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electric**

Changes for the Better

Mitsubishi Safety Controller
Application Guide

for a greener tomorrow



Enhance the safety of your production lines.



MELSEC Safety

MITSUBISHI SAFETY FA SOLUTION

Safety + High speed

Compact

Module size of 22.5mm

Simple

Response performance of 8ms

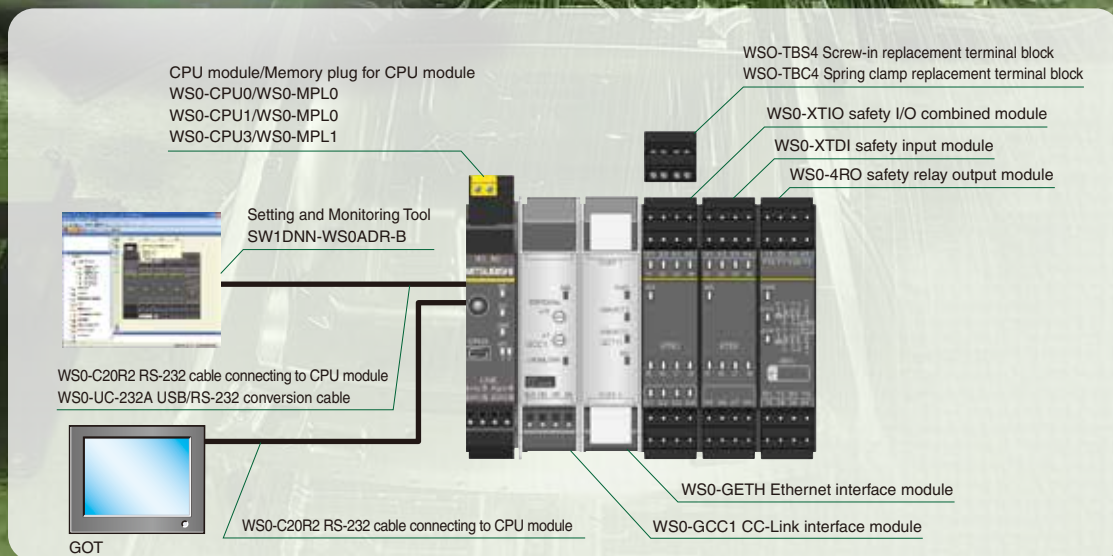
No need of complex wirings



Safety Controller MELSEC-WS series

This compact new safety controller complies with ISO13849-1 PLe and IEC61508 SIL3 safety standards. MELSEC-WS is designed to ensure safe operations of stand-alone machines or systems.

To meet your system configuration, it allows you to have up to an additional 144 I/O points. Also, the exclusive Setting and Monitoring Tool allow you to easily make settings and create logic.



Model nickname	Full model name	Description
WS0-CPU0	WS0-CPU000200	Program size: 255 FBs, Scan cycle: from 4 ms, Interface: RS-232
WS0-CPU1	WS0-CPU130202	EFI-equipped (EFI is the communication interface for setting and monitoring SICK's safety products.) Interface: RS-232
WS0-CPU3	WS0-CPU320202	EFI-equipped (EFI is the communication interface for setting SICK's safety products.) Flexi Link with EFI, Flexi Line with EFI, Interface: USB
WS0-MPL0	WS0-MPL000201	Memory plug for storing CPU parameters and programs (required)(for WS0-CPU0/WS0-CPU1)
WS0-MPL1	WS0-MPL100201	Memory plug or storing CPU parameters and programs (required)(for WS0-CPU3)
WS0-XTDI	WS0-XTDI80202	Safety input: 8-point single or 4-point dual-channel with spring clamp terminal block
WS0-XTIO	WS0-XTIO84202	Safety input: 8-point single or 4-point dual-channel, Safety output: 4-point single or 2-point dual-channel Output current: 2 A/point maximum, Spring clamp terminal block, Fast shut off response of 8 ms
WS0-4RO	WS0-4RO4002	Safety output: 2-point safety relay output-4-output 2 EDM contacts and 2 diagnostic outputs, Rated load current: 6 A/point maximum
WS0-C20R2	WS0-C20R2	RS-232 cable between PC and CPU module
WS0-C20M8U	WS0-C20M8U	USB/RS-232 cable for PC-CPU connection(2m)
WS0-UC-232A	WS0-UC-232A	USB/RS-232 conversion cable
WS0-GETH	WS0-GETH00200	Connecting to Ethernet communication (non-safe communication)
WS0-GCC1	WS0-GCC100202	Connecting to CC-Link communication (non-safe communication)
WS0-TBS4	WS0-TBS4	Screw-in replacement terminal block-4 terminal blocks included
WS0-TBC4	WS0-TBC4	Spring clamp replacement terminal block-4 terminal blocks included
SW1DNN-WS0ADR-B	SW1DNN-WS0ADR-B	MELSEC-WS Setting and Monitoring Tool

Product brochure



Mitsubishi Safety Controller MELSEC-WS Series

MELSEC Safety enables optimal safety control and improved productivity by "visualization" of safety information. Mitsubishi Electric provides a diversified product line up (safety programmable controllers, safety controllers, and safety relay modules) to meet your system configuration and create the optimal safety solution.

Mitsubishi factory automation technical information service

Some cases introduced in this guide can be watched in videos.



Introducing cases where MELSEC-WS series are used to solve safety tasks on devices and systems using each module and function blocks.

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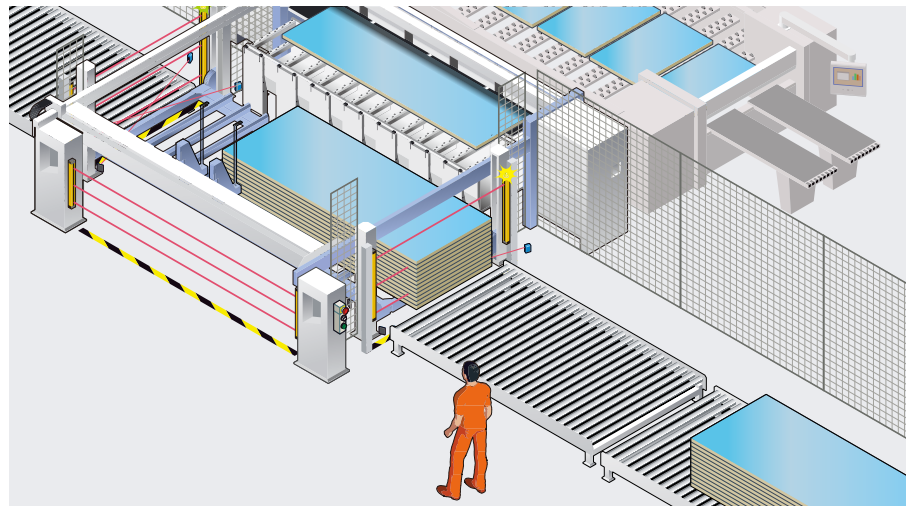
Material loading of a vertical

▶ Safety tasks

On a panel saw large panels out of wood and plastic get cut individual or as a package. The three entry points have to be protected because it is possible for a worker to enter the area of the saw. The access and exit, through which the panels automatically reach the machine to get cut, have to be protected. Thereby the controller has to detect if there are panels or a man entering the hazardous area. The accesses which are parallel to the conveyor belt have to be protected against unauthorised incidence while the going concern. Due to the high speed of the saw blade the trespass of the hazardous area would be especially dangerous. In case of an unauthorised switch off of the saw, a reset is required.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection
Industrial sector/branch	Wood, furniture
Applications/type of machine	Vertical panel saw
Safety functions	Differentiation between men and material (Muting), Emergency stop function



▶ Example of realization with safety controller

All three accesses to the machine are protected by a multiple beam safety light barrier. If a person or a subject reach the hazardous area, the machine switches off safely. Access to the entry and exit side of the saw's conveyor belt is additionally monitored by Muting. On either side two sensors which take over the muting are attached. There are two multiple beam safety light barrier located on each side as well, which are both connected to the main module of the safety controller MELSEC-WS via the EFI interface. If something else than a panel enters the hazardous area, the connected muting sensor give the information to the safety controller MELSEC-WS, which in turn shuts down the machine.

The controller detects, that there is no panel on the conveyor belt, but an object or a person, which isn't allowed to be there. The frontal access to the saw is protected by a multiple beam safety light barrier which is connected to the expansion module of the safety controller MELSEC-WS. Muting is not needed here, as nothing must enter the

machine from this side. In case of an shutdown of the saw, a manual reset on the control cabinet gets required.



▶ Advantages for users

- Space of the safety machine control area can be saved by using the safety controller MELSEC-WS.
- Downtime can be decreased with the muting function.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTIO

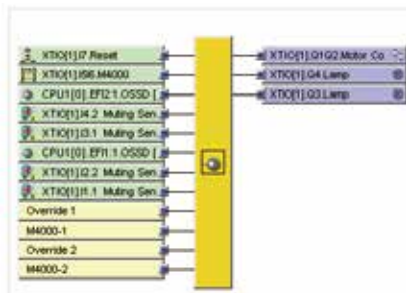
Hardware configuration



Used logic functions:

- NOT, AND, OR, EXOR
- Reset
- Switch On Delay
- Switch Off Delay
- Edge Detection
- 2 Sensor Muting
- RS Flipflop
- Interlock Monitoring

In/Out Summary Page





Automated guided system in a

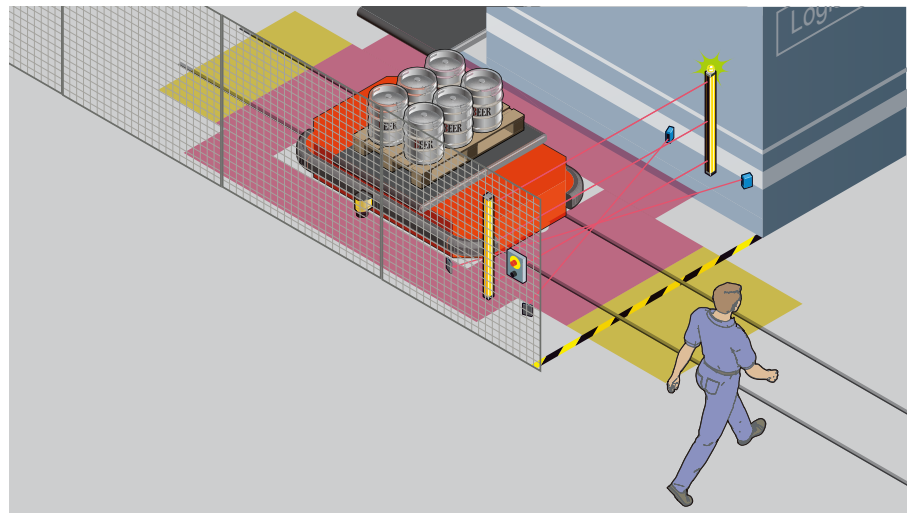
▶ Safety tasks

An automated guided vehicle (AGV) on rails transports pallets from the palletizer to the packaging machine. The area around the rails is constantly traversed by the workers. For this reason the use of a conveyor belt wouldn't be possible. To avoid a collision between the AGV and a worker or to eliminate the negligent use of the AGV as a personal means of transport, the AGV has to be protected.

If a worker climbs on the AGV, there must be a manual restart. Also the AGV has to stop, if any worker enters the hazardous area around the AGV. By leaving the hazardous area there will be a Restart after 2 sec, to avoid long downtimes. The palletizing machine and the packaging machine have also to be secured against unauthorized access.

▶ Application at a glance

The task	Safety automation, Hazardous area protection
Industrial sector/branch	Logistics
Applications/type of machine	AGV
Safety functions	Emergency stop function, Differentiation between men and material (Muting)



▶ Example of realization with safety controller

The hazardous area around the AGV is protected by two safety laser scanners, one on the left and one on the right side and two safety laser scanners, one at the front and one at the back side. The two safety laser scanners are connected to the safety controller MELSEC-WS by the EFI interface. The two safety laser scanners are connected to the expansion module of the safety controller MELSEC-WS.

The simultaneous protection field detection offers an extra level of safety for the workers. By entering the large protective field of the two safety laser scanners the AGV brought to a stop, however after two seconds there is an automatic Restart. If the smaller protection field of the two safety laser scanners is then interrupted, the AGV stops again but has to be restarted by a manual Reset as the worker is now too close to the AGV. To either side of the AGV, a protective field of the two safety laser scanners protects the area. No one can enter the AGV and thereby enter the machine without tripping a field. The protection

fields of the four safety laser scanners are active all the time, independent of which direction the AGV is heading. Finally, to stop the AGV in a hazardous situation there is an emergency stop push button on the AGV.

The protection of the entry to the palletizer is achieved through a separate the safety controller MELSEC-WS in conjunction with a multiple beam safety light barrier. Additional two sensors are installed with their reflectors for the muting.



▶ Advantages for users

- Protection field monitor with four safety laser scanners allows an automatic and manual Restart depending on the situation.
- Downtime of the AGV can be decreased with the automatic Restart.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTIO

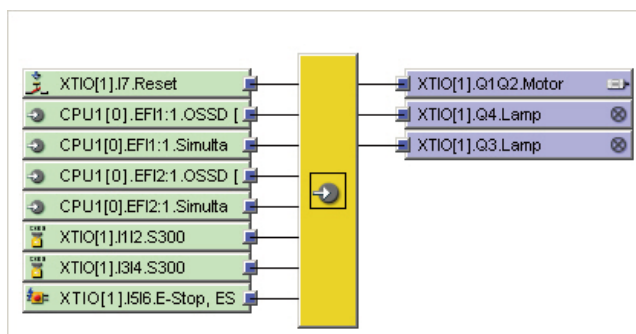
Hardware configuration



Used logic functions:

- NOT, AND
- Reset
- Switch On Delay

In/Out Summary Page





Leak detection at fuel tanks

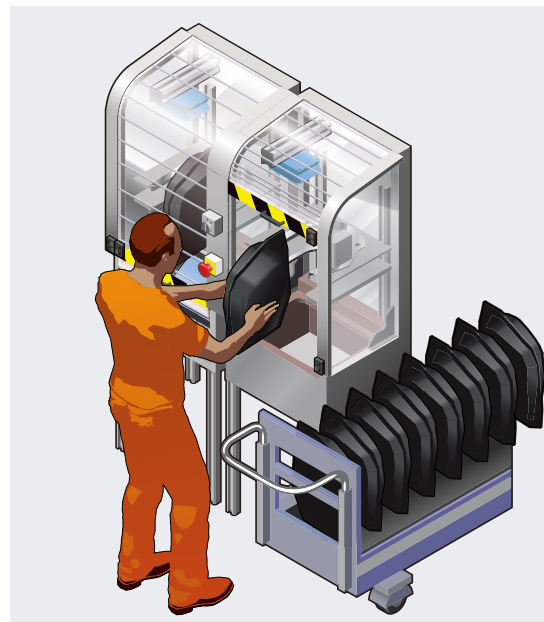
▶ Safety tasks

In the course of quality control, tanks are checked for leaks through a test machine fitted with two independent testing stations. The tanks are manually inserted into the test control unit. Faulty tanks should be detected and separated before the delivery. Therefore the tanks should be identified by a bar code scanner and afterwards checked for leaks. After a passed test, the tanks are labelled.

The unauthorized access during the current testing process should be secured by trap doors, which can only be opened when the machine is stopped. A service mode should be also possible if the doors are open. A manual stop of the machine must also be provided for a controlled stop.

▶ Application at a glance

The task	Safety automation, Hazardous area protection
Industrial sector/branch	Automotive & vehicle construction
Applications/type of machine	Leak detection at fuel tanks
Safety functions	Emergency stop function



▶ Example of realization with safety controller

Both trap doors are protected by one safety switch. In this way the testing process can only start if the doors are closed. The testing stations are controlled separately, so that the testing process can start only after one door is closed. Simultaneously, one can insert a new tank into the second testing place. If one door is opened, only the affected testing process stops.

In service mode, one enabling switch is located at each testing station. This switch provides a secured service mode of the machine and in the case of a hazardous situation stop the respective process station. By closing the trap doors afterwards, the testing process starts automatically.

Additionally, the machine is fitted with a dual-channel emergency stop pushbutton. It has to be pressed to stop of the entire machine in the case of a hazardous situation.

Therefore the emergency stop pushbutton is installed right in the middle of the two testing stations. If there is an emergency stop the machine, it starts again by pushing the designated Reset pushbutton. The safety controller MELSEC-WS collects the individual safety components and stops one or more parts of the machine depending on the hazardous situation.



▶ Advantages for users

- Safe maintenance mode is available by using an enabling switch.
- Parallel operation in two working areas becomes possible by dividing the test machine into two testing stations.

Used modules:

- CPU module
WS0-CPU0
- I/O modules
WS0-XTIO
WS0-XTDI
- Relay expansion module
WS0-4RO

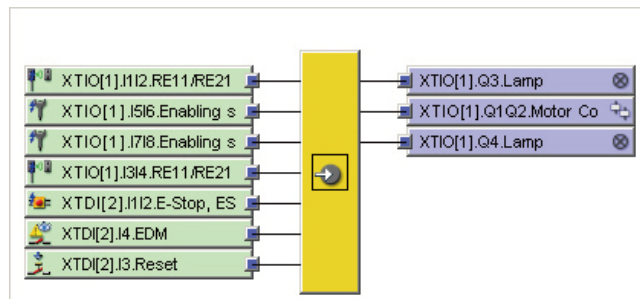
Hardware configuration



Used logic functions:

- OR
- Reset
- EDM

In/Out Summary Page





Double cell welding robot

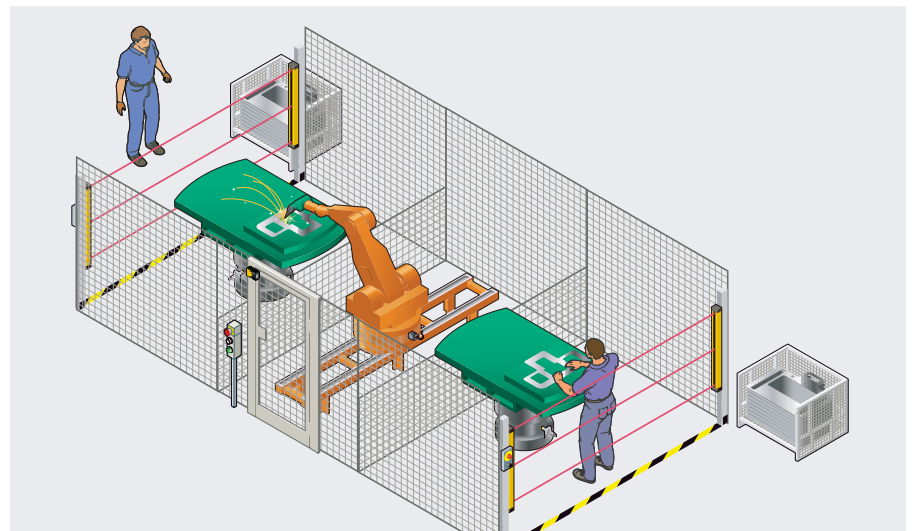
▶ Safety tasks

A double cell welding robot handles workpieces at two independent turntables. The access is protected by fences on the right and left side. In one fence there is a maintenance door. The operation is only possible if this door is closed.

The entry points by which the worker can access the turntable are always open. Hence, the finished welded pieces of metal can be removed and a new one inserted only if the arm of the robot is in the other cell. The turntable has to be in a safe position as well. Otherwise the robot must stop if someone enters this area. The cell in which the welding arm is working may not be entered. Additionally it should be possible to manually stop the robot in an hazardous situation.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection, Safe position monitoring
Industrial sector/branch	Metal & steel production
Applications/type of machine	Welding robot
Safety functions	Emergency stop function, Reset/ Restart, Safe position monitoring



▶ Example of realization with safety controller

The access through the maintenance door is secured by a safety switch. If the door is opened, the robot and the turntables stop. The entry points used to exchange material are monitored by multiple beam safety light barrier. Using two non-contact safety switches, the position of the centre of the robot is determined. Therefore an interruption of a particular entry point's multiple beam safety light barrier only stops the robot if the arm of the welding robot is in this area. The safe position of the each of the two turntables is detected by a non-contact safety switch. If the turntable and the robot are in a safe position, the worker can enter this area to change the part. All safety components are connected to the safety controller MELSEC-WS, which safely controls the machine. If there is a complete stop of the robot, the dangerous action of the turntable will also stop.

The switch-off signal is send directly from the safety

controller MELSEC-WS. After a complete stop, the Reset pushbutton has to be pushed to start the machine again. Additionally there is one emergency stop push button on each access and on each maintenance door which switches off the machine in a hazardous situation.



▶ Advantages for users

- Parallel operation in two working areas becomes possible.
- Reduced downtime minimizes the cycle time.
- Highest level of safety for the worker is provided through multiple protections.

Used modules:

- CPU module
WS0-CPU0
- I/O modules
WS0-XTIO
WS0-XTDI

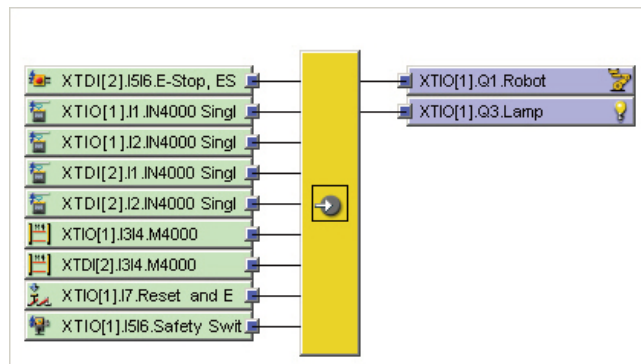
Hardware configuration



Used logic functions:

- AND, OR
- Reset

In/Out Summary Page





Stretch film winder

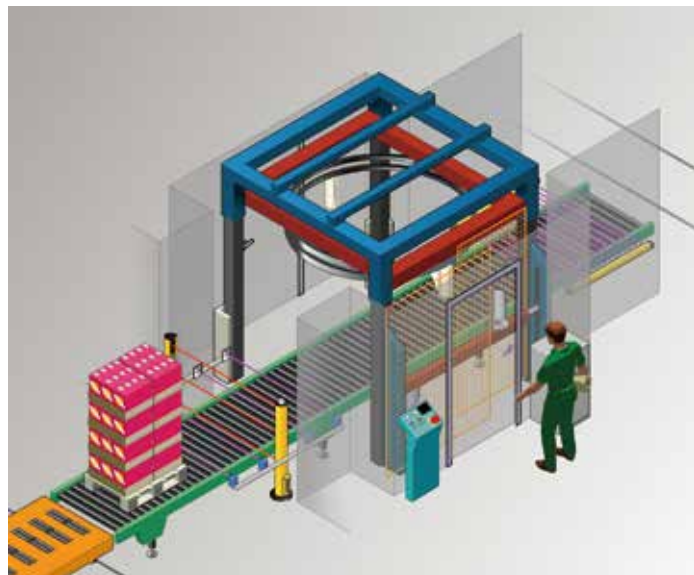
▶ Safety tasks

A high-performance thin film wrapper has to be protected against unauthorized access. The pallets reach the thin film wrapper by conveyor belt, where they are automatically wrapped by a thin stretch film. Finally, they are moved out of the machine and prepared for transport. At both ends of the machine it has to be assured that no worker can come into the winding area. This area is only accessible via two maintenance doors, one of which is used to reload the thin film.

If one of these doors is opened, or one of the accesses get entered by a worker, a reset is required. A manual stop of the wrapper by the worker must also be possible.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection
Industrial sector/branch	Packaging
Applications/type of machine	Stretch film winder
Safety functions	Differentiation between men and material (Muting), Emergency stop function, Integration of safe automation into control system on different network (Interface module), Reset/Restart



▶ Example of realization with safety controller

The access of the conveyor belt to the wrapper is protected using an multiple beam safety light barrier. Additionally there are muting sensors used to make sure that only loaded pallets can enter the machine. If a person enters, the connected the safety controller MELSEC-WS detects this different movement and shuts down the machine securely. The access by which the pallets leave the stretch film winder, is protected by a safety light curtain. It detects the pallets profile as it's leaving the thin film wrapper and shuts down the actuator if there is a different pattern. To change the thin film rolls, it is possible to entering a maintenance door which is protected by an safety door switch. If the front door is opened, the actuators of the film changing machinery are stopped, so that the change of the rolls isn't dangerous. If the back maintenance door is opened, the machine's wrapping motion stops immediately. After entering a reset is required in order to restart the

machine.

The Reset pushbuttons are on the control cabinet beside the maintenance door. There is also an emergency stop pushbutton on each side, through which a manual shut down of the machine is possible. All safety components are connected to the safety controller MELSEC-WS.



Advantages for users

- A control solution for compact and flexible safety machines is provided.
- Connection via the CC-Link interface module enables a remote state monitoring of safety machines.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTIO
- Interface module
WS0-GCC1

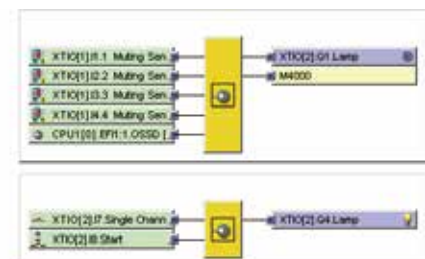
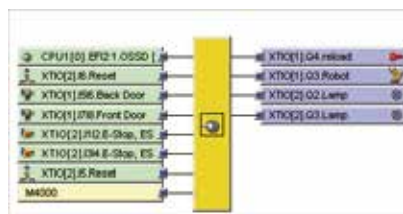
Hardware configuration



Used logic functions:

- AND
- Reset

In/Out Summary Page





Pneumatic press

▶ Safety tasks

On the pneumatical press one can choose three operating modes using an user mode switch: A two-hand mode, where the two-hand controller must be pushed during the entire cycle, a single-break mode, by which the press starts automatically after one entry into the press and a double-break mode, which starts after two entries into the press. In all three operating modes the worker must be protected from the press using a safety light curtain. For the initial start-up in two-hand mode, a reset is required. If somebody interrupts the press, the press stops and a reset is once more required. Additional there is a maintenance door, which is secured against unauthorized opening during the running of the press. After each switch-over into a new user mode, there must also be a reset required.

▶ Application at a glance

The task	Safety automation, Hazardous area protection
Industrial sector/branch	Machine tool
Applications/type of machine	Press
Safety functions	Control modes and operating mode selection, Emergency stop function, Machine controller, Reset/Restart, Safety locking function



▶ Example of realization with safety controller

The maintenance door is protected by a safety door switch and can only get opened, if the press is stopped. The frontal access to the press where the work pieces are inserted and removed is protected using a safety light curtain in all operating modes. The start of the press results from pushing the reset button on the control cabinet for single and double break mode. In two-hand mode the two-hand buttons must be pressed for the entire cycle. The safety controller MELSEC-WS takes over the connection and the controlling of all safety devices. In single-break mode, the press is activated by a reset for the first cycle, as it is in the double-break mode. By interrupting the safety light curtain either once or twice depending on the mode the cycle starts anew. In this case the safety controller MELSEC-WS detects how often and how long the light curtain is interrupted. In the case of active PSDI time

monitoring, the maximum duration of an entire PSDI is limited to 30 sec. The safety controller MELSEC-WS stops the press upon unexpected access and a Reset is necessary. An access during the press cycle stops it directly. Additionally, the main valve and the remaining valves are controlled by the safety controller MELSEC-WS and the movement of the press as well. Finally, an emergency stop pushbutton is installed outside the press which shuts down and switches it off in case of a hazardous situation.



Advantages for users

- Safety functions related to the press devices can be easily realized by using the press device prepared for the safety controller setting and monitor tool.

Used modules:

- CPU module
WS0-CPU0
- I/O modules
WS0-XTIO

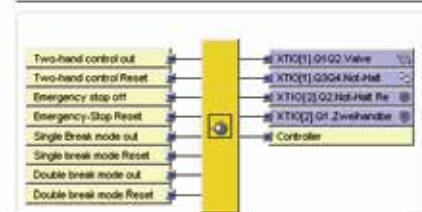
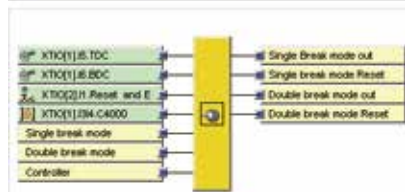
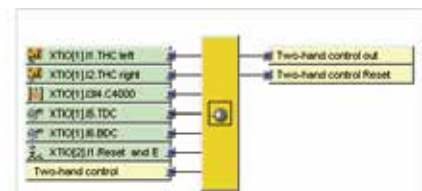
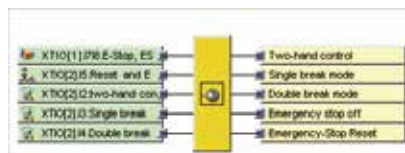
Hardware configuration



Used logic functions:

- OR
- Reset
- Two Hand Control(Type IIIA)
- User Mode Switch
- Press Single Stroke
- Break Mode

In/Out Summary Page





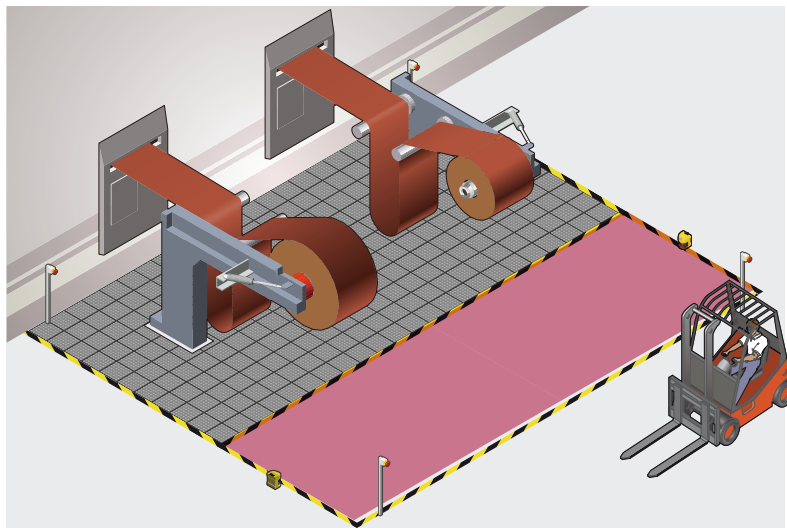
Tyre fabric winder

▶ Safety tasks

At a automotive supplier, freshly manufactured textil material is made using flow presses. The material is spooled on two rolls at the end of the machine. This material will be used to produce tires afterwards, where it will be combined with rubber. The rolls rotate slowly and take up the material. The hazard for the workers is that they can become caught up in a roll and trapped. If the rolls are full, they are rotated 90° so that they can be removed by a forklift. Afterwards a new roll can be placed there again. The hazardous rotating movement can hurt a worker and therefore access must be protected.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection
Industrial sector/branch	Automotive & vehicle construction
Applications/type of machine	Tyre fabric winder
Safety functions	Emergency stop function, Reset/Restart



▶ Example of realization with safety controller

Depending on the progress the material isn't produced at a constant rate. However the rolls rotate at a constant speed. This causes some fabric fibres to fall to the ground. This situation shouldn't be result in a shut down. The monitoring of the area is only possible via three safety mats. Due to the light weight of the fabric they won't activate the mat. The weight of a worker in contrast would activate the mat directly if he entered this area. In this case both rolls stop. Afterwards a manual restart is required from outside this area to restart both rolls. The removal area in which the forklift accepts the rolls is protected by two safety laser scanners which make sure that no worker is inside when the full rolls are removed. Additionally there are four emergency stop pushbuttons that stop the roll actuators manually. These and all other safety components are connected to the safety controller MELSEC-WS.



Advantages for users

- A smooth operation process without unexpected interruptions can be realized.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTIO

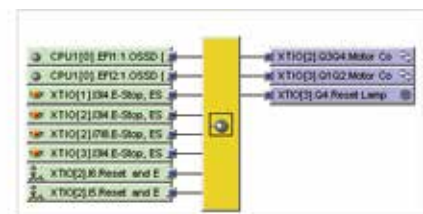
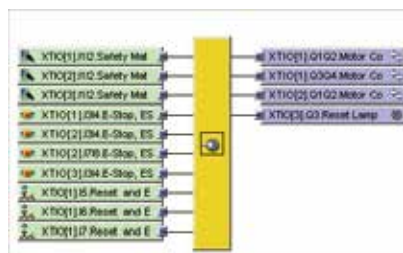
Hardware configuration



Used logic functions:

- OR
- Reset

In/Out Summary Page





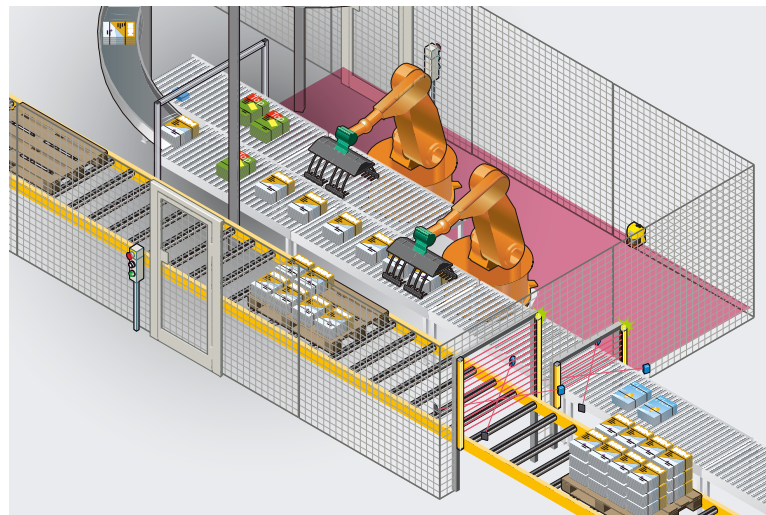
Newspaper palletizer

▶ Safety tasks

In a robot cell, two robots arrange and palletize newspaper packages which enter the cell by conveyor belt. The packages are identified by a bar code scanner and either stacked on assigned pallets afterwards or, if they couldn't get detected, sorted out by a robot. The rejected and the palletized packages leave the cell by a conveyor belt. These two accesses have to be secured, so that no worker can enter the cell through these accesses. Additional there are two maintenance doors which have to be secured against unauthorized access while the machine is running. Finally, the space in the cell behind the robot has to be secured so that no worker can enter the working space of the robot above the fences around the cell.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection
Industrial sector/branch	Print & paper
Applications/type of machine	Newspaper palletizer
Safety functions	Differentiation between men and material (Muting), Emergency stop function, Reset/Restart, Safety locking function



▶ Example of realization with safety controller

Both exits, through which the newspaper pallets or the sorted out packages leave the cell via conveyor belt, are each guarded by a safety light curtain. Both have two reflex muting sensors which allow newspapers but not workers through. The two maintenance doors are secured using a safety door switch. The access is only possible if both robots and the conveyor belts are switched off. Once this occurs, an entry button at the door can be pushed to unlock the interlock. Next to each of the doors there is an emergency stop pushbutton which causes the complete robot cell to switch off such that no hazardous situation possible. All safety components are connected to the safety controller MELSEC-WS. The safety laser scanner is connected to this safety controller MELSEC-WS and is used to monitor the free space behind the robots in the robot cell. It is excluded that a worker might enter the cell by the conveyor belt, which delivers the newspaper packages from above. If the two robots and the conveyor belts get shut down, a reset is required. The reset buttons

are installed next to the emergency stop pushbuttons.



Advantages for users

- Implementation of the safety controller MELSEC-WS in which the complex safety control logic can be executed avoids unnecessary down times and enhances the productivity.

Used modules:

- CPU module
WS0-CPU0
- I/O modules
WS0-XTIO

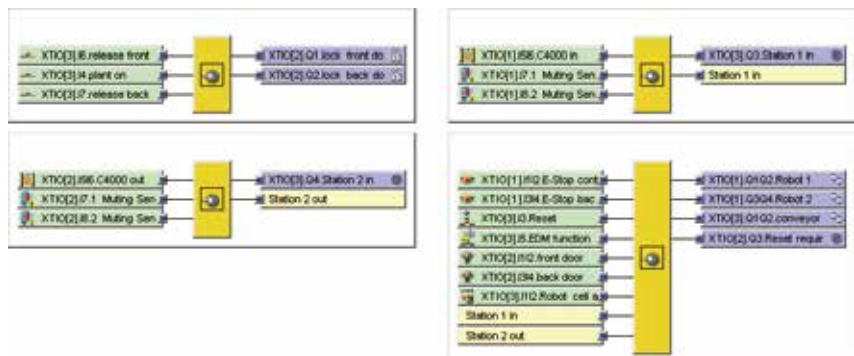
Hardware configuration



Used logic functions:

- OR
- Reset
- EDM
- Routing 1:N
- Switch Off Delay
- 2 Sensor Muting

In/Out Summary Page





Pop-up press

▶ Safety tasks

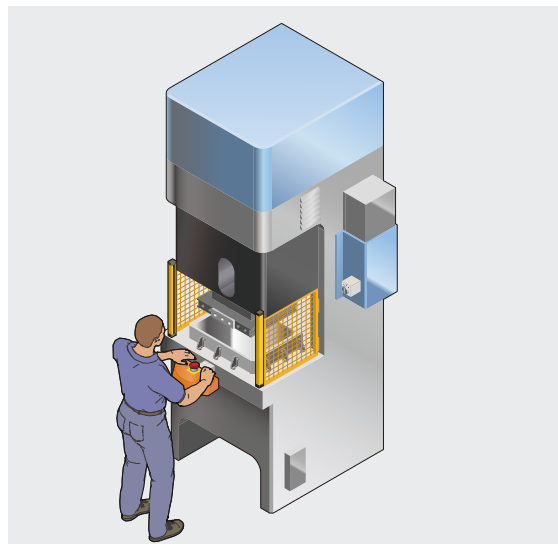
A press which produces engine parts should be secured in such a way that the dangerous movement stops if somebody enters the press.

The press handles five operating modes. Single stroke, in which a press cycle is initiated by a twohand control and the service mode, in which the press get step by step moved by the two-hand push button. Additional to these two there are a single-break mode and a doublebreak mode, in which the next press cycle is initiated by reaching into the press once or twice. Finally, there is an auto mode in which the press is started by the pushing of a reset button and is stopped only when requested.

In all five operating modes the security of the workers has to be assured as the press works with a pressure up to 80 tons.

▶ Application at a glance

The task	Safety automation, Hazardous area protection
Industrial sector/branch	Machine tool
Applications/type of machine	Press
Safety functions	Control modes and operating mode selection, Emergency stop function, Machine controller, Reset/Restart



▶ Example of realization with safety controller

To control the press process the safety controller MELSEC-WS is used. A safety light curtain is connected to this safety controller MELSEC-WS which is installed directly on the front of the press where the worker accesses it. It stops the press safely in each operating mode if there is an access to the Pop-up press. In the single and double-break mode The safety light curtain is additionally used to start the press cycle in single- and double-break mode if someone reaches into the press one or two times respectively. Therefore nothing can be inside the protecting area of the press. Additionally, the safety light curtain detects if there is an unexpected access and stops the press. To shut down the press in a hazardous case an emergency stop pushbutton is installed on the press. This and the two-hand pushbutton, which is used in the operating modes press single stroke, service mode and auto mode to control the press, are also connected to the safety controller MELSEC-WS. To start the press there is always a reset

required. The reset is also required after each operating mode switch or after a shut down of the press. This reset pushbutton is mounted on the control cabinet



Advantages for users

- Inside the safety controller MELSEC-WS the logic of all operating modes is implemented using preconfigured press logic blocks

Used modules:

- CPU module
WS0-CPU0
- I/O modules
WS0-XTIO

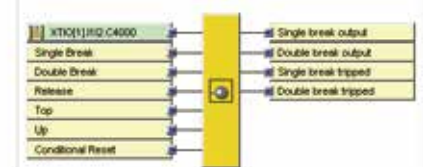
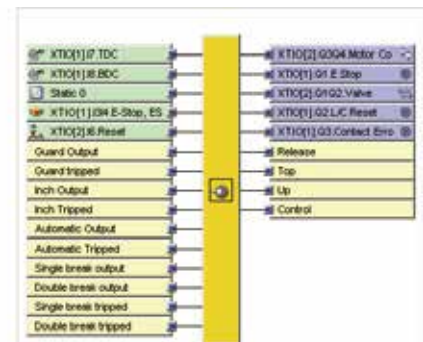
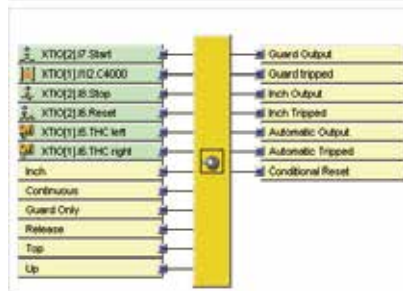
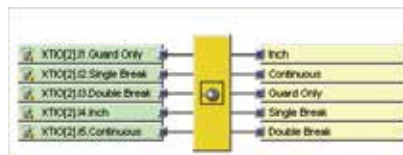
Hardware configuration



Used logic functions:

- AND, OR
- Reset
- User Mode Switch
- Universal Press Contact
- Two Hand Control(Type IIIA)
- Clock Generator
- Press Single Stroke
- Press Set Up Mode
- Break Mode

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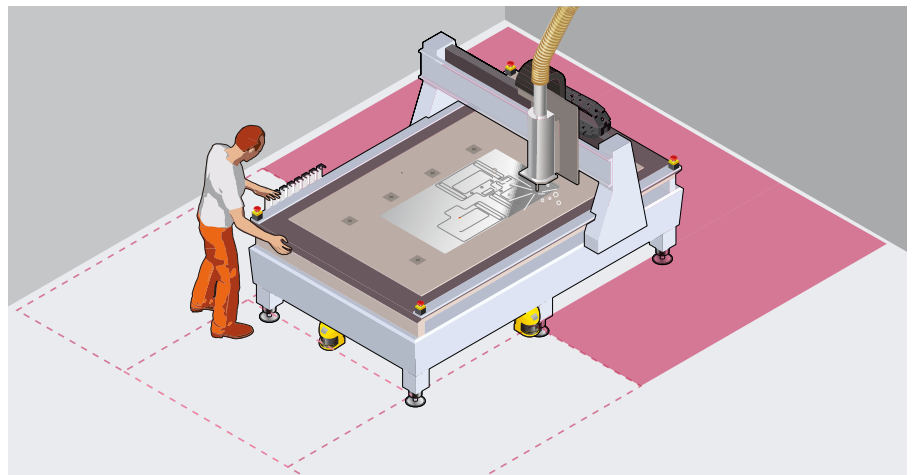
Metal plate milling machine

▶ Safety tasks

On a universal milling machine big metal plates are horizontally milled. Because the milling station is freely accessible and moveable, it has to be assured that no worker can be next to the milling head during a milling process. At the same time there has to be the possibility for the workers to check the engaged workpiece without stopping the milling process. Therefore the milling machine has to be separated into two areas. Additional there has to be the possibility to shut down the machine manually in a dangerous situation. The safety components have to be integrated into the machine controller, so that the status of the single components is available all the time.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection, Safe position monitoring
Industrial sector/branch	Metal & steel production
Applications/type of machine	Milling machine
Safety functions	Emergency stop function, Integration of safe automation into control system on different network (Interface module), Safe position monitoring



▶ Example of realization with safety controller

The milling machine is separated into two areas, right and left. If the milling head is inside of one of these areas, the access to the other area has to be possible without shutting down the milling process. Therefore the position of the milling head gets detected by a non-contact safety switch. During the position detection it's assured that the access to one of the areas is possible, if the milling head is inside the other one. The complete access area round the machine is monitored by four safety laser scanners, which are installed in the middle of each side right above the bottom. The safety laser scanners, the safety switches and four emergency stop pushbuttons, which are installed at each angle, are connected to the safety controller MELSEC-WS. Using the emergency stop pushbuttons there is always the possibility to manually initiate a safe shut down of the milling machine. If an emergency stop is activated by one of the components, a reset is required to start the machine again. The restart button is on the control cabinet of the machine. The safety controller MELSEC-WS is connected to the machine's automation controller as well via a

CC-Link Interface module, so that all states of the single components can be monitored.



Safety Controller Application Guide

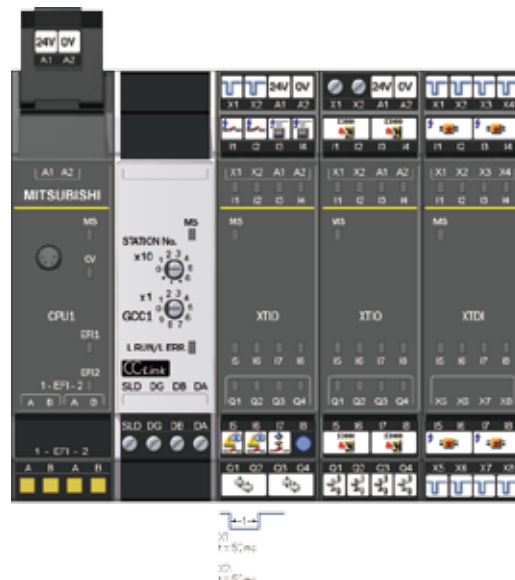
Advantages for users

- Productivity will be enhanced by using two protection fields, which are monitored by the safety controller MELSEC-WS.
- Monitoring screens and others will be integrated by transmitting the information of the safety controller side to the existing programmable controller for machine control via interface module.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTIO
WS0-XTDI
- Interface module
WS0-GCC1

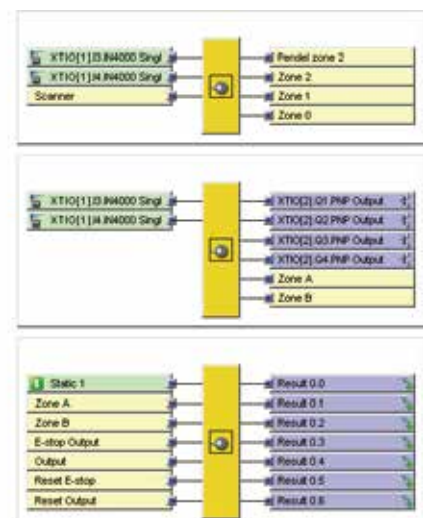
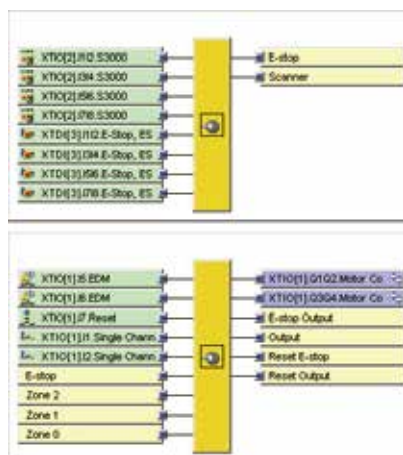
Hardware configuration



Used logic functions:

- AND, OR, NOT
- Reset
- EDM
- Routing N:N

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Test machine for computer

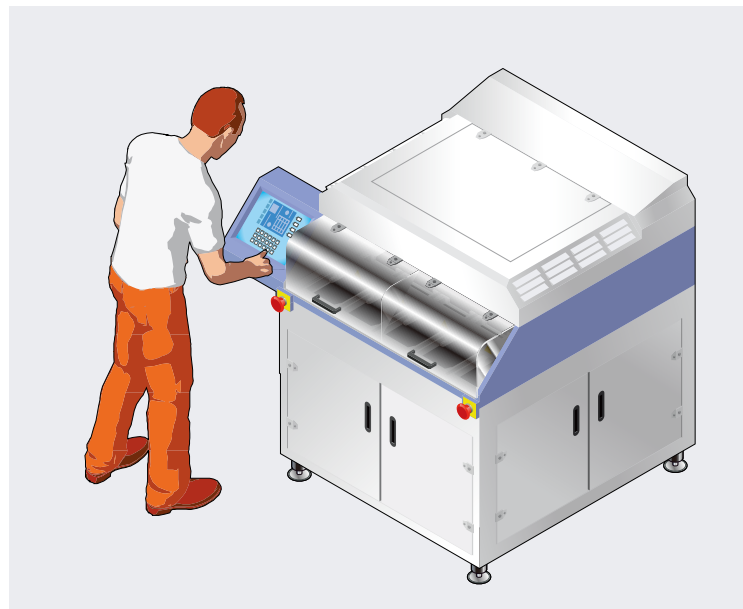
▶ Safety tasks

A machine used for testing computer chips's thermal properties should be secured against the hazard of the unauthorized opening of maintenance doors during the testing process and protecting the worker during load and unload of groups of chips. The machine is separated into two areas, the loading area and the process or thermal testing area.

In the loading area the chips get inserted or extracted. From there they are transported to the process area, where they get tested for their thermal characteristics for three different temperatures. Both areas are secured by loading or service doors. By opening one of these maintenance doors or by pushing the emergency stop pushbutton a shut down of the machine should follow to protect man and machine. The loading area only switches off the transport mechanism. The state of each door (open/ closed) should be monitored individually.

▶ Application at a glance

The task	Safety automation, Hazardous area protection
Industrial sector/branch	Electronics
Applications/type of machine	Chip testing machine
Safety functions	Emergency stop function, Integration of safe automation into control system on different network (Interface module), Safety locking function



▶ Example of realization with safety controller

The hazardous area of the transporting units inside the machine is already covered by doors. The machine is separated into the loading and the testing area, which are separated procedurally and secured by four doors. A safety switch is installed at each of the eight doors.

By opening one door of the testing area both parts of the machine stop. However, if a door of the loading area gets opened, only the hazardous transporting movements of the loading area stop. The test continues as switching off this area is time intensive and cannot be reached from the loading area.

Additionally two emergency stop pushbuttons are installed to the machine. These stop the machine manually in a hazardous situation. The connection and control of the safety components is taken over by the safety controller MELSEC-WS.

The information of the states of the machine is forwarded via an Ethernet Interface module and can get evaluated this way. In this way one can monitor the status of each door and generate a reset signal using the HMI.



▶ Advantages for users

- The operation status of each safety device can be transmitted to other machines via Ethernet interface module.
- Downtime will be reduced by separating the machine into areas.

Used modules:

- CPU module
WS0-CPU0
- I/O modules
WS0-XTIO
- Interface module
WS0-GETH

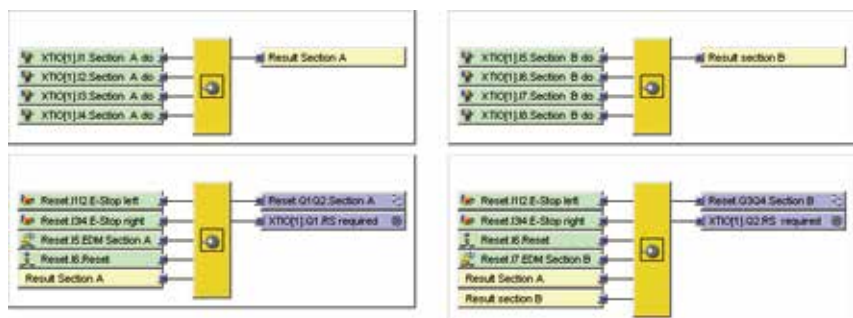
Hardware configuration



Used logic functions:

- AND
- Reset
- EDM

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Robot cell for kitchen door

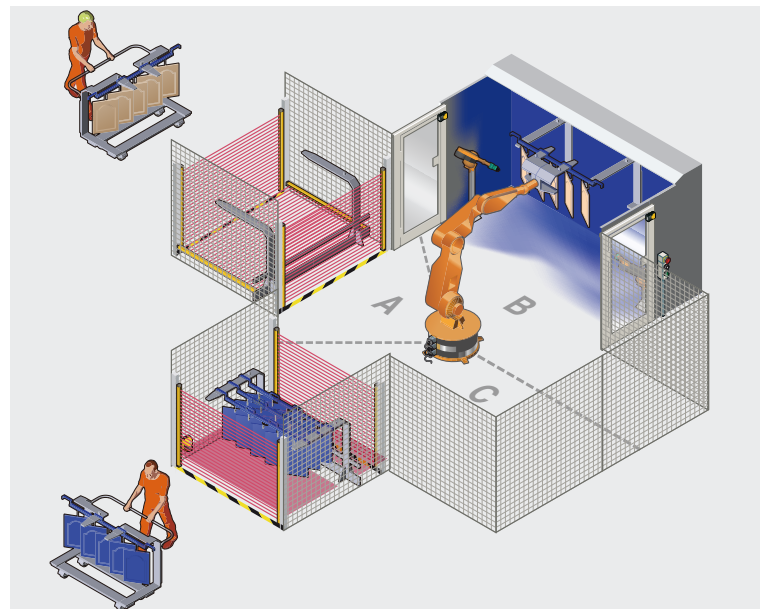
▶ Safety tasks

A robot cell for kitchen door lacquering is separated into three areas, the material loading, the lacquering area and the material unloading. The lacquering area is accessible by two locked maintenance doors. The material loading and the unloading area can be accessed by workers.

The rest of the machine is secured by fences. As long as the robot arm is not in the material loading area, this area is freely accessible for the workers. The same is true for the unloading area. The lacquering area cannot be accessed at any time unless the machine is securely shut down.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection, Safe position monitoring
Industrial sector/branch	Wood / furniture
Applications/type of machine	Lacquering robot
Safety functions	Emergency stop function, Safe position monitoring



▶ Example of realization with safety controller

The position monitoring of the robot arm is monitored by three non-contact safety switches. Both doors are barred by a safety switch and can only be unlocked if the robot has stopped. In addition there are four emergency stop pushbuttons located at the access to the robot cell, one on each service panel to stop the robot in a hazardous case.

The material loading is secured by two safety light curtains, one at the beginning and the end of this area, as well as a multiple beam safety light barrier, which is installed horizontal at the lower area and is used as an area guarding. If the robot arm is inside this area, the activation of the first light curtain or of the multiple beam safety light barrier cause to a shut down. If it is in one of the other areas, the light curtain boarding area A secures the area around the robot. The unloading area is secured in similar fashion, except

that multiple beam safety light barrier is replaced by two laser scanners as because this area is separated into two separate monitoring zones. The zone nearest to the robot is always enabled, the other one is switched on as needed. All safety components are connected to the safety controller MELSEC-WS, which shuts down the robot in a hazardous case. In case of shutdown a reset is required, which occurs from outside the cell.



▶ Advantages for users

- Lacquering process is not disrupted at any time and a reliable safety is ensured.
This avoids unnecessary down times and a higher productivity is assured.
- Workers can access the area where the robot is not actively working without shutting it off, thereby the productivity is increased.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTIO
WS0-XTDI

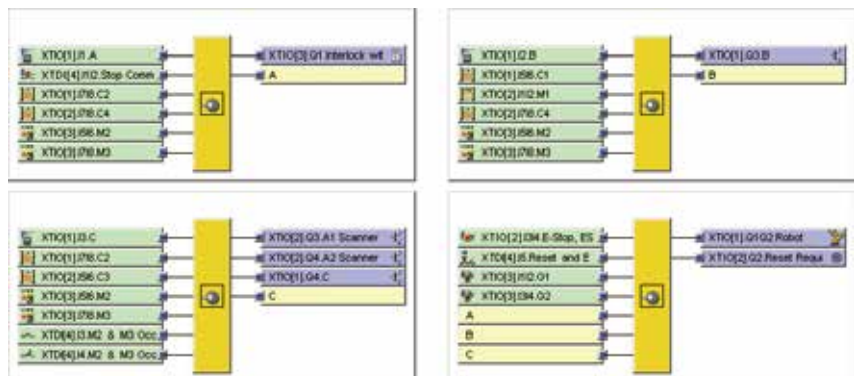
Hardware configuration



Used logic functions:

- AND, OR, NOT
- Reset
- Routing 1:N
- Interlock Monitoring

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Beer barrel washing plant

▶ Safety tasks

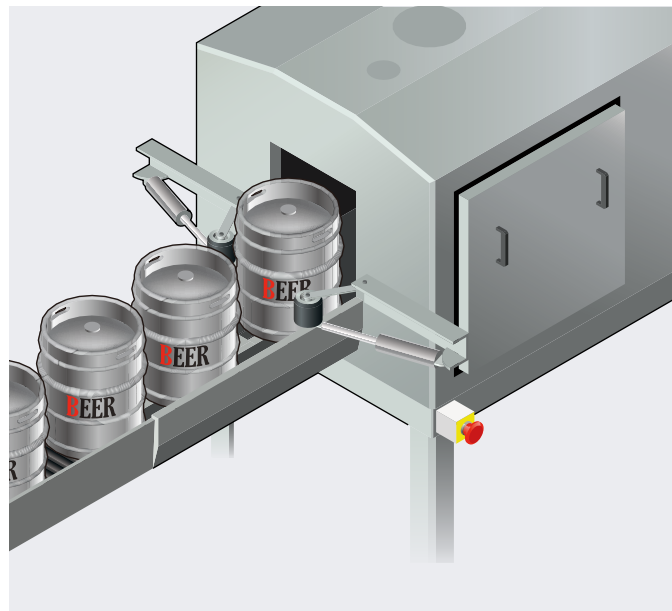
An industrial washing plant for the automatic cleaning of beer barrels should be protected. In this machine, beer barrels between 10 L and 60 L are transported into the machine by a conveyor belt.

From there the beer barrels reach an automatic washing plant and pass through the cleaning process. Finally, they are loaded onto pallets. These can be then removed by a forklift. During the complete process it has to be avoided that a worker can enter the machine. While the machine is running, pallets with barrels have to be inserted for cleaning and clean barrels must be removed all without stopping the machine.

Additional all safety components have to be monitored and diagnosed individually.

▶ Application at a glance

The task	Safety automation, Access protection
Industrial sector/branch	Food & beverage
Applications/type of machine	Beer barrel washing plant
Safety functions	Differentiation between men and material (Muting), Emergency stop function, Integration of safe automation into control system on different network (Interface module), Reset/Restart



▶ Example of realization with safety controller

The area, at which the barrels get inserted, is protected by two safety light curtains. These allow new beer barrels to enter the machine without causing shutdown but no person can enter. The cleaning process is protected mechanically such that there is no access for the worker.

After the washing process ends, the barrels are discharged from the machine. This area is accessible by two doors, which are each protected by a safety switch. The area, where the pallets are removed from the machine, is protected by a safety light curtain.

This assures that no worker can come inside a running machine, but that the pallets can be removed by forklift. The machine is also fitted with 11 single-channel, or dual-channel emergency stop pushbuttons, depending on the needed category, so that a manual shut down of the machine is possible in a hazardous situation. All safety

components are connected to the safety controller MELSEC-WS. CC-Link Interface module is used to monitor the individual safety components.

If one area is shut down a reset is required. For each area reset buttons are installed at the machine housing.



Advantages for users

- A compact safety solution for the whole equipment is provided by using the safety controller MELSEC-WS.
- Complex logics can be easily implemented.
- The status of all safety controller MELSEC-WS can be transmitted to the automatic washing plant operation side programmable controller via CC-Link.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTIO
WS0-XTDI
- Interface module
WS0-GCC1
- Relay expansion modules
WS0-4RO

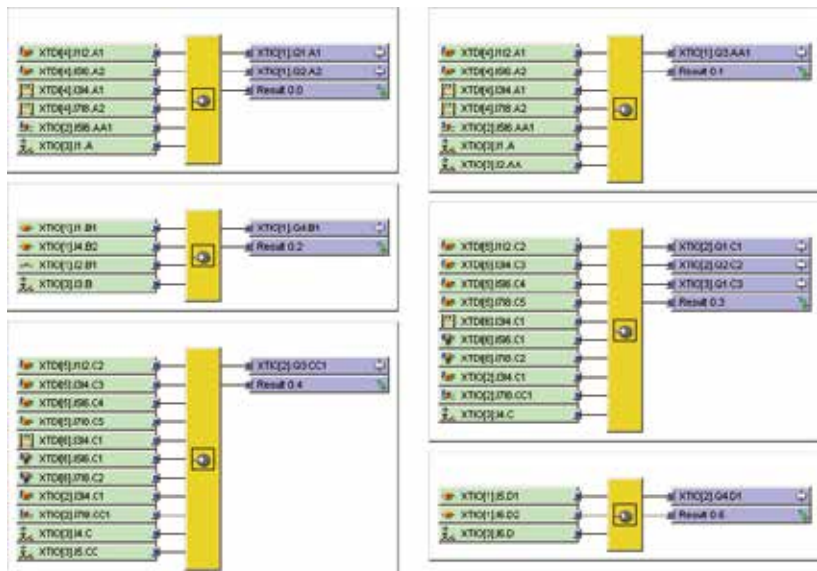
Hardware configuration



Used logic functions:

- AND, OR, NOT
- Reset
- Routing 1:N

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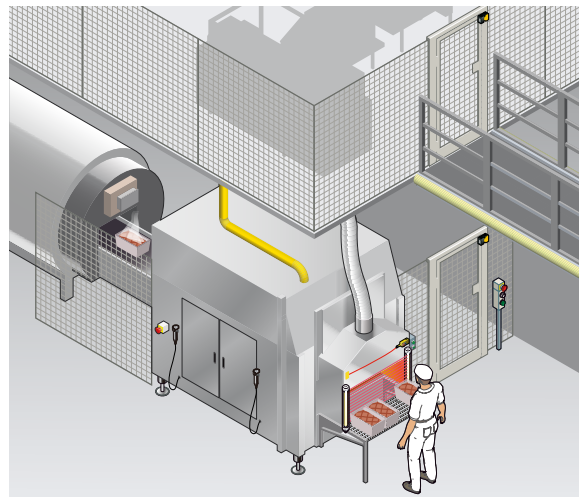
Baking station for meat loaf

▶ Safety tasks

A baking station for meat loaf is filled with baking trays by hand. These pans are taken from a conveyor belt placed into the machine one at a time. There they are consecutively baked, tilted to remove the left over grease and then finally offloaded after they pass the cooling station. While the machine is running, the access doors cannot be opened without stopping the machine. The insertion of the baking pans into the entry can only be possible between cycles, even if the conveying system is running. Additionally there should be the possibility to start each cycle manually so that adjustments to the machine can be made.

▶ Application at a glance

The task	Safety automation, Access protection, Hazardous area protection
Industrial sector/branch	Food & beverage
Applications/type of machine	Baking station for meat loaf
Safety functions	Emergency stop function, Integration of safe automation into control system on different network (Interface module), Safety locking function



▶ Example of realization with safety controller

The entry to the baking station is protected by a safety light curtain, which shuts down the conveyor belt if a pan is inserted midcycle. If a pan is inserted, there is an expected cycle start then no reset is required. If a pan is inserted during the baking process, a reset is required. Additionally, a rope switch is installed above the entry which stops the machine manually in a hazardous case. The access to the machines individual baking sections is protected by doors at the walkway side. These are monitored by a non-contact safety switch or a safety switch. At the side facing the wall, access through a maintenance door is also secured by a safety switch. Access through this door results in a controlled stop with braking. In this way the current cycle is stopped and a safe restart inhibit is assured. At the walkway side, there are two enabling switches, so that the machine can run in service mode even though the doors are opened. The floor above the machine is separated into two areas, the baking and cooling section. The access is protected by a door with a safety door switch

each. If one of the doors is opened while the machine is running, the respective area is switched off. Access to the baking and cooling sections are also secured with doors. A single beam light switch is mounted in front of these doors, monitors if any doors are opened and finally initiates a switch off command to the respective drive when one is opened. A reset is only possible when all the doors are closed. All components are connected with the safety controller MELSEC-WS which signals the stop in a hazardous case.



Safety Controller Application Guide

Advantages for users

- A complex logic is available with a sophisticated software-based safety controller MELSEC-WS.
- The protection of whole system can be realized by dividing the machine into areas with a safety controller MELSEC-WS.

Used modules:

- CPU module
WS0-CPU1
- I/O modules
WS0-XTDI
WS0-XTIO
- Interface module
WS0-GCC1

Hardware configuration



Used logic functions:

- AND, OR, NOT
- Reset
- RS Flipflop
- Two Hand Control(Type IIIA)
- Switch On Delay
- Clock Generator

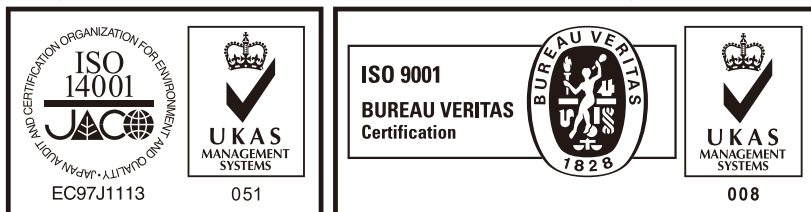
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Mitsubishi Safety Controller Application Guide

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