Original instructions

OMRON

Type G9SX-LM224-F10-□

Low Speed Monitoring Unit

English **USER'S MANUAL**

Thank you for purchasing G9SX Flexible Safety Unit.
Please read and understand this manual before using the products.
Keep this manual ready to use whenever needed.
Only qualified person trained in professional electrical technique should handle G9SX.
Please consult your OMRON representative if you have any questions or comments.
Make sure that information written in this document are delivered to the final user of the product.

OMRON Corporation

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EU Declaration of Conformity

OMRON declares that G9SX-LM□ is in conformity with the requirements of the following EU Directives:

EMC Directive 2014/30/EU
Machinery Directive 2006/42/EC

Standards

G9SX-LM□ is designed and manufactured in accordance with the following standards:

EN ISO13849-1:2015 Category 3 PL d,
IEC/EN61508 SIL3, IEC/EN62061 SIL3,
IEC/EN61000-6-2, IEC/EN61000-6-4,
UL508,
CAN/CSA C22.2 No.142

Safety Precautions

Meanings of Signal Words

The following signal words are used in this manual.

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

Suitability for Use

Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases.

NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Meaning of Alert Symbols

The following alert symbols are used in this manual.

⊘	Indicates prohibited actions.
❗	Indicates mandatory actions.

Alert Statements

⚠WARNING	
Serious injury may possibly occur due to breakdown of safety outputs. Do not connect loads beyond the rated value to the safety outputs.	⊘
Serious injury may possibly occur due to loss of required safety functions. Wire G9SX properly so that supply voltages or voltages for loads do NOT touch safety outputs accidentally or unintentionally.	❗
Serious injury may possibly occur due to damages of safety inputs. Apply protection circuitry against back electromotive force in case connecting inductive loads to safety outputs.	❗
Serious injury may possibly occur due to damages of safety inputs. Connect specified proximity sensors to the Rotation detection inputs. Cogwheel should be correctly designed and installed based on specifications of selected proximity sensors according to '8. Shape of Cogwheel and Setting of Proximity Sensors' in the operating instruction and other operation manuals or related documents supplied with the sensors. After installation of the Cogwheel, check the operation of the system before use.	❗
Serious injury may possibly occur due to loss of required safety functions. To avoid interference from surrounding metal and mutual interference, specified proximity sensors should be correctly designed and installed according to '8. Shape of Cogwheel and Setting of Proximity Sensors' and operation manuals or related documents attached to the proximity sensors.	❗
Serious injury may possibly occur due to loss of safety functions. Use appropriate devices referring to the information provided below.	❗

Controlling Devices	Requirements
Door interlocking switch Limit switch	Use approved devices with Direct Opening Mechanism complying with IEC/EN 60947-5-1 and capable of switching micro loads of 24VDC, 5mA.
Enable Switch	Use approved devices complying with IEC/EN 60947-5-1. Use devices with contacts capable of switching micro loads of 24VDC, 5mA.
Safety Sensor	Use certified devices complying with the relevant product standards, regulations and rules in the country where it is used. Consult a certification body to assess that the entire system satisfies the required safety category level.
Proximity Sensor	Use the following OMRON E2E series, three-wire DC sensors (PNP). Type E2E-X1R5F1□ Type E2E-X2MF1□ Type E2E-X2F1□ Type E2E-X5MF1□ Type E2E-X5F1□ Type E2E-X10MF1□
Relay with forcibly guided contacts	Use approved devices with forcibly guided contacts complying with IEC 61810-3 (EN 50205). For feedback purpose use devices with contacts capable of switching micro loads of 24VDC, 5mA.
Contactor	Use approved devices complying with IEC/EN 60947-4-1 auxiliary contact linked with power contact (mirror contact). For feedback purpose use devices with contacts capable of switching micro loads of 24VDC, 5mA.
Emergency stop switch	Do not connect an Emergency stop switch to G9SX-LM□.
Other devices	Evaluate whether devices used are appropriate to satisfy the requirements of safety category level.

Precautions for Safe Use

(1) Use G9SX-LM□ within an enclosure with IP54 protection or higher according to IEC/EN60529

(2) Incorrect wiring may lead to loss of safety function. Wire conductors correctly and verify the operation of G9SX-LM□ before using the system in which G9SX-LM□ is incorporated.

(3) Do not apply DC voltages exceeding the rated voltages, nor any AC voltages to G9SX-LM□. Do not connect to DC distribution network.

(4) Use DC supply satisfying requirements below to prevent electric shock.
- DC power supply with double or reinforced insulation, for example, according to IEC/EN60950 or EN50178 or a transformer according to IEC/EN61558.
- DC supply satisfies the requirement for class 2 circuits or limited voltage/current circuit stated in UL 508.

(5) Apply properly specified voltages to G9SX-LM□ inputs.
Applying inappropriate voltages cause G9SX-LM□ to fail to perform its specified function, which leads to the loss of safety functions or damages to G9SX-LM□.

(6) Be sure to correctly connect safety input devices to safety input and enable input to ensure proper operation of the safety function.

(7) The auxiliary error output, auxiliary monitoring output are NOT safety outputs. Do not use auxiliary outputs as any safety output.
Such incorrect use causes loss of safety function of G9SX-LM□ and its relevant system. Also Logical connection outputs can be used only for logical connections between G9SXs.

(8) After installation of G9SX-LM□, qualified personnel should confirm the installation, and should conduct test operations and maintenance.
The qualified personnel should be qualified and authorized to secure the safety on each phases of design, installation, running, maintenance and disposal of system.

(9) A person in charge, who is familiar to the machine in which G9SX-LM□ is to be installed, should conduct and verify the installation.

(10) Mode selector switch should be operated only by qualified personnel who is familiar to the machine. For example to avoid unauthorized personnel's unexpected operation of mode selector switch, use a selector switch with locking-key.
The machine should be stopped before the Mode selector inputs are switched.

(11) Perform daily and 6-month inspections for the G9SX-LM□. Otherwise, the system may fail to work properly, resulting in serious injury.

(12) Do not dismantle, repair, or modify G9SX-LM□. It may lead to loss of its safety functions.

(13) Conformity to IEC 61508 SIL3, IEC/EN62061 SIL3 and EN ISO13849-1 PL d was assessed with G9SX-LM□ alone. And conformity to EN ISO13849-1 Safety Category 3 was assessed with G9SX-LM□ set up with specified proximity sensors. Use only appropriate components or devices complying with relevant safety standards corresponding to the required level of safety categories.
Conformity to requirements of safety category is determined as an entire system. It is recommended to consult a certification body regarding assessment of conformity to the required safety level.

(14) OMRON shall not be responsible for conformity with any safety standards regarding to customer's entire system.

(15) Disconnect G9SX-LM□ from power supply when wiring. Devices connected to G9SX-LM□ may operate unexpectedly.

(16) Be cautious not to have your fingers caught when attaching terminal sockets to the plugs on G9SX-LM□.

(17) Do not use in combustible gases or explosive gases.

(18) Proximity sensors to be used should be selected based on the max. number of revolutions during normal operation and the number of cogwheel teeth. Please refer to the equation below;

$R \times 1/60 \times N < F$

R: Max. number of revolutions during normal operation (rpm)
N: Number of cogwheel teeth
F: Response frequency of Proximity Sensor (Hz)

Precautions for Correct Use

(1) Handle with care
Do not drop G9SX-LM□ to the ground or expose to excessive vibration or mechanical shocks. G9SX-LM□ may be damaged and may not function properly.

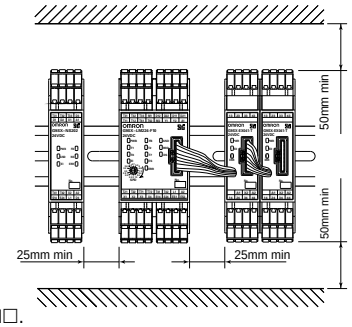
(2) Conditions of storage and usage
Do not store or use in such conditions stated below.
1) In direct sunlight
2) At ambient temperatures out of the range of -10 to 55 °C
3) At relative humidity out of the range of 25% to 85% or under such temperature change that causes condensation.
4) In corrosive or combustible gases
5) With vibration or mechanical shocks out of the rated values.
6) Under splashing of water, oil, chemicals
7) In the atmosphere containing dust, saline or metal powder.
G9SX-LM□ may be damaged and may not function properly.

(3) Mounting
Mount G9SX to DIN rails with attachments (TYPE PFP-M, not incorporated to this product), not to drop out of rails by vibration etc. especially when the length of DIN railing is short compared to the widths of G9SX.
Do not use G9SX-LM□ at altitudes over 1,000 meters.

(4) Following spacing around G9SX should be available to apply rated current to outputs of G9SX and for enough ventilation and wiring:

1) At least 25 mm beside side faces of G9SX.

2) At least 50 mm above top face of G9SX and below bottom face of G9SX.



(5) Wiring
1) For model G9SX-LM□
Use the following to wire to G9SX-LM□.
-Solid wire: 0.2 to 2.5mm^2 AWG24 to AWG12
-Stranded wire (Flexible wire): 0.2 to 2.5mm^2 AWG24 to AWG12
Strip the cover of wire no longer than 7mm.
2) For model G9SX-LM□-RT (with screw terminals)
Tighten each screw with a specified torque of 0.5 to 0.6N·m, or the G9SX-LM□ may malfunction or generate heat.
3) For Logical AND Connection
Use VCTF cable or shielded cable for Logical AND connection between units.

(6) When connecting Expansion Units (G9SX-EX□-□) to G9SX-LM□:
1) Follow the procedure below:
a) Remove the termination connector from the receptacle on G9SX-LM□.
b) Insert the head of the connecting cable of Expansion Unit to the receptacle on the G9SX-LM□.
c) Set the termination connector to the receptacle on the Expansion Unit at the end position. When G9SX-LM□ is used without expansion units, leave the termination connector set on the G9SX-LM□.
2) Do not remove the termination connector while the system is operating.
3) Before applying supply voltage, confirm that the connecting sockets and plugs are locked firmly.
4) All of the Expansion Units should be supplied with its specified voltages within 10s after the connected G9SX-LM□ is supplied with voltage. Otherwise, G9SX-LM□ detects the power-supply error for the Expansion Units.

(7) Use 1NO1NC contact switch as a mode selector switch.

(8) Use cables with length less than 100m to connect to Safety Inputs, Mode selector input, Feed-back/Reset inputs, or between Logical AND connection inputs and Logical connection outputs, respectively.

(9) Use cables with length less than 100m to connect to proximity sensor.

(10) Set the time duration of Low speed monitoring frequency preset to an appropriate value that does not cause the loss of safety function of system.

(11) Use specified cogwheels to firmly fix proximity sensors so as to prevent the sensors from dropping off.
(Refer to "8. Shape of Cogwheel and Setting for Proximity Sensors".)

(12) Logical connection between Units:
1) When using Logical AND connection inputs, set the Logical connection preset switch to 'AND' position for the units which the logical connection signal are input to.
2) Connect Logical connection outputs appropriately to Logical AND connection inputs of the relevant unit. Verify the operation of G9SX-LM□ before commissioning the system.
3) When configuring the safety related system, be sure to consider that the delay of response time caused by logical connections do not degrade the safety function of the system.

(13) To determine safety distance to hazards, take into account the delay of Safety outputs caused by the following time:
1) Response time of Safety inputs
2) Response time of Logical AND connection input
(See also "Ratings and specifications, note5")

(14) Start entire system after more than 5s have passed since applying supply voltage to all G9SXs in the system.

(15) G9SX-LM□ may malfunction due to electro-magnetic disturbances.
Be sure to connect the terminal A2 to ground.When using a DC power supply with light curtains, use DC power supply which has no interruption by a power failure of 20ms.
Connect surge suppressors to both ends of coils of an inductive load to suppress noise.

(16)This is a class A product. In residential areas it may cause radio interference, in which case the user may be required to take adequate measures to reduce interference.

(17) Devices connected to G9SX-LM□ may operate unexpectedly.
When replacing G9SX-LM□, disconnect it from power supply.

(18) Adhesion of solvent such as alcohol, thinner, trichloroethane or gasoline on the product should be avoided. Such solvents make the marking on G9SX-LM□ illegible and cause deterioration of parts.

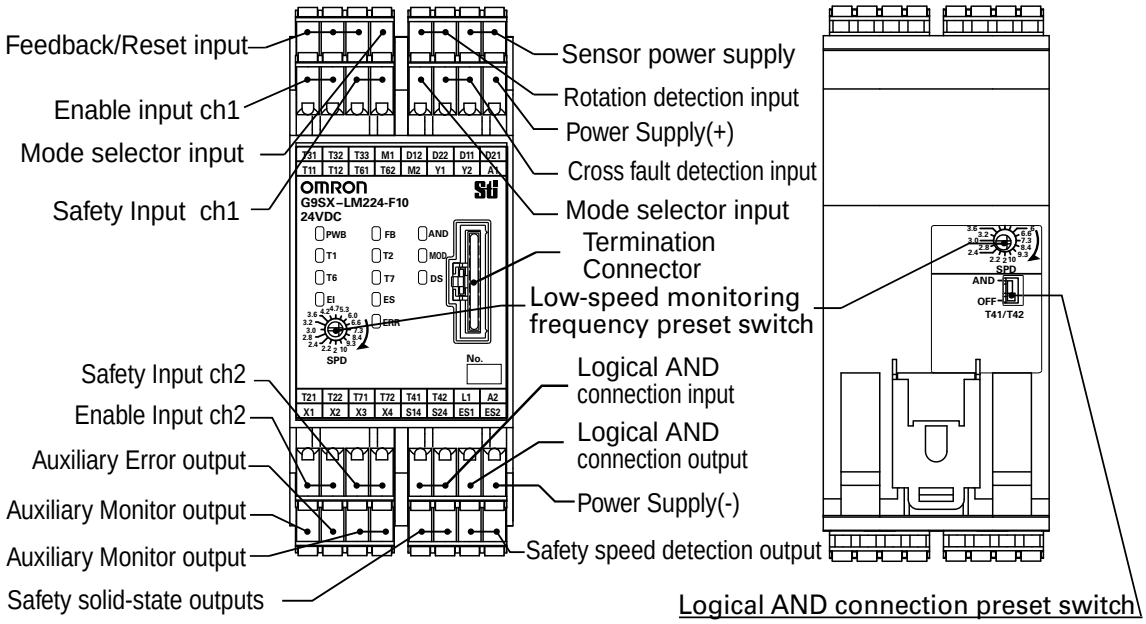
(19)Do not use a CR type of surge suppressor for the inductive load connected to an instantaneous safety output. This may cause failure or malfunction. It is recommended to use a diode+Zener-diode type of surge suppressor for an application for which a response time needs to be allowed.

(20)When reversing the rotation direction of the hazard source during low-speed operation, allow the hazard source to stop for 500ms or longer before changing the rotation direction. Reversing the rotation direction without providing for stoppage time may result in the safety outputs of G9SX-LM□ being turned OFF.

(21)Operate the reset input more than 0.4 seconds immediately after the safety outputs are OFF.
G9SX-LM□ does not accept the reset input from when the outputs are turned ON and until 0.4 seconds passes after the outputs are turned OFF.

1 Appearance and Explanation of Each Parts

Type G9SX-LM224-F10-□



*Note: When you connect the Expansion Unit, please remove the termination connector from the receptacle on the G9SX-LM□ and insert the Expansion Unit cable connector into the receptacle, and insert the terminating connector into the receptacle on the Expansion Unit at the very end (rightmost).
A maximum of five Expansion Units can be connected to one G9SX-LM□. This may be a combination of the G9SX-EX instantaneous Expansion Unit and the G9SX-EX-T OFF-delayed Expansion Unit. When the G9SX-EX-T OFF-delayed Expansion Unit is connected, it will operate in the same way as the G9SX-EX instantaneous Expansion Unit.

Settings indication (at power on)

Settings for G9SX-LM□ can be checked by indicators for approx. 3 seconds after power on.
During the settings indication term, ERR indicator will light up, however the auxiliary error output will remain off.

Indicator	Items	Setting position	indicator status	Setting	Setting status
T1	Cross fault detection (Enable Input)	Y1 terminal	lit	detection	Y1 = open
			not lit	non-detection	Y1 = 24VDC
T6	Cross fault detection (Safety Input)	Y2 terminal	lit	detection	Y2 = open
			not lit	non-detection	Y2 = 24VDC
FB	Reset	T32 or T33 terminal	lit	manual reset	T33 = 24VDC
			not lit	auto reset	T32 = 24VDC
AND	Logical AND connection input	Logical AND connection preset switch	lit	enable Logical AND input	'AND'
			not lit	disable Logical AND input	'OFF'

LED Indicators

LED	Color	Name	Function
PWR	Green	Power Supply Indicator	- Lights up while power is supplied.
ERR	Red	Error Indicator	- Lights up or blinks corresponding to the occurring an error (*1)
T1	Orange	Enable input ch1 Indicator	- Lights up while high signal is input to T12 - Blinks when an error relating to Enable input ch1 occurs. (*1)
T2	Orange	Enable input ch2 Indicator	- Lights up while high signal is input to T22 - Blinks when an error relating to Enable input ch2 occurs. (*1)
T6	Orange	Safety input ch1 Indicator	- Lights up while high signal is input to T62 - Blinks when an error relating to Safety input ch1 occurs. (*1)
T7	Orange	Safety input ch2 Indicator	- Lights up while high signal is input to T72 - Blinks when an error relating to Safety input ch2 occurs. (*1)
AND	Orange	Logical AND input Indicator	- Lights up while high signal is input to T41. - Blinks when an error relating to Logical AND connection Input occurs. (*1)
FB	Orange	Feedback/Reset input Indicator	- Lights up in the following cases: -- With automatic reset while high signal is input to T33 -- With manual reset while high signal is input to T32. - Blinks when an error relating to Feedback/Reset input occurs. (*1)
EI	Orange	Safety output indicator	- Lights up while Safety solid-state outputs (S14, S24) are in ON-state. - Blinks when an error relating to Safety solid-state output occurs. (*1)
ES	Orange	Safety speed detection output Indicator	- Lights up while Safety speed detection outputs (ES1, ES2) are in ON-state. - Blinks when an error relating to Safety speed detection outputs occurs.(*1)
MOD	Orange	Operation mode Indicator	- Lights up while the Maintenance mode is in ON-state. - Blinks when an error relating to mode selector input occurs.(*1)
DS	Orange	Rotation detection input Indicator	- Blinks when Rotation detection input signals (D12 and D22) indicate a low-speed condition (lower than the Low-speed monitoring frequency) - Light up when Rotation detection input signals (D12 and D22) indicate a standstill condition (2Hz or less) - Blinks when an error related to Rotation detection inputs occurs.(*1)

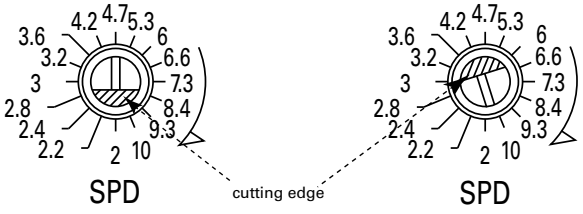
*1. See 7 Fault Detection for details.

Preset Switches

Change the value of the preset switches only when G9SX-LM□ is disconnected from power supply.
The states of the preset switches come into effect when the power supply to G9SX-LM□ turns on.

Name	Function	State/Value (position of switch)
Logical AND Connection Preset Switch	Sets Logical AND Connection Inputs to valid or invalid. (*2)	OFF (Invalid: default setting)/ AND (valid)
Low speed monitoring Preset switch	Low speed monitoring frequency preset.(*3)	2 (default setting value) /2.2/2.4/2.8/3.0/3.2/3.6/4.2/4.7/5.3 /6.0/6.6/7.3/8.4/9.3/10 (Hz) (*4)

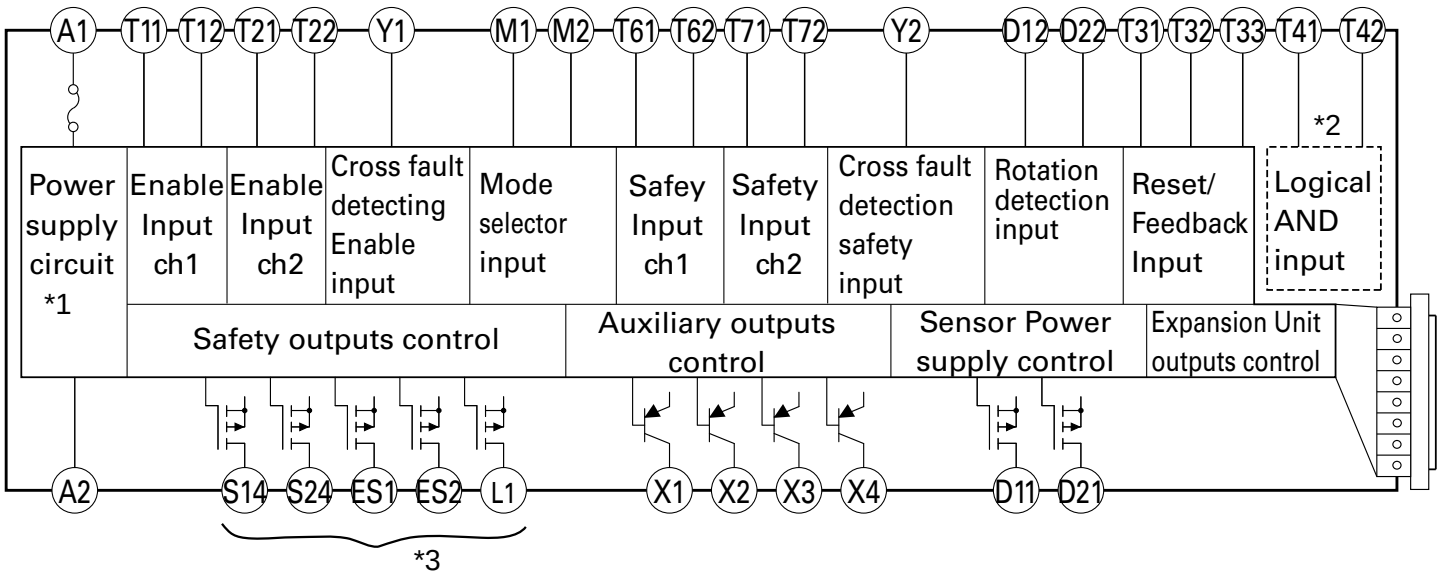
*2. When operating G9SX-LM□ using Logical AND Connection function, be sure to set the preset switch to AND (valid) position for the units which the logical input signal is input to. When the switch is set to OFF (invalid) position, it is detected as a fault.
*3. Set both of the two Low speed monitoring Preset Switches, one each on the front and back, to the same value.
*4. See illustration to the right for setting position of Low speed monitoring Preset switch. Make sure that the direction of cutting edge of preset switch is correctly pointed to the Low speed monitoring frequency value which must be set.



ex.1)Low speed monitoring frequency 2Hz setting ex.2)Low speed monitoring frequency 4.2Hz setting

2 Internal Connection

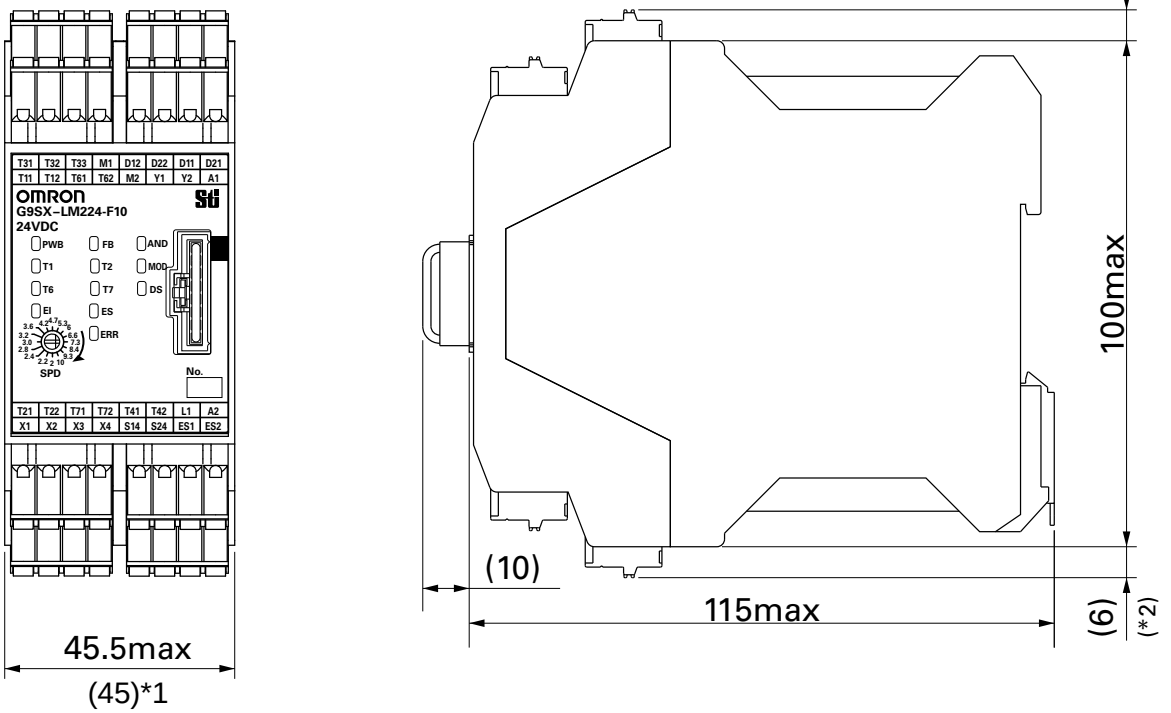
Type G9SX-LM224-F10-☐



*1 Internal power supply circuit is not isolated.
*2 Logical AND input is isolated.
*3 Safety solide-state outputs, S14 , S24,ES1,ES2 and L1, are internally redundant respectively.
*4 When G9SX-EX-T is connected, it will operate in the same way as G9SX-EX.

3 Dimensions

Type G9SX-LM224-F10-☐



Note 1. Left outline drawing is for -RC terminal type.

*1. Typical dimension.
*2. For -RC terminal type only.

4 Ratings and Specifications

Ratings

ITEM		TYPE G9SX-LM224-F10-□	
Power input	Rated supply voltage	24 VDC	
	Operating voltage range	-15% to +10% of rated supply voltage	
	Rated power consumption (See Note1)	5 W max.	
Inputs	Safety input Feedback/reset input Mode selector input	Operating voltage: 20.4VDC to 26.4VDC, Internal impedance : approx. 2.8kohm (see note2)	
	Rotation detection input	Operating voltage: 20.4VDC to 26.4VDC, Internal impedance : approx. 2.8kohm (see note2) Input frequency:1kHz max.	
Outputs	Safety solid-state output(see note3)	P channel MOS FET output	Load current: 0.8A DC max.(see note4, 5)
	Safety speed detection output (see note3)	P channel MOS FET output	Load current: 0.3A DC max.
	External indicator output	PNP transistor output	Load current: 100mA DC max.

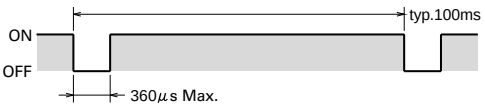
Specifications and Performance

ITEM	TYPE G9SX-LM224-F10-□
Over voltage category (IEC/EN 60664-1)	II
Operating time (OFF to ON state)(see note6, 7,12)	50ms max. (With Safety input/Enable input ON) 100ms max. (With Logical AND connection input ON)
Response time (ON to OFF state)(see note6,12)	15ms max.
Allowable time for switching Mode selector inputs (see note 9)	450ms max.
Mode selector input response time (see note 10)	50ms max.
ON-state residual voltage	3.0V max. (Safety solid-state outputs, Safety speed detection outputs and Auxiliary outputs)
OFF-state leakage current	0.1mA max. (Safety solid-state outputs, Safety speed detection outputs and Auxiliary outputs)
Maximum cable length for logical connection inputs and Safety inputs	100m max.
Number of units connected per Logical connection output.	4 units max.(see note8)
Total number of units connected with Logical connection (see note 8)	20 units max.
Number of units connected in series with Logical connection	5 units max.
Reset input time	100ms min.
Accuracy tolerance of Low speed detection frequency(see note11)	Within minus 10% of the set value
Vibration resistance	Frequency: 10 to 55 to 10Hz, Amplitude: 0.375mm half amplitude (0.75mm double amplitude)
Mechanical shock resistance	300 m/s^2 (destruction), 100 m/s^2 (malfunction)
Ambient temperature	-10 to +55 °C (No freezing or condensation)
Ambient humidity	25 to 85%RH
Weight	Approx. 240 g

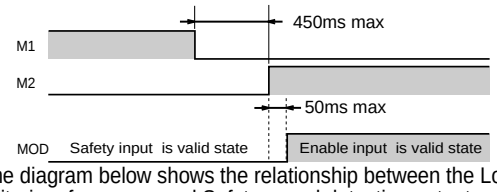
Insulation Specifications

Item		TYPE G9SX-LM224-F10-□
Insulation resistance	- Between Logical AND input terminals, and Power supply input terminals and other input and output terminals connected together.	20Mohm Min. (250VDC megger)
	- Between all terminals connected together and DIN rail.	20Mohm Min. (250VDC megger)
Dielectric strength	- Between Logical AND connection terminals, and Power supply input terminals and other input and output terminals connected together.	500VAC for 1min
	- Between all terminals connected together and DIN rail.	500VAC for 1min

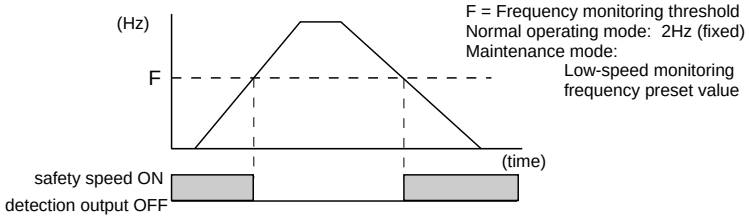
Note:
(1) Power consumption of loads not included.
(2) Ensure that more current supply than the minimum load current required for the connected control device is provided.
(3) While safety outputs are in the ON state, signal sequence shown below is output continuously for diagnosis.
When using the safety outputs as input signals to control devices (e.i. programmable controller), consider the off pulse below.



(4) The following derating is required when units are mounted side-by-side. - 0.4 A max. load current
(5) The following derating is required when inductive load is conneted to safety outputs.
- IEC/EN60947-5-1 DC-13: 0.8A
- UL508 Pilot Duty: 0.5A
(6) When multiple units are connected through logical connections, the total operating/response time will be the sum of the operating/response time of each unit connected.
(7) This is the time required to turn ON safety solid-state outputs when required conditions are met.
(8) The number of TYPE G9SX-EX401-□ (Expansion Unit) and TYPE G9SX-EX041-T-□ (Expansion Unit, Off-delayed model) not included.
(9) This is the time allowed for switching Mode selector inputs. If it exceeds 450ms, G9SX-LM will detect it as a failure.
(10) This is the time required for Safety inputs/Enable inputs to be switched following a switch of Mode selector inputs. (While MOD indicator lights up, Enable inputs are valid state. And while MOD indicator is off, Safety inputs are valid state.)



(11) The diagram below shows the relationship between the Low-speed monitoring frequency and Safety speed detection outputs.
The frequency (F) has a tolerance of - 10%.
This accuracy tolerance does not include any characteristics of proximity sensors.

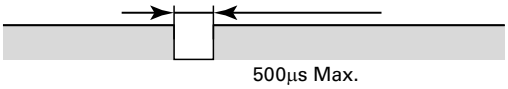


(12) Operating time and response time do not include the frequency detection time and the time affected by the characteristics of proximity sensors. For response performance of the entire system, see "Response performance regarding speed detection".

●Connecting Safety Sensors and G9SX-LM

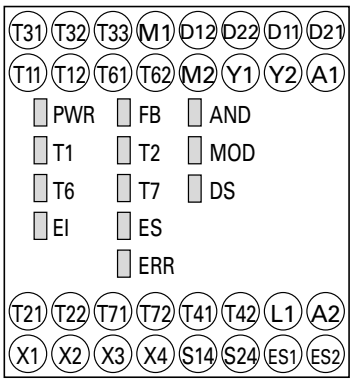
1) When G9SX-LM is connected to a safety sensor, Terminal Y1 should be connected to 24VDC for Enable input channel. Or for Safety input channel, Terminal Y2 should be connected to 24VDC. If Terminal Y1 or Y2 is open, G9SX-LM will detect it as a connection error.
2) In some cases, safety sensor outputs include off-shot pulses for self-test purpose.
Please note the following;

- Off-shot pulse width of the sensor, during the ON-state : 500μs Max.



●Terminal arrangement and LED indicators

TYPE G9SX-LM224-F10-□



●Response performance regarding speed detection

The response time of the entire system regarding speed detection can be calculated by the following formula:

Ts = Tp + Tf + Tr + Tm

Ts : Response time of the entire system
Tp : Response time of the proximity sensor
Tf : Frequency detection time of G9SX-LM
Tr : Response time of G9SX-LM
Tm : Response time of the machine

●Response time of proximity sensor (Tp)

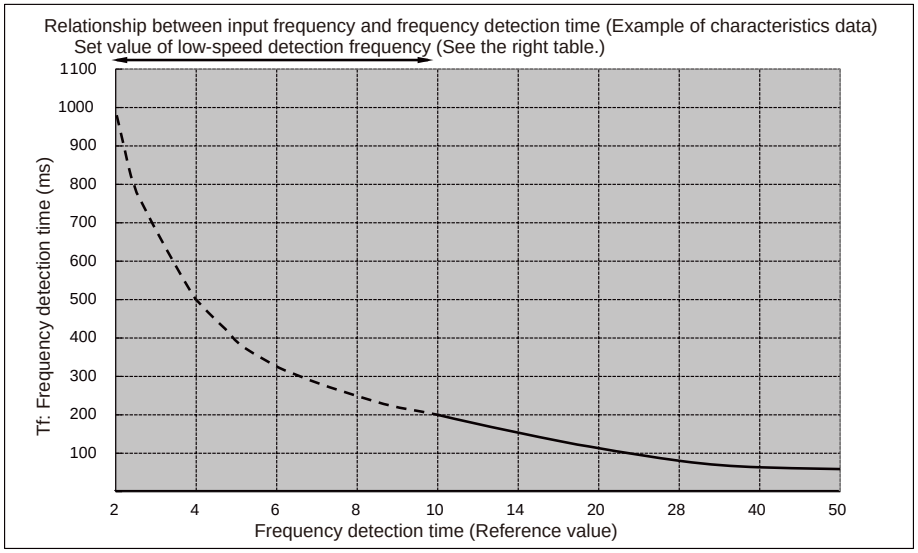
Calculation formula is as follows:

Tp = 1 / F (s)

F : Response frequency of the proximity sensor connected to G9SX-LM

●Frequency detection time of G9SX-LM□ (Tf)

The time taken to detect frequency at the rotation detection input section of G9SX-LM.
Detection time differs depending on the input frequency.
For details, see the diagram below for the characteristics data.



Set value of low-speed detection frequency	Frequency detection time (Reference value)
2 Hz	1000 ms max.
2.2 Hz	910 ms max.
2.4 Hz	835 ms max.
2.8 Hz	715 ms max.
3 Hz	670 ms max.
3.2 Hz	625 ms max.
3.6 Hz	560 ms max.
4.2 Hz	480 ms max.
4.7 Hz	430 ms max.
5.3 Hz	380 ms max.
6 Hz	350 ms max.
6.6 Hz	305 ms max.
7.3 Hz	275 ms max.
8.4 Hz	240 ms max.
9.3 Hz	220 ms max.
10 Hz	200 ms max.

●Response time of G9SX-LM□ (Tf)

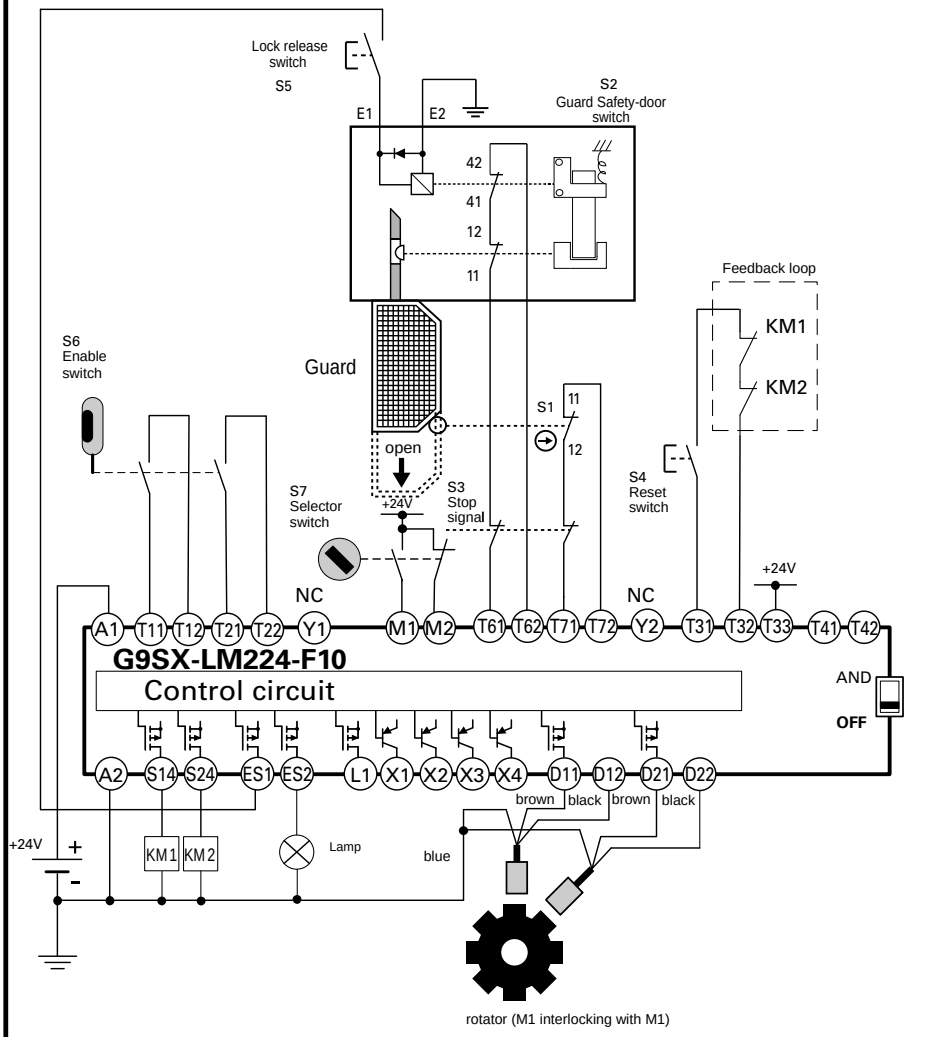
Tr = 15ms max.

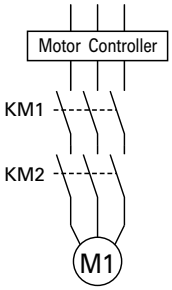
●Response time of the machine (Tm)

The time from when the machine receives a stop signal to the time when the machine's hazardous part stops.

5 Application Examples

G9SX-LM224-F10 (DC24V) <Guard lock Safety-door switch(Mechanical lock), Safety limit switch 2ch input / Enable 2ch input / manual reset>

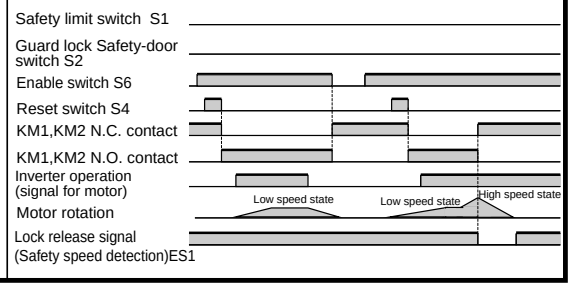




Devices	
S1	:Safety limit switch
S2	:Guard lock Safety-door switch
S3	:Stop signal
S4	:Reset switch
S5	:Lock release switch
S6	:Enable switch
S7	:Selector switch
KM1,KM2	:Contactor
M1	:3-phase motor

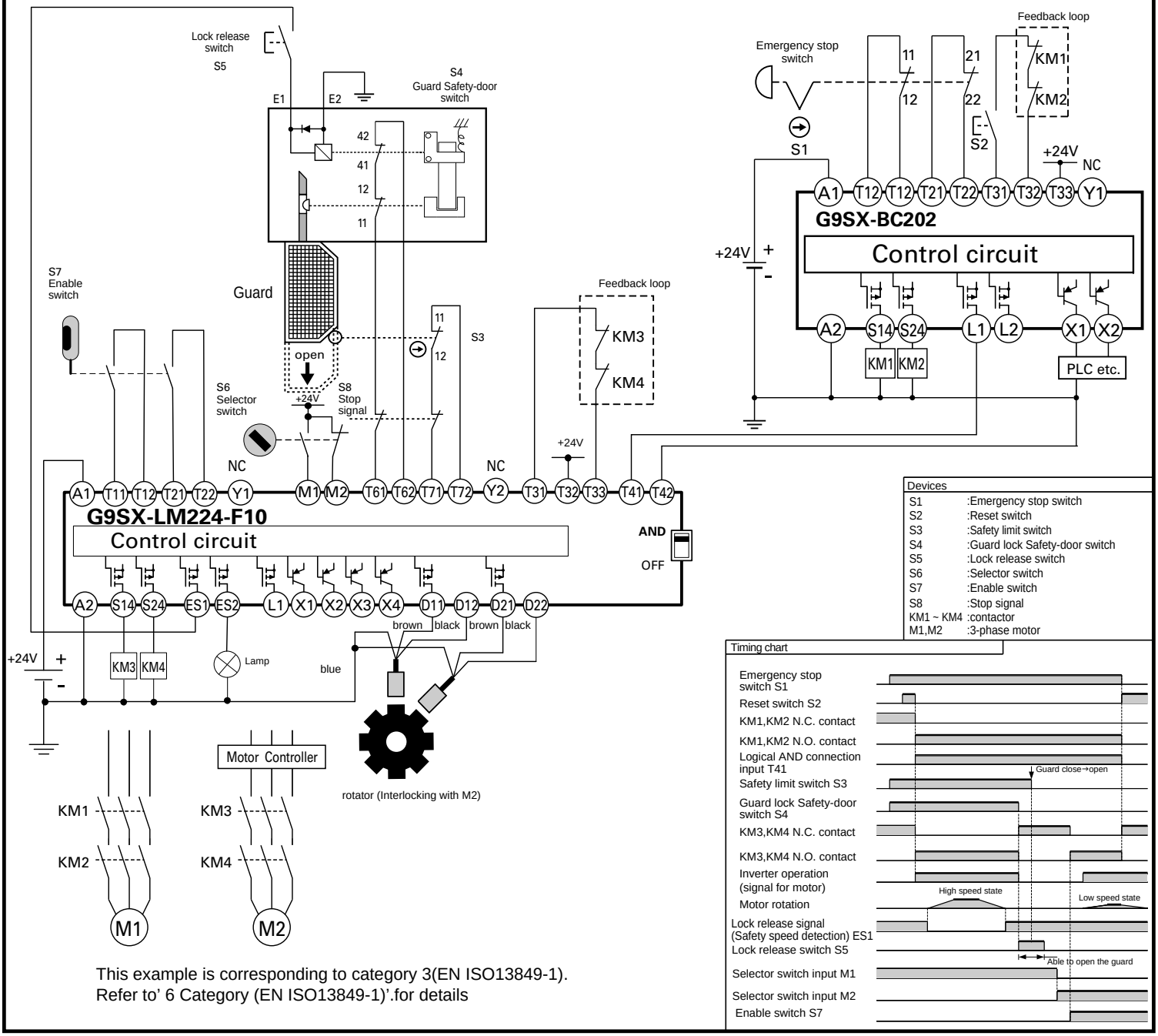
Normal Operating mode (M1:ON,M2:OFF) Timing chart

Maintenance mode (M1:OFF,M2:ON) Timing chart



This example is corresponding to category 3(EN ISO13849-1).
Refer to' 6 Category (EN ISO13849-1)' for details

G9SX-LM224-F10 (DC24V) <Guard lock Safety-door switch(Mechanical lock), Safety limit switch 2ch input / Enable switch 2ch input / auto reset>
+ G9SX-BC202 (DC24V) <Emergency stop switch 2ch input / manual reset>

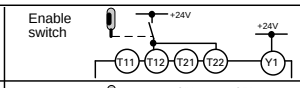
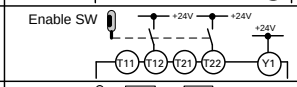
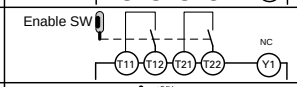
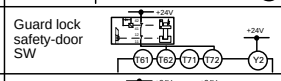
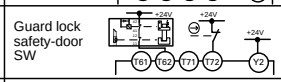
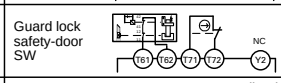
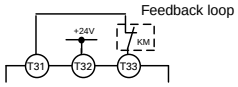
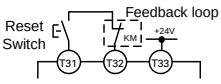
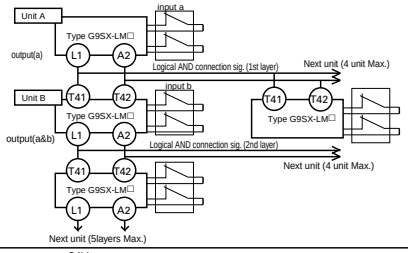
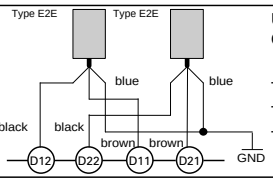


This example is corresponding to category 3(EN ISO13849-1).
Refer to' 6 Category (EN ISO13849-1)'.for details

Devices	
S1	:Emergency stop switch
S2	:Reset switch
S3	:Safety limit switch
S4	:Guard lock Safety-door switch
S5	:Lock release switch
S6	:Selector switch
S7	:Enable switch
S8	:Stop signal
KM1 ~ KM4	:contactor
M1,M2	:3-phase motor

Timing chart

Wiring of Inputs and Outputs

Signal Name	Terminal Name	Description of operation	Wiring
Power supply input	A1, A2	Connect the power source to Terminals A1 and A2.	Connect the power supply plus to the A1 terminal. Connect the power supply minus to the A2 terminal.
Enable input CH1	T11, T12	To set Safety solid-state outputs in ON state in the Maintenance mode, HIGH state signals must be input to both of Enable input CH1 and Enable input CH2 Otherwise Safety solid-state outputs cannot be in ON state.	Using 1 safety input channel 
Enable input CH2	T21, T22		Using 2 safety input channels (cross fault detection OFF) 
			Using 2 safety input channels (cross fault detection ON) 
Safety input CH1	T61, T62	To set Safety solid-state outputs in ON state in the Normal operating mode, HIGH state signals must be input to both of Safety input CH1 and Safety input CH2 Otherwise Safety solid-state outputs cannot be in ON state.	Using 1 safety input channel 
Safety input CH2	T71, T72		Using 2 safety input channels (cross fault detection OFF) 
			Using 2 safety input channels (cross fault detection ON) 
Feedback/ Reset input	T31, T32, T33	To set Safety solid-state outputs in ON state,ON state signal must be input to T33. Otherwise Safety solid-state outputs cannot be in ON state.	Auto reset 
		To set Safety solid-state outputs in ON state,the signal input to T32 must change from OFF state to ON state, and then to OFF state. Otherwise Safety solid-state outputs cannot be in ON state.	Manual reset 
Logical AND connection input	T41, T42	Logical AND connection means that lower unit(Unit B) calculates the logical multiplication (AND) of the safety output information from upper unit(Unit A) and safety input signal "b", which is input to lower unit.In the example of a right picture, the safety output of Unit C is "a" AND "b" . Connect L1 or L2 of upper unit to T41 of lower unit, and connect GND of upper unit to T42 of lower unit. To set Safety solid-state outputs of the subsequent Unit in ON state, its Logical AND Connection Preset Switch must be set to AND (enable) and High state signal must be input to T41 of the subsequent unit.	
Mode selector input	M1, M2	Either Safety input or Enable input is effectively done by 1NC1NO input. The relationship between Safety/Enable input and Mode selector inputs is as follows; M1=ON,M2=OFF → Safety input detection (Normal operating mode) M1=OFF,M2=ON → Enable input is enabled(Maintenance mode)	
Rotation detection input	D11, D12, D21, D22	Normal operation mode: To turn on Safety speed detection outputs, pulse signals from the two proximity sensors monitoring should be 2.0Hz or less. Maintenance mode: To turn on Safety speed detection outputs, the signal frequency from the two proximity sensors should be lower than the preset Low speed monitoring frequency.	 Use the following DC three-wire types, OMRON E2E series (PNP). Type E2E-X1R5F1□ Type E2E-X2MF1□ Type E2E-X2F1£ Type E2E-X5MF1£ Type E2E-X5F1£ Type E2E-X10MF1£
Cross fault detection input	Y1, Y2	Selects a mode of failure detecting (Cross fault detecting) function for safety inputs of G9SX-LM□ corresponding to the connection of Cross fault detection input.	Keep Y1 open when using T11, T21. (Cross fault detecting mode) Keep Y2 open when using T61, T71. (Cross fault detecting mode) Connect Y1 to 24VDC when NOT using T11, T21. (Wiring corresponding to category 2 or 3) Connect Y2 to 24VDC when NOT using T61, T71. (Wiring corresponding to category 2 or 3)
Safety solid-state output	S14, S24	Turns ON/OFF according to the state of safety inputs, Feedback/Reset inputs, and Logical AND connection inputs. During off-delay state, safety solid-state outputs are not able to turn ON.	Keep these outputs Open when NOT used.
Safety speed detection output	ES1, ES2	Turns ON/OFF according to the state of Rotation detection inputs. Refer to '4. Ratings and Specifications' (see note 10).	Keep these outputs Open when NOT used.
Logical connection output	L1	Outputs a signal of the same logic level as Safety solid-state outputs.	Keep these outputs Open when NOT used.
Auxiliary Monitor output	X1	Outputs a signal of the same logic level as Safety solid-state outputs	Keep these outputs Open when NOT used.
Auxiliary Error output	X2	Outputs a signal while the Error Indicator is lit or blinking.	Keep these outputs Open when NOT used.
Auxiliary Monitor output	X3	Outputs a signal of the same logic level as Safety speed detection outputs.	Keep these outputs Open when NOT used.
Auxiliary Monitor output	X4	Indicates the selected Operation mode. Normal operating mode:OFF Maintenance mode:ON	Keep these outputs Open when NOT used.

6 Performance Level and Safety category of EN ISO13849-1

The G9SX-LM□ can be used for PL=d and Category 3 required by EN ISO13849-1 European standard.
Refer to the following link for the Safety-related characteristic data:
http://www.fa.omron.co.jp/safety_6en/
However, please note that this does not mean that G9SX can be always used for this category under all similar conditions or situations.
Be sure to assess the entire system for conformity to a required category before use.
For conformity to Safety Category 3, please check the following points;
1) Use both of the two channels for Enable inputs (T11-T12, T21-22), Safety inputs (T61-62, T71-T72), and Rotation detection inputs (D11-D12, D21-D22).
2) Use direct opening action switches for safety inputs (T61-T62, T71-T72).
When limit switches are used, at least one of them should be a direct opening action limit switch.
When connecting a Safety Sensor to the G9SX-LM□, use a TYPE3 or 4 Safety Sensor.
3) Use an enabling device, such as grip-switch, for Enable inputs (T11-T12, T21-T22)
4) Connect specified Proximity sensors to Rotation detection inputs (D11-D12, D21-D22)
5) Apply input signals to T31-T32 for manual reset, or T31-T33 for auto-reset, through the N.C. contact. (Refer to '5. Application Examples)
6) Be sure to connect A2 to ground.

7 Fault Detection

When G9SX-LM detects a fault, ERR indicator and/or other indicators light up or blink to show the information of the fault.
Check and take needed measures referring to the following table, and then apply supply voltage to G9SX-LM.

ERR indicator	Other indicators	Faults	Expected causes	Checking points and measures to take
◐ Blink	–	Fault by electro-magnetic disturbance or of internal circuits.	1) By excessive electro-magnetic disturbance 2) Failure of the parts of internal circuits	1) Check the disturbance level around G9SX-LM and its related system. 2) Replace with a new product.
● Light up	◐ T1 Blink	Fault involved with Enable input ch1.	1) Failure involving the wiring of Enable input ch1 2) Incorrect setting of Cross fault detection mode 3) Failure of the parts of the circuits of Enable input ch1	1) Check the wiring to T11 and T12. 2) Check the wiring to Y1. 3) Replace with a new product.
	◐ T2 Blink	Fault involved with Enable input ch2.	1) Failure involving the wiring of Enable input ch2 2) Incorrect setting of Cross fault detection mode 3) Failure of the parts of the circuits of Enable input ch2	1) Check the wiring to T21 and T22. 2) Check the wiring to Y1. 3) Replace with a new product.
	◐ T6 Blink	Fault involved with Safety input ch1.	1) Failure involving the wiring of Safety input ch1 2) Incorrect setting of Cross fault detection mode 3) Failure of the parts of the circuits of Safety input ch1	1) Check the wiring to T61 and T62. 2) Check the wiring to Y2. 3) Replace with a new product.
	◐ T7 Blink	Fault involved with Safety input ch2.	1) Failure involving the wiring of Safety input ch2 2) Incorrect setting of Cross fault detection mode 3) Failure of the parts of the circuits of Safety input ch2	1) Check the wiring to T71 and T72. 2) Check the wiring to Y2. 3) Replace with a new product.
	◐ FB Blink	Fault involved with Feedback/Reset input.	1) Failure involving the wiring of Feedback/Reset input. 2) Failure of the parts of the circuits of Feedback/Reset input	1) Check the wiring to T31, T32, and T33 2) Replace with a new product.
		Fault of Expansion units.	1) Improper feedback signals from Expansion units 2) Abnormal supply voltage to Expansion units 3) Failure of the parts of the circuits of Safety relay contact outputs	1) Check the connecting cable of Expansion units and the connection of the termination socket. 2) Check the supply voltage to Expansion units. * Make sure that all Expansion units' PWR indicators are lit. 3) Replace the Expansion unit with a new one.
	◐ EI Blink	Fault involved with Safety solid-state outputs or Logical connection outputs.	1) Failure involving the wiring of Safety solid-state outputs 2) Failure of the parts of the circuits of Safety solid-state outputs 3) Failure involving the wiring of Logical connection output 4) Failure of the parts of the circuits of Logical connection output 5) Impermissible high ambient temperature	1) Check the wiring to S14 and S24 2) Replace with a new product. 3) Check the wiring to L1. 4) Replace with a new product. 5) Check the ambient temperature and spacing around G9SX-LM.
	◐ ES Blink	Fault involved with Safety speed detection outputs.	1) Failure involving the wiring of Safety speed detection contact outputs 2) Incorrect set values of Low speed monitoring preset 3) Failure of the parts of the circuits of Off-delayed Safety relay contact outputs 4) Impermissible high ambient temperature	1) Check the wiring to ES1 and ES2. 2) Confirm the set values of the two of Low speed monitoring preset switches. 3) Replace with a new product. 4) Check the ambient temperature and spacing around G9SX-LM224-□.
	◐ DS Blink one for 2s	Fault involved with Rotation detection inputs.	1) Failure involving the wiring of Rotation detection inputs 2) Failure involving the setting of Proximity sensor 3) Failure of the parts of Proximity sensor 4) Failure of the parts of circuits of Rotation detection inputs	1) Check the wiring to D11, D12, D21, D22, ES1 and Proximity sensor. 2) Check the state of installation cogwheel and Proximity sensor. (Refer to "8. Shape of Cogwheel and Setting for Proximity Sensors".) 3) Replace with a new Proximity sensor 4) Replace with a new product.
	◐ DS Blink twice for 2s	Fault involved with Rotation detection inputs.	1) Overspeed of the rotator 2) Different input frequencies between the Proximity sensors 3) Failure of the parts of circuits of Rotation detection inputs	1) Check the motor. 2) Check the setting of the Proximity sensors and the cogwheel. (Refer to "8. Shape of Cogwheel and Setting for Proximity Sensors".) 3) Replace with a new product.
	◐ AND Blink	Fault involved with Logic AND connection input.	1) Failure involving the wiring of Logic AND connection input 2) Incorrect setting for Logic AND connection input 3) Failure of the parts of the circuits of Logical AND connection input	1) Check the wiring to T41 and T42 * Make sure that the wiring length for T41 and T42 terminals is less than 100 meters, respectively. * Make sure that the Logical AND connection signal is branched for less than 4 units. *Use VCTF cable or shielded cable for Logical AND connection between units. 2) Confirm the set value of the Logical AND connection preset switch. 3) Replace with a new product.
	◐ MOD Blink	Fault involved with Selector switch input.	1) Failure involving the wiring of mode select input 2) Failure of the parts of the circuits of mode select input 3) Failure involving the mode selector switching time	1) Check the wiring to M1 and M2. 2) Replace with a new product. 3) Check the time set for switching the Mode selector switch
	◐ The All (without PWR) indicators Blink	Supply voltage outside the rated value.	1) Supply voltage outside the rated value	1) Check the supply voltage to Expansion units.

When some indicators blink except ERR indicator, check and take needed actions referring to the following table.

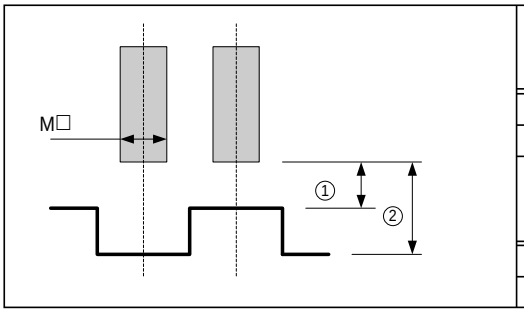
ERR indicator	The other indicators	Conditions	Expected causes of the faults	Expected causes of the faults
○ off	◐ T1 Blink or / and T2 Blink	Mismatch between Enable input ch1and Enable input ch2.	1) Safety Input status between Enable input ch1 and Enable input ch2 is different, due to contact failure or short circuit of safety input device(s) or any wiring fault.	1) Check the wiring from safety input devices to G9SX-LM. Or check the inputs sequence of Enable input devices. After removing the fault, turn both Enable inputs to OFF state.
○ off	◐ T6 Blink or / and T7 Blink	Mismatch between Safety input ch1 and Safety input ch2.	1) Safety Input status between Safety input ch1 and Safety input ch2 is different, due to contact failure or short circuit of safety input device(s) or any wiring fault.	1) Check the wiring from safety input devices to G9SX-LM. Or check the inputs sequence of safety input devices. After removing the fault, turn both safety inputs to OFF state.

Note 1. At the following, G9SX-LM□ diagnoses the proximity sensors. In that case, it is not abnormal though the operation indicator of the proximity sensor blinks.
- When the rotation of the cogwheel is stopping, and both proximity sensors are turning on.

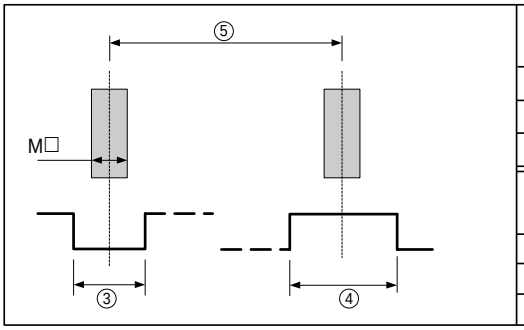
8 Shape of Cogwheel and Setting of Proximity Sensors

●Relationship between the cogwheel shape and the setting of proximity sensors

- For safe and stable detection of a rotating cogwheel, design of the cogwheel and setting of the proximity sensors should satisfy the following requirements.
  - Either one proximity sensor is turned ON.
  - If neither sensor has detected any movement for more than 1 second, G9SX-LM will detect it as an error.
  - All cogwheel tooth should be identically shaped.
  - The following tables show data for iron cogwheels.
  - For further details of the handling of proximity sensors, refer to the operation manual or related documents attached to the proximity sensors (E2E).
- Please connect two proximity sensors of the same type.
- While operation is stopped, consideration must be given so that the cogwheel and proximity sensor do not vibrate due to vibration of the device. Otherwise the proximity sensor may detect vibration of the cogwheel, resulting in the safety outputs of G9SX-LM□ being turned OFF. Take appropriate measures to keep vibration of the cogwheel at 1Hz max.
- At the following, G9SX-LM□ diagnoses the proximity sensors. In that case, it is not abnormal though the operation indicator of the proximity sensor blinks.
  - When the rotation of the cogwheel is stopping, and both proximity sensors are turning on.



Shielded	Size	M8	M12	M18
	Model	E2E-X1R5F1□	E2E-X2F1□	E2E-X5F1□
	Sensing distance	1.5mm	2mm	5mm
①	Distance of Convexity	1.2mm max	1.6mm max	4mm max
②	Distance of Concavity	4.5mm min	8mm min	20mm min
UnShielded	Size	M8	M12	M18
	Model	E2E-X2MF1□	E2E-X2F1□	E2E-X10MF1□
	Sensing distance	2mm	5mm	10mm
①	Distance of Convexity	1.6mm max	4mm max	8mm max
②	Distance of Concavity	8mm min	20mm min	40mm min



Shielded	Size	M8	M12	M18
	Model	E2E-X1R5F1□	E2E-X2F1□	E2E-X5F1□
③	Concavity Width	16mm min	24mm min	36mm min
④	Convexity Width	Concavity Width twice distance min/Concavity Width six distance max		
⑤	Sensing distance (*1)	15mm min	20mm min	35mm min
UnShielded	Size	M8	M12	M18
	Model	E2E-X2MF1□	E2E-X5MF1□	E2E-X10MF1□
③	Concavity Width	24mm min	30mm min	60mm min
④	Convexity Width	Concavity Width twice distance min/Concavity Width six distance max		
⑤	Sensing distance (*1)	60mm min	100mm min	110mm min

*1. It is a size when the proximity sensors are arranged in parallel.

●Relationship between Revolution (rpm) and Frequency

A frequency can be calculated from rpm, as shown in the equation below;

rpm x 1/60 x the number of cogwheel teeth detected by Proximity sensor = Frequency (Hz)

●Ex. Low-speed monitoring frequency

With a Low-speed rpm of 50 and 6 cogwheel teeth detected by Proximity sensor,

Frequency = 50 rpm x 1/60 x 6 = 5Hz

Be sure to set the Low-speed monitoring frequency to 6.0Hz or above, considering the accuracy tolerance of the Low-speed monitoring frequency (within 0 to -10%).

●Relationship between Motor, Cogwheel, and Hazard source.

The cogwheel should be attached to the shaft mechanically linking the motor to the hazard source.

The cogwheel should be placed between the motor and the hazard source.

OMRON

OMRON Corporation (Manufacturer)
Shiokoji Horikawa, Shimogyo-ku, Kyoto, 600-8530
JAPAN

OMRON EUROPE B.V. (Importer in EU)
Wegalaan 67-69, NL-2132 JD Hoofddorp
THE NETHERLANDS
PHONE: 31-2356-81-300 FAX: 31-2356-81-388

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.
PHONE: 1-847-843-7900 FAX: 1-847-843-7787

OMRON ASIA PACIFIC PTE. LTD.
438A Alexandra Road # 05-05/08,
Alexandra Technopark Singapore 119967
SINGAPORE
PHONE: 65-6-835-3011 FAX: 65-6-835-2711

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower, 200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
PHONE 86-21-5037-2222 FAX 86-21-5037-2200

Note: Specifications subject to change without notice.