V1000	Rated current (A)	Weight (kg)	Filter rasmi	Filter schaffner		
1x200 V	VZAB0P1BAA	10	0,6	A1000-FIV1010-RE	A1000-FIV1010-SE		
	VZAB0P2BAA						
	VZAB0P4BAA						
	VZAB0P7BAA	20	1	A1000-FIV1020-RE	A1000-FIV1020-SE		
	VZAB1P5BAA						
	VZAB2P2BAA	30	1,1	A1000-FIV1030-RE	A1000-FIV1030-SE		
	VZAB4P0BAA	40	1,2	A1000-FIV1040-RE	A1000-FIV1040-SE		
3x400 V	VZA40P2BAA	5	1,1	A1000-FIV3005-RE	A1000-FIV3005-SE		
	VZA40P4BAA						
	VZA40P7BAA	10	1,1	A1000-FIV3010-RE	A1000-FIV3010-SE		
	VZA41P5BAA						
	VZA42P2BAA						
	VZA43P0BAA			A1000-FIV3020-RE	A1000-FIV3020-SE		
	VZA44P0BAA	20	1,3				
	VZA45P5FAA	30	2,1	A1000-FIV3030-RE	A1000-FIV3030-SE		
	VZA47P5FAA						
	VZAB011FAA	50	2,9	A1000-FIV1050-RE	Under Development		
	VZAB015FAA			A1000-FIV10xx-RE	A1000-FIV10xx-RE		
3x200 V	VZA20P1BAA	10	0,8	A1000-FIV2010-RE	A1000-FIV2010-SE		
	VZA20P2BAA						
	VZA20P4BAA						
	VZA20P7BAA						
	VZA21P5BAA	20	1,1	A1000-FIV2020-RE	A1000-FIV2020-SE		
	VZA22P2BAA						
	VZA24P0BAA	30	1,3	A1000-FIV2030-RE	A1000-FIV2030-SE		
	VZA25P5FAA	50	2,4	A1000-FIV2060-RE	Under Development		
	VZA27P5FAA						
	VZAB011FAA	100	4,2	A1000-FIV2100-RE	Under Development		
	V7AB015EAA						

2 Communication cards

	<u> </u>			
Type Description			Function	Order code
	F	DeviceNet option card	Used for running or stopping the inverter, setting or referencing parameters, and ,monitoring output frequency, output current, or similar items through DeviceNet communication with the host controller.	SI-N3
	nication board	PROFIBUS-DP option card	Used for running or stopping the inverter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through PROFIBUS-DP communication with the host controller.	SI-P3
c	Commu option	Can open option card	Used for running or stopping the inverter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through CANopen communication with the host controller.	SI-S3
	C	CompoNet option card	Used for running or stopping the inverter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through CompoNet communication with the host controller.	A1000-CRT1

(3) Accessories

Types	Description	Functions	Order code
Digital operator	LCD remote operator	LCD Display operator with language support	JVOP-180
S	USB converter	USB converter unit with copy and backup function	JVOP-181
sorie	Remote operator cable (1m)	Cable for connecting remote operator	72606-WV001
Acces	Remote operator cable (3m)		72606-WV003
	24 VDC option board	24 VDC control board power supply	PS-UDC24



V1000

Safe actuating

(4) Computer software

<u> </u>								
Types	Description	Installation	Order code					
Software	Computer software	Configuration and monitoring software tool	CX-drive					
	Computer software	Configuration and monitoring software tool	CX-One					

$(\mathbf{5})$ Braking unit, braking resistor unit.

Specifications

200 V	200 V class											
Single-	phase: VZ	BOP1	BOP2	BOP4	BOP7	B1P5	B2P2	B4P0	-	-	-	-
Three-p	hase: VZ	20P1	20P2	20P4	20P7	21P5	22P2	24P0	25P5	27P5	2011	2015
Motor	For HD setting	0.12	0.25	0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15
kW *1	For ND setting	0.18	0.37	0.75	1.1	2.2	3.0	5.5	7.5	11	15	18.5
ŝ	Inverter capacity kVA	0.3	0.6	1.1	1.9	3.0	4.2	6.7	9.5	13	18	23
ut risti	Rated output current (A) at HD	0.8	1.6	3.0	5.0	8.0	11.0	17.5	25.0	33.0	47.0	60.0
utp	Rated output current (A) at ND	1.2	1.9	3.5	6.0	9.6	12.0	21.0	30.0	40.0	56.0	69.0
0 hara	Max. output voltage	Proportional	Proportional to input voltage: 0 to 240 V									
C,	Max. output frequency	400 Hz	00 Hz									
ver ply	Rated input voltage and frequency	Single-phase 3-phase 200	Single-phase 200 to 240 V 50/60 Hz 3-phase 200 to 240 V 50/60 Hz									
Pov	Allowable voltage fluctuation	-15% to +10)%									
	Allowable frequency fluctuation	+5%										
*1 _												

*1 Based on a standard 4-pole motor for maximum applicable motor output: Constant Torque (CT) mode with a 150% overload capacity Variable Torque (VT) mode with a 120% overlaod capacity

400 V class

Three-p	hase: VZ	40P2	40P4	40P7	41P5	42P2	43P0	44P0	45P5	47P5	4011	4015
Motor kW ^{*1}	For HD setting	0.2	0.4	0.75	1.5	2.2	3.0	4.0	5.5	7.5	11	15
	For ND setting	0.37	0.75	1.5	2.2	3.0	3.7	5.5	7.5	11	15	18.5
utput cteristics	Inverter capacity kVA	0.9	1.4	2.6	3.7	4.2	5.5	7.2	9.2	14.8	18	24
	Rated output current (A) at HD	1.2	1.8	3.4	4.8	5.5	7.2	9.2	14.8	18.0	24	31
	Rated output current (A) at ND	1.2	2.1	4.1	5.4	6.9	8.8	11.1	17.5	23	31	38
0 hara	Max. output voltage	0 to 480 V (p	0 to 480 V (proportional to input voltage)									
5	Max. output frequency	400 Hz	400 Hz									
* >	Rated input voltage and frequency	3-phase 380	3-phase 380 to 480 VAC, 50/60 Hz									
owe	Allowable voltage fluctuation	-15% to +10)%									
L IS	Allowable frequency fluctuation	+5%										

*1 Based on a standard 4-pole motor for maximum applicable motor output: Constant Torque (CT) mode with a 150% overload capacity Variable Torque (VT) mode with a 120% overload capacity





Born to drive machines

MX2 has been developed to harmonise advanced motor and machine control. Thanks to its advanced design algorithms the MX2 provides smooth control down to zero speed, plus precise operation for fast cyclic operations and torque control capability in open loop. The MX2 also gives you comprehensive functionality for machine control such as positioning, speed synchronisation and logic programming.

- Current vector control
- Double rating VT 120%/1 min and CT 150%/1 min
- · High speed motors up to 1000 Hz and IM & PM motor control
- Torque control in open loop vector
- Positioning functionality
- Built-in application functionality (i.e. brake control)
- Fieldbus comms: Modbus, DeviceNet, PROFIBUS, MECHATROLINK-II, EtherCAT, CompoNet



MX2

Voltage class	Constant torque		Variable torque	Order code	
	Max motor kW	Rated current A	Max motor kW	Rated current A	Standard
Single-phase 200 V	0.1	1.0	0.2	1.2	MX2-AB001-E
	0.2	1.6	0.4	1.9	MX2-AB002-E
	0.4	3.0	0.55	3.5	MX2-AB004-E
	0.75	5.0	1.1	6.0	MX2-AB007-E
	1.5	8.0	2.2	9.6	MX2-AB015-E
	2.2	11.0	3.0	12.0	MX2-AB022-E
Three-phase 200 V	0.1	1.0	0.2	1.2	MX2-A2001-E
	0.2	1.6	0.4	1.9	MX2-A2002-E
	0.4	3.0	0.55	3.5	MX2-A2004-E
	0.75	5.0	1.1	6.0	MX2-A2007-E
	1.5	8.0	2.2	9.6	MX2-A2015-E
	2.2	11.0	3.0	12.0	MX2-A2022-E
	3.7	17.5	5.5	19.6	MX2-A2037-E
	5.5	25.0	7.5	30.0	MX2-A2055-E
	7.5	33.0	11	40.0	MX2-A2075-E
	11	47.0	15	56.0	MX2-A2110-E
	15	60.0	18.5	69.0	MX2-A2150-E

Ordering information

MX2



MX2

Safe actuating

Voltage class	Constant torque		Variable torque	Order code	
	Max motor kW	Rated current A	Max motor kW	Rated current A	Standard
Three-phase	0.4	1.8	0.75	2.1	MX2-A4004-E
400 V	0.75	3.4	1.5	4.1	MX2-A4007-E
	1.5	4.8	2.2	5.4	MX2-A4015-E
	2.2	5.5	3.0	6.9	MX2-A4022-E
	3.0	7.2	4.0	8.8	MX2-A4030-E
	4.0	9.2	5.5	11.1	MX2-A4040-E
	5.5	14.8	7.5	17.5	MX2-A4055-E
	7.5	18.0	11	23.0	MX2-A4075-E
	11	24.0	15	31.0	MX2-A4110-E
	15	31.0	18.5	38.0	MX2-A4150-E

1 Line filters

Inverter		Line filter rasmi	
Voltage	Model MX2	Rated current (A)	Reference
1-Phase	AB001/AB002/AB004	10	AX-FIM1010-RE
200 VAC	AB007	14	AX-FIM1014-RE
	AB015/AB022	24	AX-FIM1024-RE
3-Phase 200 VAC	A2001/A2002/ A2004/A2007	10	AX-FIM2010-RE
	A2015/A2022	20	AX-FIM2020-RE
	A2037	30	AX-FIM2030-RE
	A2055/A2075	60	AX-FIM2060-RE
	A2110	80	AX-FIM2080-RE
	A2150	100	AX-FIM2100-RE
3-Phase	A4004/A4007	5	AX-FIM3005-RE
400 VAC	A4015/A4022/A4030	10	AX-FIM3010-RE
	A4040	14	AX-FIM3014-RE
	A4055/A4075	23	AX-FIM3030-RE
	A4110/A4150	50	AX-FIM3050-RE

① Input AC reactors

Inverter		AC reactor
Voltage	Model MX2	Order code
3-Phase 200 VAC	A2002/A2004/A2007	AX-RAI02800080-DE
	A2015/A2022/A2037	AX-RAI00880200-DE
	A2055/A2075	AX-RAI00350335-DE
	A2110/A2150	AX-RAI00180670-DE
1-Phase 200 VAC	AB002/AB004	Under development
	AB007	
	AB015/AB022	
3-Phase 400 VAC	A4004/A4007/A4015	AX-RAI07700050-DE
	A4022/A4030/A4040	AX-RAI03500100-DE
	A4055/A4075	AX-RAI01300170-DE
	A4110/A4150	AX-RAI00740335-DE

1 DC reactors

200V single phase		200V 3-phase		400V 3-phase		
Inverter	Order code	Inverter	Order code	Inverter	Order code	
MX2-AB001	AX-RC10700032-DE	MX2-A2001	AX-RC21400016-DE	MX2-A4004	AX-RC43000020-DE	
MX2-AB002		MX2-A2002		MX2-A4007	AX-RC27000030-DE	
MX2-AB004	AX-RC06750061-DE	MX2-A2004	AX-RC10700032-DE	MX2-A4015	AX-RC14000047-DE	
MX2-AB007	AX-RC03510093-DE	MX2-A2007	AX-RC06750061-DE	MX2-A4022	AX-RC10100069-DE	
MX2-AB015	AX-RC02510138-DE	MX2-A2015	AX-RC03510093-DE	MX2-A4030	AX-RC08250093-DE	
MX2-AB022	AX-RC01600223-DE	MX2-A2022	AX-RC02510138-DE	MX2-A4040	AX-RC06400116-DE	
-		MX2-A2037	AX-RC01600223-DE	MX2-A4055	AX-RC04410167-DE	
		MX2-A2055	AX-RC01110309-DE	MX2-A4075	AX-RC03350219-DE	
		MX2-A2075	AX-RC00840437-DE	MX2-A4011	AX-RC02330307-DE	
		MX2-A2011	AX-RC00590614-DE	MX2-A4015	AX-RC01750430-DE	
		MV0 40015	AV DC00440050 DE			

① Chokes

-		
Diameter	Description	Model
21	For 2.2 KW motors or below	AX-FER2102-RE
25	For 15 KW motors or below	AX-FER2515-RE
50	For 45 KW motors or below	AX-FER5045-RE

1 Output AC reactor

Inverter		AC reactor
Voltage	Model MX2	Order code
200 VAC	A2001/A2002/A2004/ AB001/AB002/AB004	AX-RA011500026-DE
	A2007/AB007	AX-RA007600042-DE
	A2015/AB015	AX-RA004100075-DE
	A2022/AB022	AX-RA003000105-DE
	A2037	AX-RA001830160-DE
	A2055	AX-RA001150220-DE
	A2075	AX-RA000950320-DE
400 VAC	A4004/A4007/A4015	AX-RA016300038-DE
	A4022	AX-RA011800053-DE
	A4030/A4040	AX-RA007300080-DE
	A4055	AX-RA004600110-DE
	A4075	AX-RA003600160-DE

(2) Accessories

	Additional						
Types	Description	Functions	Order code				
Digital operator	LCD remote operator	5 Line LCD remote operator with copy function, cable length max. 3 m	AX-0P05-E				
	Remote operator cable	3 meters cable for connecting remote operator	3G3AX-CAJOP300-EE				
	LED remote operator	LED remote operator, cable length max. 3 m	3G3AX-OP01				
	Mounting kit for LED operator	Mounting kit for LED operator on panel	4X-KITMINI				
Accessories	PC configuration cable	Mini USB to USB connector cable	AX-CUSBM002-E				

Safe actuating

③ Communication option boards						
Description	Functions	Model				
PROFIBUS option card	Used for running or stopping the inverter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through PROFIBUS communications with the host controller	3G3AX-MX2-PRT				
DeviceNet option card	Used for running or stopping the inverter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through DeviceNet communications with the host controller.	3G3AX-MX2-DRT				
Ethercat option card	Under development	3G3AX-MX2-ERT				
CompoNet option card	Used for running or stopping the inverter, setting or referencing parameters, and monitoring output frequency, output current, or similar items through CompoNet communications with the host controller.	3G3AX-MX2-CRT				
Mechatrolink II option card	Under development	3G3AX-MX2-ML2				
CanOpen option card		3G3AX-MX2-CORT				

④ Braking unit, braking resistor unit

Inverter					Braking resistor unit					
Voltage	Max. motor kW	Inverter N	/IX2	Connectable min. resistance Ω	Inverter mounted type (3 %ED, 10 sec max)		Braking torque %	Inverter mounted type (10%ED, 10 sec max)		Braking torque %
		3-phase	1-phase		Туре АХ-	Resist Ω		Туре АХ-	Resist Ω	
200 V	0.12	2001	B001	100	AX-REM00K1400-IE	400	200	AX-REM00K1400-IE	400	200
(single-/three-phase)	0.25	2002	B002				180		180	
	0.55	2004	B004		AX-REM00K1200-IE	200	180	AX-REM00K1200-IE	200	180
	1.1	2007	B007	50			100	AX-REM00K2070-IE	70	200
	1.5	2015	B015		AX-REM00K2070-IE	70	140	AX-REM00K4075-IE	75	130
	2.2	2022	B022	35			90	AX-REM00K4035-IE	35	180
	4.0	2040	-		AX-REM00K4075-IE	75	50	AX-REM00K6035-IE	35	100
	5.5	2055	-	20	AX-REM00K4035-IE	35	75	AX-REM00K9020-IE	20	150
	7.5	2075	-	17			55	AX-REM01K9017-IE	17	110
	11	2110	-		AX-REM00K6035-IE	35	40	AX-REM02K1017-IE	17	75
	15	2150	-	10	AX-REM00K9017-IE	17	55	AX-REM03K5010-IE	10	95
400 V	0.55	4004	-	180	80 AX-REM00K1400-IE	400	200	AX-REM00K1400-IE	400	200
(three-phase)	1.1	4007	-				200			200
	1.5	4015	-		AX-REM00K1200-IE	200	190	AX-REM00K2200-IE	200	190
	2.2	4022	-	100	AX-REM00K2200-IE	200	130	AX-REM00K5120-IE	120	200
	3.0	4030	-		AX-REM00K2120-IE	120	160			160
	4.0	4040	-				120	AX-REM00K6100-IE	100	140
	5.5	4055	-	70	AX-REM00K4075-IE	75	140	AX-REM00K9070-IE	70	150
	7.5	4075	-				100	AX-REM01K9070-IE	70	110
	11	4110	-		AX-REM00K6100-IE	100	50	AX-REM02K1070-IE	70	75
	15	4150	-	35	AX-REM00K9070-IE	70	55	AX-REM03K5035-IE	35	110

$\textcircled{\textbf{5}} \textbf{Computer software}$

Description	Installation	Model
Computer software	Configuration and monitoring software tool	CX-drive
Computer software	Configuration and monitoring software tool	CX-One



The 5-star servo drive. High performance and compact servo family with integrated ML-II.

- Advance autotuning function
- Enhanced vibration supression function
- Standard support for analog voltage/pulse train reference series or MECHATROLINK-II communications reference series.
- · Support for direct drive servomotors, linear servomotors and linear sliders
- Integrated safety stop function
- · Frequency response of 1.6 kHz

Ordering information

Sigma-5 analog/pulse reference configuration



Note: The symbols (12345... show the recommended sequence to select the components in a Sigma-5 servo system

Servo motors, power & encoder cables

Note: (1)(2) Refer to the servo motors chapter for detailed motor specifications and selection

Sigma-5 servo drive

Safe actuating

Servo d	ervo drives						
Symbol	Specifica	Specifications Compatible rotary servo motors (Compatible direct drive motors (1)	Compatible linear motors (1)	Order code	
3	1 phase 230 VAC	50 W	SGMAH-A5D_, SGMJV-A5A_, SGMAV-A5A_	-	-	SGDV-R70A01A	
			-	-	SGLGW-30A050_	SGDV-R70A05A	
		100 W	SGMAH-01A_, SGMPH-01A_, SGMJV-01A_, SGMAV-01A_, SGMEV-01A_	-	-	SGDV-R90A01A	
			-	-	SGLGW-30A080_, SGLGW-40A140_	SGDV-R90A05A	
		200 W	SGMAH-02A_, SGMPH-02A_, SGMJV-02A_, SGMAV-02A_, SGMEV-02A_	SGMCS-07B_	-	SGDV-1R6A01A	
			-	-	SGLGW-60A140_, SGLGW-40A253_, SGLFW-20A_, SGLFW-35A120_	SGDV-1R6A05A	
		400 W	SGMAH-04A_, SGMPH-04A_, SGMJV-04A_, SGMAV-04A_, SGMEV-04A_	SGMCS-02B_, SGMCS-05B_, SGMCS-04C_, SGMCS-10C_, SGMCS-14C_, SGMCS-08D_, SGMCS-17D_, SGMCS-25D_		SGDV-2R8A01A	
			-		SGLGW-40A365_, SGLGW-60A253A_	SGDV-2R8A05A	
		750 W	SGMAH-08A_, SGMPH-08A_, SGMJV-08A_, SGMAV-08A_, SGMEV-08A_	SGMCS-16E_, SGMCS-35E_	-	SGDV-5R5A01A	
			-		SGLGW-60A365A_, SGLFW-35A230_, SGLFW-50A200_	SGDV-5R5A05A	
		1.5 kW	SGMPH-15A_, SGMAV-10A_, SGMEV-15A_	SGMCS-45M_, SGMCS-80M_, SGMCS-80N_	-	SGDV-120A01A008000	
				-	SGLGW-90A200A_, SGLFW-50A380_, SGLFW-1ZA200_	SGDV-120A05A008000	
	3 phase 400 VAC	hase 0.5 kW) VAC	SGMAH-03D_, SGMPH-04D_, SGMGH-05D_, SGMEV-04D_, SGMGV-05D_	-	-	SGDV-1R9D01A	
			-	-	SGLFW-35D_	SGDV-1R9D05A	
		1.0 KW	SGMAH-07D_, SGMPH-08D_, SGMGH-09D_, SGMSH-10D_, SGMUH-10D_, SGMEV-08D_, SGMGV-09D_, SGMSV-10D_	-	-	SGDV-3R5D01A	
			-	-	SGLFW-50D200_, SGLTW-35D170_, SGLTW-50D170_	SGDV-3R5D05A	
		1.5 kW	SGMPH-15D_, SGMGH-13D_, SGMSH-15D_, SGMUH-15D_, SGMEV-15D_, SGMGV-13D_, SGMSV-15D_	-	-	SGDV-5R4D01A	
			-	-	SGLFW-50D380_, SGLFW-1ZD200_	SGDV-5R4D05A	
		2 kW	SGMGH-20D_, SGMSH-20D_, SGMGV-20D_, SGMSV-20D_		-	SGDV-8R4D01A	
			-	-	SGLFW-1ED380_, SGLTW-35D320_, SGLTW-50D320_	SGDV-8R4D05A	
		3 kW	SGMGH-30D_, SGMSH-30D_, SGMUH-30D_, SGMGV-30D_, SGMGV-30D_	-	-	SGDV-120D01A	
				-	SGLFW-1ZD380_, SGLFW-1ED560_, SGLTW-40D400_	SGDV-120D05A	
		5 kW	SGMGH-44D_, SGMSH-50D_, SGMUH-40D_, SGMGV-44D_, SGMSV-50D_	-	-	SGDV-170D01A	
			-	•	SGLTW-40D60_, SGLTW-80D400_	SGDV-170D05A	
		6 kW	SGMGH-55D_, SGMGV-55D_	-	-	SGDV-210D01A	
		7.5 kW	SGMGH-75D_, SGMGV-75D_	-	-	SGDV-260D01A	
		11 kW	SGMGH-1AD_, SGMGV-1AD_	-	-	SGDV-280D01A	
		15 kW	SGMGH-1ED_, SGMGV-1ED_	-	-	SGDV-370D01A	

Control cables (for CN1)

Symbol	Description	Connect to	Length	Order code
4	Servo relay unit	CJ1W-NC1_3		XW2B-20J6-1B (1 axis)
		CJ1W-NC2_3/4_3		XW2B-40J6-2B (2 axis)
		CJ1M-CPU22/23		XW2B-20J6-8A (1 axis)
				XW2B-40J6-9A (2 axis)
5	Cable to servo drive	Servo relay units XW2B0J6B	1 m	XW2Z-100J-B4
			2 m	XW2Z-200J-B4



Sigma-5 servo drive

Safe actuating

Symbol	Description	Connect to	Length	Order code
6	Position control unit connecting cable	CJ1W-NC113	0.5 m	XW2Z-050J-A14
			1 m	XW2Z-100J-A14
		CJ1W-NC213/413	0.5 m	XW2Z-050J-A15
			1 m	XW2Z-100J-A15
		CJ1W-NC133	0.5 m	XW2Z-050J-A18
			1 m	XW2Z-100J-A18
		CJ1W-NC233/433	0.5 m	XW2Z-050J-A19
			1 m	XW2Z-100J-A19
		CJ1M-CPU22/23	0.5 m	XW2Z-050J-A27
			1 m	XW2Z-100J-A27
7	Control cable	For general purpose controllers	1 m	R88A-CPW001S
			2 m	R88A-CPW002S
8	Relay terminal block cable	General purpose controller	1 m	R88A-CTW001N
			2 m	R88A-CTW002N
	Relay terminal block		-	XW2B-50G5

Battery backup for absolute encoder (for CN2 encoder cable)

Symbol	Name	Order code		
9	Battery	JZSP-BA01		
Note: When the encoder cables with a battery case are used no battery is required for CN1				

(between pin 21 and 22). Battery for CN1 is ER6VCN3.

Cable (for CN5)

Symbol	Name	Order code
(10)	Analog monitor cable	R88A-CMW001S
		DE9404559

USB personal computer cable (for CN7)

Symbol	Name
(1)	USB mini connector cable

Note: Double shield USB cable recommended

Cable for Safety Functions (for CN8)

Symbol	Name	Order code
12	Safety connector with 3 m cable (with loose wires at one end) $\label{eq:safety}$	JZSP-CVH03-03-E

Order code JZSP-CVS06-02-E

Note: When using the safety function, connect this cable to the safety devices. Even when not using the safety function, use servo drive with the Safe Jumper Connector (JZSP-CVH05-E) connected.

Filters

Symbol	Applicable servo drive	Rated current	Rated voltage	Order code
(13)	SGDV-R70AA, SGDV-R90AA, SGDV-1R6AA, SGDV-2R8AA	5 A	250 VAC single-phase	R88A-FI5-1005-RE
	SGDV-5R5AA	9 A		R88A-FI5-1009-RE
	SGDV-120A01A008000	16 A		R88A-FI5-1016-RE
	SGDV-1R9DA, SGDV-3R5DA, SGDV-5R4DA	4.3 A	400 VAC three-phase	R88A-FI5-3004-RE
	SGDV-8R4DA, SGDV-120DA	8.6 A		R88A-FI5-3008-RE
	SGDV-170D A	14.5 A		R88A-FI5-3012-RE

Connectors

Specifications	Order code
I/O connector kit (for CN1)	R88A-CNU11C
Sigma-5 drive encoder connector (for CN2)	JZSP-CMP9-1
Safe jumper connector	JZSP-CVH05-E

Computer software

Specifications	Order code
Configuration and monitoring software tool for servo drives and inverters. (CX-drive version 1.50 or higher)	CX-drive
Complete OMRON software package including CX-drive. (CX- Dne version 3.0.2 or higher)	CX-One



Accurax G5 servo drive



Accurate, fast and safe motion control in compact size

Accurax G5 gives you the extra edge to build accurate, faster, smaller and safer machines. You will benefit from an almost 25% reduction in motor weight, and gain 50% cabinet space. You will achieve sub micron precision and ms settling time.

- MECHATROLINK-II and analogue/pulse servo drive models
- Safety conforming IS013849-1 performance level D
- High response frequency of 2 kHz
- High resolution serial encoder for greater accuracy provided by 20 bits encoder
- External encoder input for full close loop
- Real time auto-tuning
- Advanced tuning algorithms

Ordering information

Accurax G5 series MECHATROLINK-II reference configuration



Servo motors, power & encoder cables

Note: 12 Refer to the Accurax G5 servo motor section for servomotor, motor cables or connectors selection

Servo drives

Symbol	Specifications		Servo drive model	(1) Compatible G5 series rotary servo motors
3	1 phase 230 VAC	100 W	R88D-KN01H-ML2	R88M-K05030(H/T)
				R88M-K10030(H/T)
		200 W	R88D-KN02H-ML2	R88M-K20030(H/T)
		400 W	R88D-KN04H-ML2	R88M-K40030(H/T)
		750 W	R88D-KN08H-ML2	R88M-K75030(H/T)
		1.0 kW	R88D-KN10H-ML2	R88M-K1K020(H/T)
	1.5 kW	1.5 kW	R88D-KN15H-ML2	R88M-K1K030(H/T)
				R88M-K1K530(H/T)
				R88M-K1K520(H/T)
				R88M-K90010(H/T)



Safe actuating

Model

Model

R88A-RR08050S

R88A-RR080100S

R88A-RR22047S

R88A-RR50020S

TJ1-MC04 (4 axes) TJ1-MC16 (16 axes) TJ2-MC64 (64 axes)

CJ1W-NCF71 (16 axes) CJ1W-NC471 (4 axes) CJ1W-NC271 (2 axes)

CS1W-NCF71 (16 axes) CS1W-NC471 (4 axes) CS1W-NC271 (2 axes)

CJ1W-MCH72

Symbol	Specifications		Servo drive model	1 Compatible G5 series rotary servo motors
3	3 phase 400 VAC	600 W	R88D-KN06F-ML2	R88M-K40020(F/C)
				R88M-K60020(F/C)
		1.0 kW	R88D-KN10F-ML2	R88M-K75030(F/C)
				R88M-K1K020(F/C)
		1.5 kW	R88D-KN15F-ML2	R88M-K1K030(F/C)
				R88M-K1K530(F/C)
				R88M-K1K520(F/C)
			R88M-K90010(F/C)	
		2.0 kW	R88D-KN20F-ML2	R88M-K2K030(F/C)
				R88M-K2K020(F/C)
		3.0 kW	R88D-KN30F-ML2	R88M-K3K030(F/C)
				R88M-K3K020(F/C)
				R88M-K2K010(F/C)
		5.0 kW	R88D-KN50F-ML2	R88M-K4K030(F/C)
				R88M-K5K030(F/C)
				R88M-K4K020(F/C)
				R88M-K5K020(F/C)
				R88M-K3K010(F/C)
Control o	cables (for CN1)			

Symbol	Description	Connect to	Length	Model
4	I/O connector kit (26 pins)	For I/O general purpose	-	R88A-CNW01C
5	Terminal block cable		1 m	XW2Z-100J-B34
			2 m	XW2Z-200J-B34
6	Terminal block (M3 screw and for pin terminals)		-	XW2B-20G4
	Terminal block (M3.5 screw and for fork/round terminals)		-	XW2B-20G5
	Terminal block (M3 screw and for fork/round terminals)		-	XW2D-20G6

MECHATROLINK-II Motion controllers

Trajexia stand-alone motion controller

Trajexia-PLC motion controller

Position Controller Unit for CJ1 PLC

Position Controller Unit for CS1 PLC

External regenerative resistor
Symbol Specifications

50 Ω, 80 W

100 Ω, 80 W

47 Ω, 220 W

 $20~\Omega,\,500~W$

Symbol Name

10

(11)

Analogue monitor (for CN5)				
Symbol	Name	Length	Model	
7	Analogue monitor cable	1m	R88A-CMK001S	
MECHAT	ROLINK-II cables (for CN6)			
Symbol	Specifications	Length	Model	
8	MECHATROLINK-II Terminator resistor	-	JEPMC-W6022-E	
	MECHATROLINK-II cables	0.5 m	JEPMC-W6003-A5-E	
		1 m	JEPMC-W6003-01-E	
		3 m	JEPMC-W6003-03-E	
		5 m	JEPMC-W6003-05-E	
		10 m	JEPMC-W6003-10-E	
		20 m	JEPMC-W6003-20-E	
		30 m	JEPMC-W6003-30-E	
USB personal computer cable (for CN7)				

		30 m	JEPINC-W6003-30-E	
JSB personal computer cable (for CN7)				
Symbol	Name	Length	Model	
9	USB mini-connector cable	2m	AX-CUSBM002-F	

Filters

Symbol	Applicable servodrive	Rated current	Leakage current	Rated voltage	Model
(12)	R88D-KN01H-ML2, R88D-KN02H-ML2	2.4 A	3.5 mA	250 VAC single-phase	R88A-FIK102-RE
	R88D-KN04H-ML2	4.1 A	3.5 mA		R88A-FIK104-RE
	R88D-KN08H-ML2	6.6 A	3.5 mA		R88A-FIK107-RE
	R88D-KN10H-ML2, R88D-KN15H-ML2	14.2 A	3.5 mA		R88A-FIK114-RE
	R88D-KN06F-ML2, R88D-KN10F-ML2, R88D-KN15F-ML2	4 A	0.3 mA / 32 mA ^{*1}	400 VAC three-phase	R88A-FIK304-RE
	R88D-KN20F-ML2	6 A	0.3 mA / 32 mA ¹		R88A-FIK306-RE
	R88D-KN30F-ML2, R88D-KN50F-ML2	12.1 A	0.3 mA / 32 mA ¹		R88A-FIK312-RE

(

^{*1} Momentary peak leakage current for the filter at switch-on/off.

Connectors

Specifications	Model
External encoder connector (for CN4)	R88A-CNK41L
Safety I/O signal connector (for CN8)	R88A-CNK81S

Computer software

pecifications	Model
onfiguration and monitoring software tool for servo drives nd inverters. (CX-drive version 1.91 or higher)	CX-drive

1. Risk assessment – why and how

Machine Directive 2006/42/EC stipulates that machinery should not present a risk to persons working in an industrial area, to property or to domestic animals. To fulfill this basic requirement, the most basic task in providing a usable and safe machine is to perform a risk assessment according to EN ISO 12100, which is mandatory for new machines and also for machines that are restored (e.g. integrate a new PLC system into an existing machine).

To give an overview, the basic principle is shown below. Of course, this is just a part of the whole process. To fully comply to the requirements of machine directive, please consider EN ISO 12100 and all other relevant standards completely when performing the risk assessment.

EN ISO 12100 covers the whole process of the risk assessment:



Step 1: Determination of the limits of the machinery

First step in the risk assessment process is the determination of the limits of the machinery, taking into account all the phases of the machinery life. To define the limits of a machine, it's necessary to know the process, the people involved, the environment and finally the products. Every machine has certain areas where limitations can exist, like limitations in use, in space, in time or in environmental aspects.

Step 2: Hazard identification

Essential step in the whole process is the identification of the foreseeable hazards since it is assumed that a hazard sooner or later will lead to a harm if no countermeasures are taken. EN ISO 12100 includes a list of examples for different types or groups of hazards like mechanical hazards, electrical hazards, thermal hazards, etc. that need to be considered in this step.

Step 3: Risk estimation

In this step, the risk for the user of the machinery is estimated, based on the severity of the harm and the probability of occurrence. In this part it's not only the technical issues to be covered. Since there are humans, there is also a part of the risk based on the human factors and – unfortunately – another part how a possibility to defeat the safety measures in the machinery is misused by the operation personal.

Step 4: Risk evaluation

As a part of the whole iterative process, it is mandatory to evaluate if the introduction of measures to reduce the risk leads to new hazards or hazardous conditions. If so, they need to be added to the whole documentation and suitable protective measures should be taken.

Step 5: Risk reduction

After identification, estimation and evaluation, finally the risk reduction needs to be done, following a hierarchy of measures:

- · Eliminating or reduce hazards by design and construction.
- · Use technical protection devices and additional potential protective measure.
- Reduce the risk by user information (manuals, pictograms, light, sound etc.).

Finally all these measures to protect workers should not lead to a machine that is not usable any more. If protective measures just hinder the worker in production, they will find a way to cheat the safety system – and are in a more risky situation as it would be without the safety measures. Designers of machinery should combine the production friendly thinking with the ideas of risk assessment, so they should think about:

- · how the safety system works in all machine operation modes
- accessibility of machine parts in maintenance (use doors with interlocking instead of guards with mechanical fixing)
- a safe area to observe production without stopping the machine
- a clever routine to restart production after a stop from the safety system

Additional information and support is available through the Omron sales network and our specialized Omron safety partners.



2. Explanation of direct opening

A basic design principle of E-Stops, Safety limit switches and Safety door switches is the direct or positive opening of contacts. A description of this design principle can be found in EN 60947-5-1:

The switch contacts must withstand the impulse voltage specified by EN 60947-5-1 when the contacts have been forcibly opened with the positive operating force (POF) and positive over-travel (POT) exceeding the contact welding force, which is equivalent to 10N.

The switch relies on spring pressure to close the contacts when the guard is in the closed position (or the Emergency stop pushbutton is not pressed). If the spring fails, the switch always will fail to a safe condition because the mechanical design ensures opening of the contacts just by the movement of the actuator.

Example: Safety limit switch

Closed position Gate Impulse withstand voltage 2.5 kV Positive opening

If a switch complies with the requirements for direct or positive opening, this symbol can be found on the product:

1	.)
	-)
\sim	\sim

contact marking

Related products			
Emergency stop pushbuttons	Rope pull switches	Safety limit switches	Safety door switches
A22E, A165E	ER-series	D4N, D4BN, D4NH, D4F	D4NS, D4BS, D4GS, D4GL, D4NL

3. Emergency Stop

Machines must be fitted with one or more emergency stop devices to enable danger to be averted (see EN ISO 13850). These are most commonly provided in the form of a manual pushbutton assembly which an operator strikes in an emergency. The pushbutton is clearly visible with red/yellow coloring and will stop the dangerous process as quickly as possible, without creating additional hazards.

Example of an Emergency stop pushbutton:



Emergency stop pushbutton

Another way to set up this function is by using rope pull switches. They provide the Emergency Stop function along the whole rope span.

Example of a rope pull switch



Rope pull switches

Application on a conveyor system



Both systems require a manual or key-operated reset to enable a safety check of the system to be performed prior to restarting the machine. So the reset of the safety system and restart of the machine are separate functions since the Machine Directive requires that a reset of the safety system shall not initiate a restart of the machine.

Related products	
Emergency stop pushbuttons	Rope pull switches
A22E, A165E	ER-series

4. Application hints on Safety limit switches and Key operated switches

If the hazard is on a part of the machine which does not require access, it should be permanently guarded with fixed guards.

Movable guard safety devices are used in the following situations:

- Intervention into the hazardous area to operate the machine
- · Adjustments in the machine
- Troubleshooting situations •
- Maintenance

Examples for incorrect and correct mounting of Safety Limit Switches:

Movable guard closed position





Wrong: Switch is not automatically

In some applications, access to hazardous areas is only allowed after the machine has come to a complete standstill. Safety door switches with integrated locking function protect workers in these areas.

According to the Machine Directive, a safety device has to be solidly designed, impose no further risks and may not easily be overridden or manipulated.

To support these requirements correct mounting of the safety limit switches is mandatory. If mounting is not correct, a failure of the switch may lead to a dangerous condition since the position of the guard is not monitored.



Wrong: Switch is not automatically activated when opening the safety devices.



Right: Switch is automatically activated.

activated when opening the safety devices.

Right: Switch is automatically activated.

Related products Safety limit switches

D4N, D4BN, D4NH, D4F

Examples for key-operated switches:





By means of a separated actuator the switch is automatically activated.

Related products
Safety door switches
D4NS, D4BS, D4GS, D4GL, D4NL



5. Application of non-contact switches

Monitoring of guards or doors can also be achieved by using non-contact switches. The system is made of an actuator (a combination of magnets) and a sensing element:



Working without physical contact of actuator and sensing element, the switch cannot generate particles due to abrasion, which is e.g. a basic requirement in food processing.

Non-contact switches are commonly used in packaging machines and when it comes to food or pharmaceutical industries, machine parts are mainly made of stainless steel. Non-contact switches are often placed behind machine covers so that the effects of cleaning will not damage them. Therefore an operation range of more than 10mm ensures flexibility in application and coverage of mechanical tolerances.

Non-contact switches are based on two electromechanical/ electronic principles:

Magnetic Reed Contact

A Reed Contact is used to sense if the actuator is close to the sensing element. These reed contacts close when the actuator is there and they open when the actuator is removed. For safety applications, special design measures are taken to ensure a behavior similar to direct opening. Magnetic reed contacts are able to carry high electric loads without using additional relays or contactors.

- Hall effect sensors
- These are electronic circuits and sense the magnetic field of the actuator. Halleffect sensors are free of wear and tear, so they ensure a very long lifetime of the switch together with electronic safety outputs.

Related products

TGR-non-contact switches	Vibration tolerant system	
F3S-TGR-N_R F3S-TGR-N_C	D40A + G9SX-NS	



6. Application of Safety Sensors

Safety sensors are photoelectric switches with transmitting and receiving elements and integrated safety function. Requirements for all the different types of safety sensors are set in EN 61496.

If safety sensors are used, it is mandatory to check if the hazard really can be protected by an optoelectronic device. There are many applications where parts can be ejected from a machine, causing severe harm to persons hit by these projectiles. A fence or guard is the better solution for these areas.

Safety sensors are based on a through-beam principle, having a separate transmitter and receiver. If there is no object in the sensing distance, the outputs will be ON, if the sensing area is blocked, the outputs will be in OFF condition.

To detect fingers, hands or the entire body, there are different setups of safety sensors available. This setup of the optical beams is characterized as the resolution of the safety sensor, indicating the smallest object that can be "seen".

Finger protection (14 mm resolution):

This system is able to detect one single finger and stop the machine if an object of that size is in the protected area.

Since the minimum object is very small, the intrusion into the dangerous zone is also very small and the distance to the hazard can be small as well.

Press- or stamping machines require this type of safety sensor in the related standard.

Where frequent access to a process is a demand, the use of safety sensors is the most efficient combination of protecting workers and high productivity.

Safety Sensors can be used to detect parts of the human body, like fingers or hands, or the entire human body. Data showing the standard parameters can be found in EN IS013852 and EN IS0 13853.





Hand protection (20 - 35 mm resolution):

This system is able to detect a hand and stop the machine if an object of that size is in the protected area.

Since the minimum object is a now in the size of a hand, the distance to the hazard needs to be bigger than for the finger protection.

Packaging machines require this type of safety sensor for many applications in the related standard.



Body protection:

This setup is able to detect the entire human body. It is used in applications, where a person can walk into a dangerous area.

Applications in storage and conveying industry often require this functionality together with special functions like muting.





To ensure that the machine is stopped before the worker can reach the hazardous zone, all safety sensors need to be mounted in a proper distance. The safety distance "S" is the minimum safe distance between the safety sensor and the point of operation. Calculation of the safety distance "S" is based on the European standard EN ISO 13855 and applies to safety light curtains that are used in industrial environments.

Safety distance for safeguarding danger points:



Calculation example for systems with a resolution of <40 mm

Formula according to EN ISO 13855: $S = (K \times T) + C$

- Where S = minimum distance in millimeters from the danger zone to the detection point, line, plane or zone. If the result of the calculation is less than 100mm, a distance of at least 100mm must still be maintained.
 - K = Approach speed in mm/s. In the close area of 500mm, the speed is calculated at 2000mm/s. If the distance is greater than 500 mm, K can be calculated as 1600 mm/s. In this case, however, a minimum of 500 mm applies for the safety distance.
 - T = the overall system stopping performance in seconds
 - $T = t_1 + t_2 + t_3$
 - t_1 = response time of the safety sensor in seconds.
 - $t_2 = response time of the safety interface t_{si}$, if any.
 - $t_3 = \text{maximum stopping time of the machine } t_m \text{ in seconds.}$ Please refer to the technical information of the safety Interface and the machine for the response time and stopping time details.
 - C = 8 x (d-14 mm), but not less than zero.
 - d = minimum object resolution of the safety sensor in millimeters, therefore:

S = (2000 mm/s x T) + 8 x (d-14 mm)

This formula applies for all minimum distances of S up to and including 500 mm. The minimum value of S shall not be less than 100 mm.

If S is found to be greater than 500 mm using the formula above, then the formula below can be used. In this case the minimum value of S shall not be less than 500 mm.

S = (1600 mm/s x T) + 8 x (d-14 mm)

Safety distance for safeguarding danger areas:



The height of the protective field "H" above the reference plane and the resolution "d" of the safety sensor system have the following relationship:

 $H_{min} = 15 \text{ x} (d - 50) \text{ or } d = (H_{min} / 15) + 50$

- H_{min} = Height of the protective field above the reference plane, maximum height = 1000 mm.
 It is considered that if height is equal or less than 300 mm, adults can not crawl under.
- d = resolution of the safety sensor system
- $S = (K \times T) + C$

For K and T please refer to the previous chapter

- $\label{eq:constraint} \begin{array}{l} C = (1200 \text{ mm} 0.4 \text{ x H}) \text{ but not less than 850 mm (arm length)} \\ H = \text{Height of protective field above the floor} \end{array}$
- S = (1600 mm x T) + (1200 0.4 x H)



Safety distance and beam heights in access guarding



According to EN ISO 13855:

Resolution	Lowest beam above reference plane	Highest beam above reference plane	Additional amount C (see formula)
14 mm	In accordance with EN ISO 13855	In accordance with EN ISO 13855	0 mm
30 mm	In accordance with EN ISO 13855	In accordance with EN ISO 13855	128 mm

The height of the protective field "H" above the reference plane and the resolution "d" of the safety sensor have the following relationship:

```
S = (K \times T) + C
```

For K and T please refer to the previous chapter

```
C = 8 x (d - 14)
```

d = resolution of the safety sensor system

S = (2000 mm x T) + 8 x (d - 14)

Additional Guarding

Areas of access to the point of hazardous operation not guarded by a safety sensor must be protected by suitable means such as a fixed barrier guard, an interlocked guard or a safety mat system.



guarding

operation guarding

quarding

Muting

Production processes need exchange of material. In many applications there is no possibility to find a solution that protects the workers and enables this flow of material by just opening parts of the mechanical guarding. Safety Sensors are the common solution - but the machine just stops when the protective field is obscured.

As a function in Safety Sensors, Muting enables a safe and automatic suppression of the safety function. Additional, appropriately selected and positioned sensors detect the material and ensure that a person will not enable the muting function.

Muting is often used to protect Palletizers or wrapping machines like shown in the example:



Blanking

This function can be used to allow the presence of parts of the workpiece or the machine in the detection zone of the Safety Sensor. If Blanking is used, the outputs remain ON even if there are one or more beams interrupted. This has an influence on the detection capability and results in a bigger safety distance in some applications.

OMRON

Basically there a different ways to set up a blanking application:

Fixed Blanking

In this mode, beams in a defined area are "ignored". This is used for applications like shown, e.g. a supporting table.

The gaps on the sides of this supporting table need additional guarding by fixed guards to ensure there is no access by the worker.



Floating Blanking

In machines where material is cut or bended, one or more beams along the whole Safety Sensor are "ignored". In setup, the number of disabled beams is defined and programmed. Especially in this operation mode, a close look on the resulting resolution of the Safety Sensor and the Safety distance is mandatory.



136

7. Safety Relay Units in different safety categories

The risk assessment according to EN ISO 12100 will result in a required performance level acc. EN ISO 13849-1. Safety Relay Units are ready to be used in applications up to a safety category 4 and a performance level up to PLe – but how to connect the inputs and outputs in the correct way?

The categories shown below represent the structure of the safety system acc. EN ISO 13849-1. Please check additional requirements regarding product reliability data, diagnostic coverage and common cause failure in your application.

Safety Category 2

Basic Safety Principle: Test of the components in use



- **Safety Input:** A Safety Limit Switch or a Safety Door Switch is used to monitor the position of the guard.
- Safety Control: A Safety Relay unit is used to check the correct operation of the Safety Limit Switch or Safety Door Switch. Additionally, a periodical test of the operation is mandatory. Since there is only one Safety Switch, this test will show if the Switch or the contactor on the output side fails. The reaction on the failure shall be a safe condition of the machine.
- Safety Output: A Contactor is used on the Safety Output. Attention only if above test is carried out, this circuit can conform Safety Category 2 acc. EN ISO 13849-1. In other cases, a second output path is recommended.

Safety Category 3

Basic Safety Principle: Redundancy of the components to ensure tolerance against one single fault



- **Safety Input:** Redundant Safety Limit Switches or Safety Door Switches are used to monitor the position of the guard.
- Safety Control: A Safety Relay unit is used to check the correct operation of the Safety Limit Switches or Safety Door Switches. Based on the redundant input and output components, a failure of one of these components can be detected by the Safety Control and a safe condition can be reached.
- Safety Output: Redundant Contactors are used on the Safety Outputs. The function of the contactors is monitored via the feedback contacts. If one of the N0 contacts weld, the feedback will disable the reset function of the Safety Control.

Safety Category 4

Basic Safety Principle: Redundancy of the components and testing to ensure tolerance against more than one single fault



Related products			
Programmable Safety Units	Flexible Safety Relay Unit	Expandable Safety Relay Unit	Compact Safety Relay Unit
NE1A-SCPU01, NE1A-SCPU02, G9SP	G9S-X	G9S-A	G9S-B



8. Stop Categories

Last element in the safety chain is the hazardous movement by an electric motor, pneumatic or hydraulic cylinders. Based on the application, it is necessary to find the correct way to stop a movement without adding additional hazards for the workers. IEC/EN 60204-1 defines three different Stop Categories:

Stop Category 0

Definition: Power is removed from the machine actuators e.g. the motor to stop the movement immediately. So the motor will finally stop, but there is no control how long this will take, since the mechanical load may vary. To have faster stopping, brakes or other stopping can be used in addition.

Behavior:



Application: All applications where a variation in the stopping time does not lead to hazardous conditions.

Stop Category 1

Definition: This is a controlled stop condition with power available to the machine actuators to achieve the stop. Power to the machine actuators is removed when the stop condition is finally reached. The time to remove the power can be realized by using a safe off-delay timer in a Safety Relay Unit or a Unit to safely monitor the Standstill of a machine.

Behavior:



All applications where proper ramp-down is needed. Heavy loads may **Application:** need a Stop Category 1 since there can be an additional risk from the heavy load collapsing.

All applications where precise stopping performance is needed like unlocking a safety door on a fence system.

Stop Category 2

Definition: This is a controlled stop condition with power available to the machine actuators to achieve the stop. Power to the machine actuators is kept after the stop condition is finally reached. The position of the motor has to be monitored as a Safety function while the motor is in Stop mode. If the position is left, the power to the motor is removed in a safe way.







9. Safety Drives

Electric Motors, covering from Standard AC motor to State of the Art Servo Motors, traditionally were a hot spot during the machine risk evaluation, since stopping and controlling 'load' dynamics in a safe way in the past implied a big amount of external devices and engineering hours in order to achieve the expected safety level. Moreover as complexity of the safety solution increases, machine certification becomes more complex too.

Looking into European regulation, Machine Directive stipulates that machinery sold in Europe should not present a risk for the operator working with this machine. The only way to achieve this is to make sure that any errors in the safety system will not lead to a loss of the safety function.

A Safety Drive is an Electronic Motion Driver with embedded safety technology, therefore a relevant part of the functional safety is managed by the drive itself, reducing the complexity of the overall machine safety solution. A notified body confirms that the drive and its components are certified.

Benefits of Safety Drives:

- Faster reaction times contactors are not necessary any longer
- Reduction of Total Cost of Ownership design of the circuit is more simple, wearing elements are removed, wiring is more simple
- More simple Machine Certification since all elements have a declaration of conformity

Related products

Inverter with integrated Safety Function V1000, MX2





10. Definition of Terms and abbreviations

Term	Explanation
Actuator	An actuator converts electrical signals into mechanical, hydraulic or pneumatic quantities.
Blanking	Please see the Safety Sensor Section for details
Category	The classification of the safety-related part of the control system is characterized by its behavior under fault conditions and the immunity against faults.
Channel	An element or group of elements executing a function independently. For Safety Category 3 or 4 acc. EN 954-1 (EN ISO 13849-1), a two-channel structure is recommended to withstand at least one single fault.
Danger	Definition from ISO 12100-1: Potential source of damage. This can be danger due to crushing, pinching, electric shock etc.
Emergency stop	Definition from EN 60204-1, Annex D: An operation in an emergency that is designed to stop a process or movement that is potentially dangerous.
Failure	A component or device Is no longer executing its specific function
Fault	A component is in an unintentional status, characterized by the loss of the capability to execute a specified function
Feedback circuit	Contactors can be monitored by using a feedback circuit. The NC contacts of a contactor can be used to monitor the operability of the contactors by a Safety Relay Unit or a programmable Safety Controller. If one of the NO contacts is welded, a restart is blocked by the Safety Relay Unit.
Functional safety	Part of the safety of the machine and the machine control system which depends on the correct functioning of the Safety-related electrical control systems, other technology safety-related system and external risk reduction facilities.
Machinery safety	State achieved when measures have been taken to reduce the risk to an accepted residual risk after the risk assessment has been carried out.
Muting	Please see the Safety Sensor Section for details
Risk	The combination of the probability of the occurrence of damage and the extent of the damage.
Safety	The collective term of machinery safety and functional safety.
Safety function	If this function fails, the risk of the machine or the control system can increase.
Security	Common term for protective guarding. A person or item is safeguarded through monitoring.
Stop category	EN 60204-1 defines three different stopping functions. Please refer to the Stop Category Section for details.
Abbreviations	Explanation
B10d	Number of cycles until 10% of components fail causing danger
λ	Failure Rate
λS	Failure Rate (failure to safe side)
λ d	Failure Rate (failure to danger)
CCF	Common cause failure
DC	Diagnostic coverage
DCavg	Average diagnostic coverage
Designated architecture	Designated architecture of an SRP/CS
HFT	Hardware fault tolerance
MTBF	Mean time between failures (during normal operation)
MTTF	Mean time to failure
MTTFd	Mean time to dangerous failure
MTTR	Mean time to repair (always significantly less than the MTTF)
PFH	Probability of failure per hour
PFHD	Probability of dangerous failure per hour
PL	Performance Level, Ability of safety-related parts to perform a safety function under foreseeable conditions, to achieve the expected risk reduction



PLr

SIL

SILCL

SRP/CS

SRECS

T1

T2

ТΜ

ß

C

SFF

Required performance level

SIL claim limit (suitability)

Diagnostic test interval

Safe failure fraction

Mission time

Safety-related parts of a control system

Safety-related electrical control systems

Susceptibility to common cause failure

Lifetime or proof test interval, assumed lifetime of safety system

Duty cycle (per hour) of an electromechanical component

Safety integrity level





technical specifications and performance charts

Note:

Although we do strive for perfection, Omron Europe BV and/or its subsidiary and affiliated companies do not warrant or make any representations regarding the correctness or completeness of information described in this catalogue. Product information in this catalogue is provided ,as is' without warranty of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. In a jurisdiction where the exclusion of implied warranties is not valid, the exclusion shall be deemed to be replaced by such valid exclusion, which most closely matches the intent and purpose of the original exclusion. Omron Europe BV and/or its subsidiary and affiliated companies reserve the right to make any changes to the products, their specifications, data at its sole discretion at any time without prior notice. The material contained in this catalogue may be out of date and Omron Europe BV and/or its subsidiary and affiliated companies make no commitment to update such material.

OMRON

Authorised Distributor:

ADVANCED INDUSTRIAL AUTOMATION

Control Systems

Programmable logic controllers
 Human-machine interfaces
 Remote I/0

Motion & Drives

Motion controllers
 Servo systems
 Inverters

Control Components

- Temperature controllers Power supplies Timers Counters Programmable relays
- Digital panel indicators
 Electromechanical relays
 Monitoring products
 Solid-state relays
- Limit switches Pushbutton switches Low voltage switch gear

Sensing & Safety

- Photoelectric sensors Inductive sensors Rotary encoder Cable connectors
- Displacement & width-measuring sensors Vision systems Safety networks
 Safety sensors Safety units/relay units Safety door/guard lock switches