Standstill Monitoring Unit
G9SX-SM

Sensor-less Monitoring of Standstill for Machines with Long Inertia

• Standstill is monitored by the motor’s back electromotive force (BEMF) signal.
• Features a “Standard Configuration”, allowing immediate use without sensitivity adjustment.
• “User Configuration” also available for fine-tuning of sensitivity.
• Detailed LED indications enable easy fault diagnosis.
• Safety Category 4 (EN954-1), PLe(ISO13849-1), SIL 3 (IEC/EN 62061) certified.

Be sure to read the “Precautions” on page 17.

Model Number Structure

Model Number Legend
G9SX-@@@@-@@

1. Functions
SM: Standstill Monitoring Unit
2. Output Configuration (Safety Outputs)
0: None
3. Output Configuration (Safety standstill detection outputs)
3: 3 outputs
4. Output Configuration (Auxiliary Outputs)
2: 2 outputs
5. Terminal block type
RT: Screw terminals
RC: Spring-cage terminals

List of Models

<table>
<thead>
<tr>
<th>Safety outputs</th>
<th>Safety standstill detection output</th>
<th>Auxiliary output</th>
<th>Rated voltage</th>
<th>Terminal block type</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
<td>3</td>
<td>2</td>
<td>24 VDC</td>
<td>Screw terminals</td>
<td>G9SX-SM032-RT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spring-cage terminals</td>
<td>G9SX-SM032-RC</td>
</tr>
</tbody>
</table>

Be sure to read the “Precautions” on page 17.
Specifications

Ratings

Power input

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated supply voltage</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Operating voltage range</td>
<td>-15% to 10% of rated supply voltage</td>
</tr>
<tr>
<td>Power consumption *</td>
<td>4 W max.</td>
</tr>
</tbody>
</table>

* Power consumption of loads not included.

Inputs

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated power supply voltage for AC induction motor</td>
<td>415 VAC max. (50/60 Hz)</td>
</tr>
<tr>
<td>Rated input voltage</td>
<td>Standstill detection input (between Z1 and Z2 and between Z3 and Z4) *1 480 VAC max. (120 Hz max.) *2</td>
</tr>
<tr>
<td>Internal impedance</td>
<td>Standstill detection input: Approx. 660 kΩ EDM input: Approx. 2.8 kΩ *3</td>
</tr>
</tbody>
</table>

*1. Input the motor phase-to-phase voltage between Z1 and Z2 and between Z3 and Z4.
*2. When a motor with AC240V or more is used, connect neutral point of the power supply to earth.
*3. Use a contact that is applicable to microloads (24 VDC, 5 mA) for connection to the EDM input.

Outputs

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<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety standstill detection output #1</td>
<td>Source output (PNP), load current: 0.3 A DC max. #2</td>
</tr>
<tr>
<td>Auxiliary output (output monitor/error)</td>
<td>Source output (PNP), load current: 100 mA DC max.</td>
</tr>
</tbody>
</table>

#1. While safety standstill detection outputs are in the ON state, the following pulse signal is output continuously for output circuit diagnosis.
When using the safety standstill detection outputs as input signals to control devices (i.e. Programmable Controllers), consider the pulse signal shown below.

<table>
<thead>
<tr>
<th>ON</th>
<th>Approx. 100 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>360 μs max</td>
</tr>
</tbody>
</table>

#2. The following derating is required when Units are mounted side-by-side.
G9SX-SM032-□: 0.2 A max. load current
Fault Detection
When the G9SX-SM detects a fault, the ERR indicator and/or other indicators light up or blink to inform the user about the fault. Take actions based on the table shown below. After the action, turn the power on again.

<table>
<thead>
<tr>
<th>EER indicator</th>
<th>Other indicator</th>
<th>Fault</th>
<th>Expected causes of the fault</th>
<th>Checking points and measures to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blink</td>
<td></td>
<td>Fault by electromagnetic disturbance or of internal circuits.</td>
<td>1) Excessive electromagnetic disturbance 2) Failure of the internal circuit</td>
<td>1) Check the disturbance level around G9SX-SM and its related system. 2) Replace with a new product.</td>
</tr>
<tr>
<td>CH1 blinks</td>
<td></td>
<td>Faults involved with Standstill detection input 1</td>
<td>1) Failure involving the wiring of standstill detection input 1</td>
<td>1) Check the wiring to Z1 and Z2. 2) Replace with a new product.</td>
</tr>
<tr>
<td>CH2 blinks</td>
<td></td>
<td>Faults involved with Standstill detection input 2</td>
<td>1) Failure involving the wiring of standstill detection input 2 2) Failure of the circuit of standstill detection input 2</td>
<td>1) Check the wiring to Z3 and Z4. 2) Replace with a new product.</td>
</tr>
<tr>
<td>EDM blinks</td>
<td></td>
<td>Faults involved with EDM input</td>
<td>1) Failure involving the wiring of EDM input 2) Failure of the circuit of the EDM input</td>
<td>1) Check the wiring to T31 and T32 2) Replace with a new product.</td>
</tr>
<tr>
<td>ES blinks</td>
<td></td>
<td>Faults involved with Safety Standstill detection outputs</td>
<td>1) Failure involving the wiring of Safety standstill detection outputs 2) Failure of the circuit of Safety standstill detection output 3) Impermissible high ambient temperature</td>
<td>1) Check the wiring to T31 and T32 2) Replace with a new product. 3) Check the ambient temperature and spacing around G9SX-SM.</td>
</tr>
<tr>
<td>SET blinks</td>
<td></td>
<td>Faults involved with Operation mode settings</td>
<td>1) Incorrect set values of Standstill determining time preset switches. 2) Failure of the circuit of mode settings</td>
<td>1) Check the set values of the two of Standstill determining time preset switches. 2) Replace with a new product.</td>
</tr>
</tbody>
</table>

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 G9SX units. |

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

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<th>Other indicator</th>
<th>Fault</th>
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</thead>
<tbody>
<tr>
<td>Light off</td>
<td>SET blinks</td>
<td>Tuning Mode operation</td>
<td>Operating Mode is in Tuning Mode of User Configuration.</td>
<td>Check if the Operation preset switch and the Mode preset switch on the back side are properly set. In the User Configuration Mode, safety standstill detection outputs will NOT be turned ON.</td>
</tr>
</tbody>
</table>

Dimensions and Terminal Arrangement
(unit: mm)

Note: Above outline drawing is for -RC terminal type.
### Characteristics

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<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>G9SX-SM032-RT (with screw terminals)</th>
</tr>
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<tbody>
<tr>
<td>Over-voltage category (IEC/EN 60664-1)</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>Response time (Standstill detection ON to OFF)</td>
<td>50 ms max.</td>
<td></td>
</tr>
<tr>
<td>Detection voltage (Standstill detection voltage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Configuration: 10 mV max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User Configuration: 100 mV max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON-state residual voltage</td>
<td>3.0 V max.</td>
<td></td>
</tr>
<tr>
<td>(Safety standstill detection outputs and auxiliary outputs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF-state leakage current</td>
<td>0.1 mA max.</td>
<td></td>
</tr>
<tr>
<td>(Safety standstill detection outputs and Auxiliary outputs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum cable length for standstill detection inputs and EDM inputs</td>
<td>100 m max.</td>
<td>(External connection impedance: 100 Ω max. and 10 nF max.)</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between standstill detection inputs (Z1,Z2⇔Z3,Z4)</td>
<td>100 MΩ min., 500 VDC megger</td>
<td></td>
</tr>
<tr>
<td>Between standstill detection input terminals connected together and output terminals connected together</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between all terminals without standstill detection input terminals connected together and DIN rail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dielectric strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between standstill detection inputs (Z1,Z2⇔Z3,Z4)</td>
<td>1,650 VAC for 1 min.</td>
<td></td>
</tr>
<tr>
<td>Between standstill detection input terminals connected together and Power supply input terminals and other input and output terminals connected together</td>
<td>2,200 VAC for 1 min.</td>
<td></td>
</tr>
<tr>
<td>Between all terminals without standstill detection input terminals connected together and DIN rail</td>
<td>500 VAC for 1 min.</td>
<td></td>
</tr>
<tr>
<td>Between standstill detection input terminals connected together and DIN rail</td>
<td>2,200 VAC for 1 min.</td>
<td></td>
</tr>
<tr>
<td>Vibration resistance Frequency: 10 to 55 to 10 Hz, 0.375-mm single amplitude (0.75-mm double amplitude)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical shock resistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destruction</td>
<td>300 m/s²</td>
<td></td>
</tr>
<tr>
<td>Malfunction</td>
<td>100 m/s²</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-10 to +55 °C (no icing or condensation)</td>
<td></td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>25% to 85%</td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td>Terminal block : IP20, Main body : IP40</td>
<td></td>
</tr>
<tr>
<td>Terminal tightening torque</td>
<td>0.6N·m</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 200 g</td>
<td></td>
</tr>
</tbody>
</table>

*For G9SX-SM032-RT (with screw terminals)*
Internal Connection

G9SX-SM032-□ (Standstill Monitoring Unit)

*1. Internal power supply circuit is not isolated.
*2. Standstill detection inputs are isolated respectively.
*3. The Safety standstill detection outputs, ES1 - ES3, are internally redundant respectively.

Wiring of inputs and outputs

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Terminal Name</th>
<th>Description of operation</th>
<th>Wiring</th>
</tr>
</thead>
</table>
| 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 plus to the A1 terminal.  
|                              |               |                                                                                        | Connect the power supply minus to the A2 terminal.                    |
| Standstill detection input 1 | Z1,Z2         | To turn on the Safety standstill detection outputs, both standstill detection inputs must be below the threshold voltage. Otherwise, Safety standstill detection outputs will NOT be turned ON. | Connect Z1 and Z2 to the motor lines respectively.                    |
| Standstill detection input 2 | Z3,Z4         |                                                                                        | Connect Z3 and Z4 to the motor lines respectively.                    |
| EDM input                    | T31,T32       | To turn on the 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                                             |
| Safety standstill detection  | ES1,ES2,ES3   | Turns ON/OFF according to the state of standstill detection inputs and EDM input.       | Keep these outputs Open when NOT used.                               |
| output                       |               |                                                                                        |                                                                      |
| Auxiliary output (Monitor)   | X1            | Outputs a signal while the motor is determined as in a standstill condition.             | Keep these outputs Open when NOT used.                               |
| Auxiliary output (Error)     | X2            | Turns ON when the error indicator is blinking or lit.                                    | Keep these outputs Open when NOT used.                               |

For short-circuit protection due to incorrect wiring, use a fuse that meets the following conditions:
Rated voltage: Motor supply voltage or more
Rated current: 1A max.
**Functions**

**Configuration and Mode**

Use the "Operation Preset switch" on the back side to select either Standard Configuration or User Configuration. The selected configuration mode is enabled at power-on. Normally, please use Standard Configuration which is set as factory default. If the standstill determining time is found too long in the Standard Configuration mode, switch to User Configuration and adjust the standstill determining time.

**Standard Configuration**

When G9SX-SM detects that the standstill detection input voltage is 10 mV or less, it will turn on safety standstill detection outputs, determining the motor is in a standstill condition.

In Standard Configuration, any settings with the Mode preset switch on the back of the unit and both of the Standstill determining time preset switches on the front and on the back of the unit are disabled.

**User Configuration**

When G9SX-SM detects that the standstill detection input voltage has been 100 mV or less for a predetermined standstill determining time or longer, it will turn ON safety standstill detection outputs, determining the motor is in a standstill condition.

In User Configuration, two modes are available: Tuning mode (TUN) and Monitoring Mode (MON). Either can be selected by setting the "Mode Preset switch". The selected mode is applied at power-on.

**Operation Preset switch/Mode Preset switch**

Use switches on the back side of the unit for operation preset and mode preset.

Manipulation of preset switches must be done while the power is off.

<table>
<thead>
<tr>
<th>Mode name</th>
<th>Function</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuning Mode</td>
<td>Use this mode to adjust the standstill determining time. This mode is only for adjusting the standstill determining time. ♦</td>
<td>To preset the standstill determining time, use the &quot;DET TIME switch (the standstill determining time preset switch)&quot; on the front side. Once the DET TIME setting is changed, the new setting immediately comes into effect on the system without having to perform a power cycle. When a standstill condition is detected, the auxiliary monitor output is turned ON and the ES Indicator is lit, but safety standstill detection outputs are NOT turned ON.</td>
</tr>
<tr>
<td>Monitoring Mode</td>
<td>Use this mode in normal operation after the Standstill determining time is fixed.</td>
<td>In this mode, G9SX-SM operation depends on the &quot;DET TIME switches (the standstill determining time preset switches)&quot;; one each on the front side and the back side. The DET TIME (standstill determining time) setting values come into effect at power on.</td>
</tr>
</tbody>
</table>

If the optimal standstill determining time is already known, the value can be applied to the Monitoring Mode, without having to use the Tuning Mode.

**Operation Preset switch/Mode Preset switch**

Use switches on the back side of the unit for operation preset and mode preset.

**Standstill Determining Time Preset Switch**

Presets the standstill determining time in User Configuration. Configuration is made through switches on the front and back side of the unit. Operation can be normal only if both switch values are the same. If the values are different, an error occurs.

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<td>Presets the standstill determining time in User Configuration</td>
<td>1/2/4/6/8/10/12/14/16/18/20/22/24/26/28/30 (Factory shipment)(s)</td>
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**Operation Preset switch/Mode Preset switch**

Use switches on the back side of the unit for operation preset and mode preset.

Manipulation of preset switches must be done while the power is off.

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</table>
G9SX-SM

Operation

Functions

**Standard Configuration**

"Standard Configuration" allows standstill detection without tuning sensitivity.

- Wire inputs and outputs
- Set the operation preset switch on the back side to "STD"
- Turn the power ON

Starting up under Standard Configuration

**User Configuration**

"User Configuration" allows manual tuning to adjust sensitivity. User Configuration has Tuning Mode to tune sensitivity and Monitoring Mode to detect the standstill condition.

1. **Start up under the Tuning Mode**
   - Wire inputs and outputs
   - Set the operation preset switch on the back side to "USR"
   - Set the mode preset switch on the back side to "TUN"
   - Turn the power on

Starting up under Tuning Mode

2. **Adjust sensitivity**

   Set the standstill determining time preset switch on the front side to 1 second and test the actual machine standstill timing t1 and t2 of ES indication (auxiliary output X1) turning on

   Timing t2 is ahead
   - NO
   - YES

   Use under the "Standard Configuration"

   Set the standstill determining time preset switch on the front side to the closest value to delta t (second), a time difference between t1 and t2, and test the timing again

   Machine stops before ES indicator (auxiliary output X1) turns ON
   - NO
   - YES

   Turn the power off and set the standstill determining time preset switch on the back side to the value set on the front side.

   Sensitivity tuning completed

3. **Monitor under the User Configuration**

   Set the operation preset switch on the back side to "USR"

   Set the mode preset switch on the back side to "TUN"

   Turn the power on

Starting up under Monitoring Mode

(NO)

YES

NOTES:

Machine stops before ES indicator (auxiliary output X1) turns ON

ES indicator turns ON

ES

Δt

Machine stops

STOP

Monitoring Mode

Standstill detecting time (second)

Usable range

0.5 to 5
LED Indicators

<table>
<thead>
<tr>
<th>Marking</th>
<th>Color</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWR</td>
<td>Green</td>
<td>Power supply indicator</td>
<td>Lights up while power is supplied.</td>
</tr>
<tr>
<td>EDM</td>
<td>Orange</td>
<td>EDM input indicator</td>
<td>Lights up while a HIGH state signal is input to T32. Blinks when error relating to EDM (External Device Monitoring) input occurs.</td>
</tr>
<tr>
<td>CH1</td>
<td>Orange</td>
<td>Standstill detection input ch1 indicator</td>
<td>Lights up while the standstill detection input voltage between Z1 and Z2 is below the threshold voltage. Blinks when an error relating to standstill detection input ch1 occurs. *</td>
</tr>
<tr>
<td>CH2</td>
<td>Orange</td>
<td>Standstill detection input ch2 indicator</td>
<td>Lights up while the standstill detection input voltage between Z3 and Z4 is below the threshold voltage. Blinks when an error relating to standstill detection input ch2 occurs. *</td>
</tr>
<tr>
<td>ES</td>
<td>Orange</td>
<td>Safety standstill detection output indicator</td>
<td>Lights up while the Safety standstill detection outputs (ES1, ES2, ES3) are in the ON-state. Blinks when an error relating to the Safety standstill detection input occurs. *</td>
</tr>
<tr>
<td>SET</td>
<td>Orange</td>
<td>Setting indicator</td>
<td>Depending on the status of operation preset switch and mode preset switch. See below for details. Standard Configuration: Turns OFF Tuning Mode in User Configuration: Blinks Monitoring Mode in User Configuration: Lights up Blinks when an error relating the selected configuration mode occurs. *</td>
</tr>
<tr>
<td>ERR</td>
<td>Red</td>
<td>Error indicator</td>
<td>Lights up or blinks depending on the occurring error *</td>
</tr>
</tbody>
</table>

* Refer to “Fault Detection” on the next page for details

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.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Item</th>
<th>Indicator status</th>
<th>Setting mode</th>
<th>Setting status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET</td>
<td>Standard/User Configuration</td>
<td>Not lit</td>
<td>Standard Configuration</td>
<td>STD</td>
</tr>
<tr>
<td></td>
<td>Light up</td>
<td>Setting mode</td>
<td></td>
<td>Setting status</td>
</tr>
</tbody>
</table>


Fault Detection
When the G9SX-SM detects a fault, the ERR indicator and/or other indicators light up or blink to inform the user about the fault. Take actions based on the table shown below. After the action, turn the power on again.

<table>
<thead>
<tr>
<th>EER indicator</th>
<th>Other indicator</th>
<th>Fault</th>
<th>Expected causes of the fault</th>
<th>Checking points and measures to take</th>
</tr>
</thead>
</table>
| Blink         | --             | Fault by electromagnetic disturbance or of internal circuits. | 1) Excessive electromagnetic disturbance  
2) Failure of the internal circuit | 1) Check the disturbance level around G9SX-SM and its related system.  
2) Replace with a new product. |
| CH1 blinks    |                | Faults involved with Standstill detection input 1 | 1) Failure involving the wiring of standstill detection input 1  
2) Failure of the circuit of standstill detection input 1 | 1) Check the wiring to Z1 and Z2.  
2) Replace with a new product. |
| CH2 blinks    |                | Faults involved with Standstill detection input 2 | 1) Failure involving the wiring of standstill detection input 2  
2) Failure of the circuit of standstill detection input 2 | 1) Check the wiring to Z3 and Z4.  
2) Replace with a new product. |
| EDM blinks    |                | Faults involved with EDM input | 1) Failure involving the wiring of EDM input  
2) Failure of the circuit of the EDM input | 1) Check the wiring to T31 and T32  
2) Replace with a new product. |
| ES blinks     |                | Faults involved with Safety Standstill detection outputs | 1) Failure involving the wiring of Safety standstill detection outputs  
2) Failure of the circuit of Safety standstill detection outputs  
3) Impermissible high ambient temperature | 1) Check the wiring to ES1, ES2 and ES3  
2) Replace with a new product.  
3) Check the ambient temperature and spacing around G9SX-SM. |
| SET blinks    |                | Faults involved with Operation mode settings | 1) Incorrect set values of Standstill determining time preset switches.  
2) Failure of the circuit of mode settings | 1) Check the set values of the two of Standstill determining time preset switches.  
2) Replace with a new product. |
| 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 G9SX units. |

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

<table>
<thead>
<tr>
<th>EER indicator</th>
<th>Other indicator</th>
<th>Fault</th>
<th>Expected causes of the fault</th>
<th>Checking points and measures to take</th>
</tr>
</thead>
</table>
| Light off     | SET blinks     | Tuning Mode operation | Operating Mode is in Tuning Mode of User Configuration. | Check if the Operation preset switch and the Mode preset switch on the back side are properly set.  
In the User Configuration Mode, safety standstill detection outputs will NOT be turned ON. |

Dimensions and Terminal Arrangement
(unit: mm)

Standstill Monitoring Unit
G9SX-SM032-

Terminal arrangement

Note: Above outline drawing is for -RC terminal type.
Application Examples

G9SX-SM032 (24 VDC) (3-phase Induction Motor) + G9SX-AD322-T15 (24 VDC)  
(Guard Lock Safety Door Switch, 2-channel Safety Limit Switch Inputs/Manual Reset)

**Note:** This circuit example is equivalent to Safety Category 4 (Stop Category 1).  
For details, see "Safety Category (EN954-1)."

For short-circuit protection due to incorrect wiring, use a fuse that meets the following conditions:
- Rated voltage: Motor supply voltage or more
- Rated current: 1A max.

---

**Timing Chart**

Guard-opened → closed  
Guard closed → opened

Guard Lock Safety Door Switch
- Safe limit switch S2
- Stop signal S3
- Reset switch S4
- Lock release switch S5

KM1, KM2: Contactor
M: 3-phase induction motor
G9SX-SM

G9SX-SM032 (24 VDC) (3-phase Induction Motor)  
+ G9SX-BC202 (24 VDC) (2-channel Emergency Stop Switch Inputs/Manual Reset)  
+ G9SX-GS226-T15 (24 VDC)  
(Guard Lock Safety Door Switch + 2-channel Safety Limit Switch Inputs/Manual Reset)

**Note:**  
1. This circuit example is equivalent to Safety Category 3 (Stop Category 2). For details, see "Safety Category (EN954-1)".  
2. Power for the inverter is cut when the motor rotation is detected in this system with a guard open. Its response time is an accumulation of G9SX-SM and G9SX-GS. Determine a safety distance to hazards in view of this response time.  
*For short-circuit protection due to incorrect wiring, use a fuse that meets the following conditions: Rated voltage: Motor supply voltage or more Rated current: 1A max.*
Timing Chart

Emergency Stop Switch S1

Reset switch S2

Guard opened → closed

Guard closed → opened

Guard Lock Safety, door Switch S3

Guard can be opened.

Safety Limit Switch S4

Logical AND connection input T41

Reset switch S5

KM1, KM2 NC contact

KM1, KM2 NO contact

Inverter operation (signal for motor)

Motor rotation

Inertial rotation condition

Standstill detection input 1 voltage

Standstill detection input 2 voltage

Lock release signal

Safety standstill detection output ES

Lock release switch S6
G9SX-SM032 (24 VDC) (3-phase Induction Motor with Star-Delta wiring)
+ G9SX-BC202 (24 VDC)
(Guard Lock Safety Door Switch + 2-channel Safety Limit Switch inputs/Manual Reset)

**Note:** This circuit example is equivalent to Safety Category 4 (Stop Category 0).
For details, see “Safety Category (EN954-1)”.
*For short-circuit protection due to incorrect wiring, use a fuse that meets the following conditions:
Rated voltage: Motor supply voltage or more
Rated current: 1A max.
## Operational procedure

### Standard Configuration

<table>
<thead>
<tr>
<th>Operation</th>
<th>LED indicator</th>
<th>Machine operation</th>
<th>ES output</th>
<th>X1 output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire inputs and outputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set the operation preset switch on the back side to &quot;STD&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Initial configuration display</strong></td>
<td>PWR EDM CH1 CH2 ES SET</td>
<td>Standstill</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td><strong>Monitoring starts</strong></td>
<td>PWR EDM CH1 CH2 ES SET</td>
<td></td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td><strong>Machine operation</strong></td>
<td>PWR EDM CH1 CH2 ES SET</td>
<td>Rotating</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td><strong>Decelerating</strong></td>
<td>PWR EDM CH1 CH2 ES SET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standstill</strong></td>
<td>PWR EDM CH1 CH2 ES SET</td>
<td></td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

**Note:** LED indication is based on wiring equivalent to safety category 4. For wiring equivalent to category 3, EDM lights up even during the machine operation.
# User Configuration

## Tuning Mode

<table>
<thead>
<tr>
<th>Operation</th>
<th>LED indicator</th>
<th>Machine operation</th>
<th>ES output</th>
<th>X1 output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire inputs and outputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set the operation preset switch on the back side to “USR”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set the mode preset switch on the back side to “TUN”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set the standstill determining time preset switch on the front side to 1 second</td>
<td></td>
<td>Standstill</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Initial configuration display

- **PWR**
- **EDM**
- **CH1**
- **CH2**
- **ES**
- **SET**
- **ERR**

### Tuning starts

- **PWR**
- **EDM**
- **CH1**
- **CH2**
- **ES**
- **SET**
- **ERR**

### Machine trial run

Rotation is detected and CH1/CH2/ES turn OFF (Auxiliary output X1 turns OFF)

- **PWR**
- **EDM**
- **CH1**
- **CH2**
- **ES**
- **SET**
- **ERR**

### Stop command

CH1/CH2/ES light up (Auxiliary output X1 turns ON)

- **PWR**
- **EDM**
- **CH1**
- **CH2**
- **ES**
- **SET**
- **ERR**

### Note

LED indication is based on wiring equivalent to safety category 4. For wiring equivalent to category 3, EDM lights up even during the machine operation.
## Tuning Mode (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>LED indicator</th>
<th>Machine operation</th>
<th>ES output</th>
<th>X1 output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the standstill determining time preset switch on the front side to T seconds</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Machine trial run</td>
<td>[Image of LED indicators: PWR, CH1, CH2, ES, EDM, SET]</td>
<td>[Image of machine rotating]</td>
<td>Rotating</td>
<td>OFF</td>
</tr>
<tr>
<td>Stop command</td>
<td>CH1/CH2 light up</td>
<td>[Image of LED indicators: PWR, CH1, CH2, ES, EDM, SET]</td>
<td>[Image of machine decelerating]</td>
<td>OFF</td>
</tr>
<tr>
<td>ES lights up (auxiliary output X1 is ON)</td>
<td>[Image of LED indicators: PWR, CH1, CH2, ES, EDM, SET]</td>
<td>[Image of machine standstill]</td>
<td>Standstill</td>
<td>--</td>
</tr>
</tbody>
</table>

If ES lights up before the machine comes to standstill, set a larger DET time and repeat the procedure from machine trial run to stop command.

**Note:** LED indication is based on wiring equivalent to safety category 4. For wiring equivalent to category 3, EDM lights up even during the machine operation.
## Monitoring Mode

<table>
<thead>
<tr>
<th>Operation</th>
<th>LED indicator</th>
<th>Machine operation</th>
<th>ES output</th>
<th>X1 output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the operation preset switch on the back side to “USR”</td>
<td>USR STD CONFIG</td>
<td>Set the standstill determining time preset switch on the back side to a setup value determined by the Tuning Mode</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Set the mode preset switch on the back side to “MON”</td>
<td>TUN MON MODE</td>
<td>--</td>
<td>Standstill</td>
<td>---</td>
</tr>
<tr>
<td>Initial configuration display</td>
<td></td>
<td></td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Monitoring starts</td>
<td></td>
<td></td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Machine operation Rotation is detected and ES turns OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop command CH1/CH2 light up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ES lights up after a specified DET time passed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** LED indication is based on wiring equivalent to safety category 4. For wiring equivalent to category 3, EDM lights up even during the machine operation.
Precautions

⚠️ 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-SM properly so that supply voltages or voltages for loads do NOT touch the safety inputs 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 loss of safety functions. Use devices appropriate for the application and the condition where G9SX-SM is used.

<table>
<thead>
<tr>
<th>Control Devices</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guard lock Safety-door Switch</td>
<td>Use certified devices with Direct Opening Mechanism complying with IEC/EN 60947-5-1. Use approved devices with Direct Opening Mechanism complying with IEC/EN 60947-5-1, mechanical lock type and capable of solenoid coil 24VDC, less than 300mA.</td>
</tr>
<tr>
<td>Safety Relay</td>
<td>Use certified devices with forcibly guided contacts complying with EN 50205. For feedback purpose use devices with contacts capable of switching micro loads of 24VDC, 5mA.</td>
</tr>
<tr>
<td>Contactor</td>
<td>Use contactors with forcibly guided mechanism to input the signal to Feedback/Reset input of G9SX-SM through the NC contact of the contactor. For feedback purpose use devices with contacts capable of switching micro loads of 24VDC, 5mA. Failure to open contacts of a contactor cannot be detected by monitoring its auxiliary NC contact without forcibly guided mechanism.</td>
</tr>
<tr>
<td>Other devices</td>
<td>Evaluate whether devices used are appropriate to satisfy the requirements of safety category level.</td>
</tr>
</tbody>
</table>

Precautions for Safe Use

1. Use G9SX-SM within an enclosure with IP54 protection or higher of IEC/EN60529.
2. Incorrect wiring may lead to loss of safety function. Wire conductors correctly and verify the operation of G9SX-SM before commissioning the system in which G9SX-SM is incorporated.
3. Do not apply DC voltages exceeding the rated voltages, or any AC voltages to the G9SX-SM power supply input.
4. Use DC supply satisfying requirements below to prevent electric shock.
   - DC power supply with double or reinforced insulation, for example, according to IED/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-SM inputs. Applying inappropriate voltages cause G9SX-SM to fail to perform its specified function, which leads to the loss of safety functions or damages to G9SX-SM.
6. Auxiliary error outputs and auxiliary monitoring outputs are NOT safety outputs. Do not use auxiliary outputs as any safety output. Such incorrect use causes loss of safety function of G9SX-SM and its relevant system.
7. After installation of G9SX-SM, 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.
8. A person in charge, who is familiar to the machine in which G9SX-SM is to be installed, should conduct and verify the installation.
9. G9SX-SM determines that motor stops when the standstill detection input voltage is predetermined value or less. According to the characteristic or load condition of motor, it may turn on safety detection outputs before motor stops completely. In that case, before operation, the qualified personnel should verify that risk of the rotation condition after output is acceptable.
10. Perform daily and 6-month inspections for the G9SX-SM. Otherwise, the system may fail to work properly, resulting in serious injury.
11. Do not dismantle, repair, or modify G9SX-SM. It may lead to loss of its safety functions.
12. 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.
13. OMRON shall not be responsible for conformity with any safety standards regarding to customer’s entire system.
14. Disconnect G9SX-SM from power supply when wiring, to prevent electric shock or unexpected operation.
15. Be cautious not to have your fingers caught when attaching terminal sockets to the plugs on G9SX-SM.
16. Do not use in combustible gases or explosive gases.
17. Driving voltage of the motor is impressed to the standstill detection inputs. Connect recommended fuse (1A Max.) and tighten the wirings by rated tightening torque to the standstill detection inputs.
1. Handle with care
   Do not drop G9SX-SM to the ground or expose to excessive vibration or mechanical shocks. G9SX-SM may be damaged and may not function properly.

2. Conditions of storage
   Do not store in such conditions stated below.
   a. In direct sunlight
   b. At ambient temperatures out of the range of -10 to 55°C.
   c. At relative humidity out of the range of 25% to 85% or under such temperature change that causes condensation.
   d. In corrosive or combustible gases
   e. With vibration or mechanical shocks out of the rated values.
   f. Under splashing of water, oil, chemicals
   g. In the atmosphere containing dust, saline or metal powder. G9SX-SM may be damaged and may not function properly.

3. Mounting
   Mount G9SX-SM 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-SM.
   Do not use G9SX-SM at altitudes over 1,000 meters.

4. Following spacing around G9SX should be available to apply rated current to outputs of G9SX-SM and for enough ventilation and wiring:
   a. At least 25 mm beside side faces of G9SX-SM.
   b. At least 50 mm above top face of G9SX-SM and below bottom face of G9SX-SM.

5. Wiring
   a. G9SX-SM032-
      • Use the following to wire to G9SX-SM.

<table>
<thead>
<tr>
<th>Solid wire</th>
<th>0.2 to 2.5mm² AWG24 to AWG12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stranded wire</td>
<td>0.2 to 2.5mm² AWG24 to AWG12</td>
</tr>
<tr>
<td>(Flexible wire)</td>
<td></td>
</tr>
</tbody>
</table>

   • Strip the cover of wire no longer than 7mm.
   • It is recommended that stranded wire should be terminated with insulation-covered bar terminal (0.25 to 2.5mm²) at its ends before using for connection.
   b. G9SX-SM-RT (with screw terminals)
      Tighten each screw with a specified torque of 0.5 to 0.6N·m, or the G9SX-SM may malfunction or generate heat.

6. Use cables with length less than 100m to connect to standstill detection Inputs and EDM input respectively.

7. Driving voltage of the motor is impressed to the standstill detection input and there is a possibility that a high level of noise is superimposed. The line of the standstill input must be separately installed from other signal lines.

8. Set the time duration of Standstill determining time to an appropriate value that does not cause the loss of safety function of system.

9. Tuning Mode in User Configuration is only for adjusting the Standstill determining time. In Tuning Mode, auxiliary monitor output is enabled however Safety standstill detection outputs are not enabled. After the tuning is complete, be sure to change from Tuning Mode to Monitoring Mode for actual operation.

10. Safety standstill detection outputs are only for controlling a guard lock safety-door switch with mechanical lock. They can not be used as safety outputs to drive contactors, or to control a guard lock safety-door switch with solenoid lock.

11. To determine safety distance to hazards, take into account the delay of safety standstill detection outputs caused by the response time.

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

13. G9SX-SM may malfunction due to electro-magnetic disturbances. Be sure to connect the terminal A2 to ground.

14. 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.

15. Devices connected to G9SX-SM may operate unexpectedly. When replacing G9SX-SM, disconnect it from power supply.

16. Adhesion of solvent such as alcohol, thinner, trichloroethane or gasoline on the product should be avoided. Such solvents make the marking on G9SX-SM illegible and cause deterioration of parts.
17. Connectable motor
   AC induction motors can be connected to the G9SX-SM.
   • Servo motors cannot be connected.
   • To use a motor with power specification of 240VAC or higher,
   ground the neutral point of the electrical supply.

18. G9SX-SM does not have motor fault detective function or motor protective function. For motor protection, use designated external protective devices.

19. For use with inverter
   The dynamic break setting time should be set to 30 seconds or shorter. Otherwise, the G9SX-SM may detect a disconnect fault of the wiring. Also in the following cases, the standstill detection function may not properly work even while the motor is in standstill.
   a. An inverter with a large output residual voltage is used, and the contactor connected in serial with the inverter is in the ON state.
   b. The inverter is executing the auto tuning function.

Safety Category (EN 954-1)
In the condition shown in Application Examples, G9SX can be used for the corresponding categories up to category 4. This does NOT mean that G9SX-SM can always be used for required category under all the similar conditions and situations.
Conformity to the categories must be assessed as a whole system. When using G9SX-SM for safety categories, be sure to confirm the conformity as a whole system.

Safety Category 4 (EN 954-1)
1) Connect a fuse to each of the Standstill detection input lines.
2) Provide signals of different phases for the Standstill detection inputs (Z1-Z2, Z3-Z4).
3) Connect Guard lock Safety-door switches to any one of Safety Standstill detection outputs: ES1, ES2 or ES3.
4) Input the signal through a NC contact of the contactor to EDM input T31-T32. (Refer to "Application Examples" on page 9.)
5) Be sure to connect A2 to ground.

Compliance with International Standards
G9SX-SM032
- Certified by TÜV-SUD
  EN954-1 Cat.4
  IEC/EN61508 SIL3
  IEC/EN62061 SIL3
  ISO13849-1 PLe
  EN1088
  EN50178
  IEC/EN60204-1
  IEC/EN61000-6-2
  IEC/EN61000-6-4
- Certified by UL
  UL508
  CAN/CSA C22.2 No.142
Terms and Conditions of Sale

1. Offer, Acceptance. These terms and conditions (these "Terms") are deemed part of every order placed, purchase, request for quotation, order acknowledgment, confirmations, catalogs, manuals, brochures and other documents, whether electronic or in written, and all purchases or shipments of products and/or services by Omron ("Omron"). Omron objects to any terms or conditions proposed in Buyer’s purchase order or other documents which are inconsistent with, or in addition to, these Terms.

2. Prices; Payment Terms. All prices stated are current, subject to change with or without notice by Omron for non-complying Product; (i) repair the non-complying Product, or (ii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for any warranty, repair, inspection expenses regarding the Products unless Omron’s analysis confirms that the Products were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for any delay or failure in delivery or in any way not made to Buyer. Omron Companies shall not be liable for any delay or failure in delivery resulting from causes beyond Omron’s control, including earthquakes, fires, floods, strikes or other labor disputes, shortage of labor or materials, accidents to machinery, acts of sabotage, riots, delay in or lack of transportation or the force majeure.

3. Shipping. Unless otherwise expressly agreed in writing by Omron:
   a. Shipment will be by a carrier selected by Omron; Omron will not drop ship (unless otherwise expressly agreed in writing by Omron) if Buyer object to any terms or conditions proposed in Buyer’s purchase order or other documents which are inconsistent with, or in addition to, these Terms.
   b. Such carrier shall act as the agent of Buyer and delivery to such carrier shall constitute delivery to Buyer.
   c. All sales and shipments of Products shall be FOB shipping point (unless otherwise stated in writing by Omron), at which point title and risk of loss shall pass from Omron to Buyer; provided that Omron shall retain a security interest in the Products until the full purchase price is paid;
   d. Delivery and shipping dates are estimates only; and
   e. Omron will package Products as it deems proper for protection against normal handling and extra charges apply to special conditions.

4. Commission or Other Sales Incentives. Any commission or other sales incentives paid by Omron to any agent or other party for selling or offering to sell Products to Buyer will be retained by Omron unless otherwise agreed in writing by Omron. Any such agreements will be evidenced in writing by Omron, signed by an authorized representative of Omron.

5. Customer Objectives. The Products are designed, built and marketed for the intended use as set forth in these Terms. Omron reserves the right to stop shipments or require satisfactory security for all outstanding orders, at its option, may charge Buyer 1-1/2% interest per month or any other rate allowed by law.

6. Governmental Approvals. Buyer shall not handle, store, install or maintain the Products in such a way that renders the Products unsuitable for their intended use. Buyer shall make all applicable governmental and other approvals and obtain all necessary licenses for the sale, distribution, use or handling of the Products.
Authorized Distributor:

**Automation Control Systems**
- Machine Automation Controllers (MAC)
- Programmable Controllers (PLC)
- Operator interfaces (HMI) - Distributed I/O - Software

**Drives & Motion Controls**
- Servo & AC Drives
- Motion Controllers & Encoders

**Temperature & Process Controllers**
- Single and Multi-loop Controllers

**Sensors & Vision**
- Proximity Sensors
- Photoelectric Sensors
- Fiber-Optic Sensors
- Amplified Photomicrosensors
- Measurement Sensors
- Ultrasonic Sensors
- Vision Sensors

**Industrial Components**
- RFID/Code Readers
- Relays
- Pushbuttons & Indicators
- Limit and Basic Switches
- Timers
- Counters
- Metering Devices
- Power Supplies

**Safety**
- Laser Scanners
- Safety Mats
- Edges and Bumpers
- Programmable Safety Controllers
- Light Curtains
- Safety Relays
- Safety Interlock Switches

Note: Specifications are subject to change.

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