Vol. 07  Conveyor System Utilizing Safety Observation Function

**Issues at production sites**

1. Safety measures in case of people entering in a restricted area
2. Ensuring safe speed for area where people works

**System Example**

**Application**
- Conveyor system
- Press-fit machine
- Press machine
- Print machine
- Vertical form, fill & seal
- Horizontal form, fill & seal

**PLC CPU**
- Q06UDEHCPU
- GOT 1000 series
- Main base unit: Q35DB

**Motion CPU**
- Q172DSCPU
- Safety signal module: Q173DSXY
- I/O module: QX40, QY40P

**Servo amplifier**
- MR-J4-B
- HG-SR

**Setup Procedure**

1. Safety Signal Wiring
2. System Structure Settings
3. Parameter Settings for Safety Observation Function

(Note 1) Motion controllers and servo amplifiers attain "Safety category 3, SIL2". Take an additional safety measure or consider applicability based on the risk analysis.

**Control Flow**

**Belt Conveyor Drive Axis 1**
- Car frames are moved on conveyor belt.
- Robots mount pane windows on cars.
- Speed Monitoring Function

**Belt Conveyor Drive Axis 2**
- Car frames are moved on conveyor belt.
- Workers mount seats inside of car frames.
- To the next conveyor line
- Speed Monitoring Function

**Issue 1**
- Shut-off Function

**Issue 2**
- Ensuring safe speed for area where people works

**Car Frames are moved on conveyor belt.**
**Robots mount pane windows on cars.**
**To the next conveyor line**

**Belt Conveyor Drive Axis 1**
- Car frames are moved on conveyor belt.
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**Belt Conveyor Drive Axis 2**
- Car frames are moved on conveyor belt.
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**Issue 1**
- Shut-off Function

**Issue 2**
- Ensuring safe speed for area where people works
Offering the Best Solution

Solution 1

Shut-off Function

Various Reliable Safety Systems Can Be Created with Multiple Safety Functions

System using “Safety signal comparison function” of Motion CPU

Each of the Motion and PLC CPU independently performs the safety monitoring functions at the same time (giving double CPU safety monitoring). Safety control can be combined with general control, which enables to create more flexible and simple safety systems. This is the best for a system monitoring multiple signals from safety monitoring equipment, such as forced stop buttons, light curtains, etc.

Safety Functions
- STO, SS1, SS2, SOS, SLS, SBC, SSM
- Specification of Q173DSXY Safety signal module

<table>
<thead>
<tr>
<th>Points</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input signal</td>
<td>20 points x 2 systems</td>
</tr>
<tr>
<td>Output signal</td>
<td>1 point x 2 systems</td>
</tr>
<tr>
<td></td>
<td>11 points x 2 systems</td>
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</tbody>
</table>

Solution 2

Speed Monitoring Function (SLS)

Securing Safe Speeds All the Time

This "Speed monitoring function" checks if the motor speed has exceeded the specified “Safety speed” or not. A safe operation speed can be ensured by comparing the feedback and command speed with the “Safety speed”. When an error occurs, the STO and SS1 functions shut off the power.

STO, SS1

- Specification of MR-J3-D05 Safety logic module

<table>
<thead>
<tr>
<th>Points</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input signal</td>
<td>2 points x 2 systems</td>
</tr>
<tr>
<td>Output signal</td>
<td>4 points x 2 systems</td>
</tr>
</tbody>
</table>

(Note-1): Two magnetic contactors are not required when STO function is used. However, in this diagram, one magnetic contactor is used to shut off the power at alarm occurrence.

STO

- Specification of MR-J4 Servo amplifier

<table>
<thead>
<tr>
<th>Points</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>Input signal</td>
<td>1 point x 2 systems</td>
</tr>
<tr>
<td>Output signal</td>
<td>1 point x 2 systems</td>
</tr>
</tbody>
</table>

(Note-1): Two magnetic contactors are not required when STO function is used. However, in this diagram, one magnetic contactor is used to shut off the power at alarm occurrence.
Setup Procedure

Step 1: Safety Signal Wiring

This diagram shows a wiring example of a safety system using a safety signal module. The light curtain signals are wired to the input terminals of the safety signal module, and the module's output terminals are to the STO terminal on the servo amplifier.

(Note) This example is compliant with EN ISO 13849-1 Category3 Pld.

Step 2: System Structure Settings

Set the servo amplifier and the servo motor on System Structure screen.

Step 3: Parameter Settings for Safety Observation Function

Set the Number of the safety signal modules, etc. with the Safety signal comparison parameter. Set the "Safety speed", Speed monitoring axis No., etc. with the Speed monitoring parameter.
## Advanced Features for World-class Safety

### Safety Standard

1. Amplifier + Motion controller "Safety Observation Function"
2. Amplifier only
3. Amplifier + Safety logic module "MR-J3-D05"

<table>
<thead>
<tr>
<th>Specifications</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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</thead>
<tbody>
<tr>
<td><strong>IEC61800-5-2 Safety standard</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe torque off (STO)</td>
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<tr>
<td>The STO function shuts off power to the motor electronically using the internal circuit by responding to the input signals (EM1) from external equipment. It shuts off through secondary-side output. This function corresponds to the Stop category 0 of IEC 60204-1.</td>
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<tr>
<td><strong>IEC61800-5-2 Safety standard</strong></td>
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<td></td>
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<tr>
<td>Safe stop 1 (SS1)</td>
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<tr>
<td>Responding to the input signals from external equipment (EM2), the SS1 function initiates the motor deceleration. After a required time delay for motor stop is passed, the SS1 function initiates the STO function. This function corresponds to the Stop category 1 of IEC 60204-1.</td>
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<tr>
<td><strong>IEC61800-5-2 Safety standard</strong></td>
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<tr>
<td>Safe stop 2 (SS2)</td>
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<tr>
<td>Responding to the input signals from external equipment (EM2), the SS2 function initiates the motor deceleration. After a required time delay for motor stop is passed, the SS2 function initiates the STO function. This function corresponds to the Stop category 2 of IEC 60204-1.</td>
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<tr>
<td><strong>IEC61800-5-2 Safety standard</strong></td>
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<tr>
<td>Safely-limited speed (SLS)</td>
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<tr>
<td>This function monitors the motor not to exceed the required speed limit. If the speed exceeds the limit, the motor power is shut off by the STO or SS1 function.</td>
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<tr>
<td><strong>IEC61800-5-2 Safety standard</strong></td>
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<tr>
<td>Safe speed monitor (SSM)</td>
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<tr>
<td>The SSM signal is outputted when the motor speed is below the specified speed limit.</td>
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<tr>
<td><strong>IEC61800-5-2 Safety standard</strong></td>
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<tr>
<td>Safe brake control (SBC)</td>
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<tr>
<td>This function outputs a safety output signal for external brake control.</td>
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**Solution**

Man, machine and environment in perfect harmony

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Specifications are subject to change without notice.