TRANSLATION OF THE ORIGINAL INSTRUCTIONS

MITSUBISHI ELECTRIC

WS0-4RO4002

Safety Controller Safety Relay Output Module User's Manual (Hardware)

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MODEL	WS-SR-U-HW-E
IB(NA)-0800531ENG-G(2604)SICK	

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Precautions regarding warranty and specifications

MELSEC-WS series products are jointly developed and manufactured by Mitsubishi and SICK AG, Industrial Safety Systems, in Germany. Note that there are some precautions regarding warranty and specifications of MELSEC-WS series products.

<Warranty>
- The gratis warranty term of the product shall be for one (1) year after the date of delivery or for eighteen (18) months after manufacturing, whichever is less.
- The onerous repair term after discontinuation of production shall be for four (4) years.
- Mitsubishi shall mainly replace the product that needs a repair.
- It may take some time to respond to the problem or repair the product depending on the condition and timing.

<Specifications>
- General specifications of the products differ.

	MELSEC-WS	MELSEC-Q	MELSEC-QS
Operating ambient temperature *Température ambiante de fonctionnement*	-25 to 55°C*1 *-25 à 55°C* *1	0 to 55°C *0 à 55°C*	0 to 55°C *0 à 55°C*
Operating ambient humidity	10 to 95%RH	5 to 95%RH	5 to 95%RH
Storage ambient temperature	-25 to 70°C	-25 to 75°C	-40 to 75°C
Storage ambient humidity	10 to 95%RH	5 to 95%RH	5 to 95%RH

*1: When the WS0-GCC100202 is included in the system, operating ambient temperature will be 0 to 55°C.
**1: Avec un module WS0-GCC100202 inclus dans le système, la température ambiante de service est de 0 à 55°C.*

- EMC standards that are applicable to the products differ.

	MELSEC-WS	MELSEC-Q, MELSEC-QS
EMC standards	EN 61000-6-2, EN 55011	EN 61131-2

1 About this document

1.1 Documentations for the MELSEC-WS system

This manual describes the mounting of the safety relay output module of a MELSEC-WS safety controller.
Mounting of the MELSEC-WS CPU modules (WS0-CPU0 and WS0-CPU1), network modules (WS0-GETH and WS0-GCC1) and safety I/O modules (WS0-XTIO and WS0-XTDI) is described in separate manuals.
The installation, configuration and commissioning of the MELSEC-WS safety controller are described in the "Safety Controller User's Manual" and "Safety Controller Setting and Monitoring Tool Operating Manual".

Title	Number
Safety Controller User's Manual	WS-CPU-U-E
Safety Controller Ethernet Interface User's Manual	WS-ET-U-E
Safety Controller CC-Link Interface User's Manual	WS-CC-U-E
Safety Controller Setting and Monitoring Tool Operating Manual	SW1DNN-WS0ADR-B-O-E

1.2 Function of this document

This manual instructs the technical staff of the machine manufacturer and/or of the machine operator on the safe operating of the CPU module of the MELSEC-WS safety controller.
In addition mounting protective devices also requires specific technical skills which are not detailed in this documentation.
This manual does not provide instructions for operating the machine in which the safety controller is, or will be, integrated. Information of this kind will be found in the manuals for the machine.

2 On safety

This chapter deals with your own safety and the safety of the equipment operators.

- Please read this chapter carefully before beginning with the installation.

2.1 Qualified safety personnel

The MELSEC-WS safety controller may only be installed by qualified safety personnel.
Qualified safety personnel are defined as persons who …
- have undergone the appropriate technical training **and**
- who have been instructed by the responsible machine operator in the operation of the machine and the current valid safety guidelines **and**
- have access to the MELSEC-WS manuals and have read and familiarized themselves with them **and**
- have access to the manuals for the protective devices (e.g. light curtains) connected to the safety controller and have read and familiarized themselves with them.

2.2 Applications of the device

The MELSEC-WS safety controller is a configurable controller for safety applications. It can be used
- in accordance with IEC 61508 to SIL 3
- in accordance with IEC 62061 to SIL 3
- in accordance with EN/ISO 13849-1 up to Performance Level e

The degree of safety actually attained depends on the external circuit, the realization of the wiring, the parameter configuration, the choice of the pick-ups and their location at the machine.
Opto-electronic and tactile safety sensors (e.g. light curtains, laser scanners, safety switches, sensors, emergency-stop buttons) are connected to the safety controller and are linked logically. The corresponding actuators of the machines or systems can be switched off safely via the switching outputs of the safety controller.

2.3 Correct use

ATTENTION

The MELSEC-WS safety controller fulfils the requirements of Class A (industrial applications) in accordance with the "Interference emission" basic specifications!
Le contrôleur de sécurité MELSEC-WS a été conçu en conformité aux exigences des appareils de Classe A (applications industrielles) pour ce qui concerne les spécifications de base dans le domaine des "émissions d'interférences" !
The MELSEC-WS safety controller is therefore only suitable for use in an industrial environment and not for private use.
Le contrôleur de sécurité MELSEC-WS peut donc s'utiliser dans un environnement industriel mais n'a pas été prévu pour un usage domestique.

The MELSEC-WS safety controller may only be used within specific operating limits (voltage, temperature, etc., refer to the technical data and to the section "Application areas of the device"). It may only be used by specialist personnel and only at the machine at which it was mounted and initially commissioned by qualified personnel in accordance with the "Safety Controller User's Manual".
The modules of the MELSEC-WS safety controller conform to Class A, Group 1, in accordance with EN 55011. Group 1 encompasses all the ISM devices in which intentionally generated and/or used conductor-bound RF energy that is required for the inner function of the device itself occurs.
Mitsubishi Electric Corporation accepts no claims for liability if the equipment is used in any other way or if modifications are made to the device, even in the context of mounting and installation.
UL/CSA applications:
- Use 60°C/75°C conductors.
- The terminal tightening torque must be 5-7 lbs in.
- To be used in a Pollution Degree 2 environment only.
- Memory plug and CPU module shall be supplied by an isolating power source protected by an UL248 fuse, rating 42.4VDC which is the maximum voltage requirements of UL508.
- The safety functions are not evaluated by UL. The approval is accomplished according to UL508, general use applications.

Applications UL/CSA:
- *Utiliser des conducteurs 60°C/75°C.*
- *Le couple de serrage des bornes doit être de 5-7 lbs in.*
- *À utiliser uniquement en environnement polluant de degré 2.*
- *La prise mémoire et le module CPU doivent être alimentés à partie d'une source isolée protégé par un fusible UL248, d'un' tension nominale de 42,2V cc, ce qui est le maximum admissible pour UL508.*
- *Les fonctions de sécurité n'ont pas été évaluées par UL. L'agrément a été accordé selon UL508 pour applications universelles.*

2.4 General protective notes and protective measures

ATTENTION

Observe the protective notes and measures!
Respecter les consignes de sécurité et mesures de protection!
Please observe the following items in order to ensure proper use of the MELSEC-WS safety controller.
Pour garantir une utilisation correcte du contrôleur de sécurité MELSEC-WS, veuillez observer les points suivants.

- When mounting, installing and using the MELSEC-WS safety controller, observe the standards and directives applicable in your country.
- The national rules and regulations apply to the installation, use and periodic technical inspection of the MELSEC-WS safety controller, in particular:
  - Machinery Directive 2006/42/EC
  - EMC Directive 2004/108/EC (valid until April 19th, 2016)
  - EMC Directive 2014/30/EU (valid as of April 20th, 2016)
  - Use of Work Equipment Directive 2009/104/EC
  - Low-Voltage Directive 2006/95/EC (valid until April 19th, 2016)
  - Low-Voltage Directive 2014/35/EU (valid as of April 20th, 2016)
  - Work safety regulations/safety rules
- Manufacturers and owners of the machine on which a MELSEC-WS safety controller is used are responsible for obtaining and observing all applicable safety regulations and rules.
- It is imperative that the notices, in particular the test notices of the manual must be observed.
- The tests must be carried out by specialised personnel or specially qualified and authorised personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time by third parties.
- The external voltage supply of the device must be capable of buffering brief mains voltage failures of 20ms as specified in EN 60204.
- The system may not start up normally if power is restored immediately after power supply was shut down (within five seconds). Wait for five seconds or longer before restoring power.
- The modules of the MELSEC-WS system conform to Class A, Group 1, in accordance with EN 55011.
  - Group 1 encompasses all the ISM devices in which intentionally generated and/or used conductor-bound RF energy that is required for the inner function of the device itself occurs.

ATTENTION

The MELSEC-WS system fulfils the requirements of Class A (industrial applications) in accordance with the "Interference emission" basic specifications!
Le système MELEC-WS a été conçu en conformité aux exigences des appareils de Classe A (applications industrielles) pour ce qui concerne les spécifications de base dans le domaine des "émissions d'interférences" !
The MELSEC-WS system is therefore only suitable for use in an industrial environment and not for private use.
Le système MELSEC-WS peut donc s'utiliser dans un environnement industriel mais n'a pas été prévu pour un usage domestique.

2.5 Transportation Precautions

ATTENTION

The MELSEC-WS safety controller is a precision device. During transportation, avoid impacts larger than general specifications by using dedicated packaging boxes and shock-absorbing pallets. Failure to do so may cause failures in the MELSEC-WS safety controller. After transportation, verify operation of the MELSEC-WS safety controller and check for damage of the mounting part, etc.
Le contrôleur de sécurité MELSEC-WS est un appareil de précision. Pendant le transport, éviter les chocs dépassant les spécifications générales en utilisant des cartons d'emballage spéciaux et des palettes atténuant les chocs. Le non-respect de cette consigne peut entraîner des défaillances du contrôleur de sécurité MELSEC-WS. Après le transport, vérifier le fonctionnement du contrôleur de sécurité MELSEC-WS et vérifier que la pièce à monter n'est pas endommagée, etc.

2.6 Disposal

Disposal of unusable or irreparable devices should always occur in accordance with the applicable country-specific waste-disposal regulations (e.g. European Waste Code 16 02 14).

3 Conditions of use for the product

(1) Although Mitsubishi Electric has obtained the certification for Product's compliance to the international safety standards IEC61508, ISO13849-1 from TUV Rheinland, this fact does not guarantee that Product will be free from any malfunction or failure. The user of this Product shall comply with any and all applicable safety standard, regulation or law and take appropriate safety measures for the system in which the Product is installed or used and shall take the second or third safety measures other than the Product. Mitsubishi Electric is not liable for damages that could have been prevented by compliance with any applicable safety standard, regulation or law.

(2) Mitsubishi Electric prohibits the use of Products with or in any application involving, and Mitsubishi Electric shall not be liable for a default, a liability for defect warranty, a quality assurance, negligence or other tort and a product liability in these applications.
   (a) power plants,
   (b) trains, railway systems, airplanes, airline operations, other transportation systems,
   (c) hospitals, medical care, dialysis and life support facilities or equipment,
   (d) amusement equipments,
   (e) incineration and fuel devices,
   (f) handling of nuclear or hazardous materials or chemicals,
   (g) mining and drilling,
   (h) and other applications where the level of risk to human life, health or property are elevated.

(3) Mitsubishi Electric shall have no responsibility or liability for any problems involving programmable controller trouble and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

4 Product description

4.1 Safety relay output modules WS0-4RO

The WS0-4RO safety relay output modules make contact-based outputs with positive-action relay contacts available.

A maximum of four WS0-4ROs can be connected to a MELSEC-WS system.

The WS0-4RO output modules consist of two independent redundant switch-off paths.

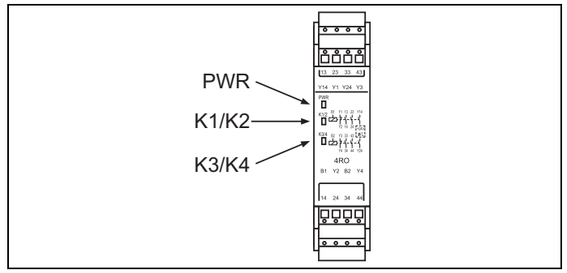
- Two safe contact-based enabling current paths
- One non-isolated safe enabling current path
- One NC EDM contact for each.

Each safe enabling current path consists of the series-connected relay contacts of two redundantly operating positive-action relays.

The WS0-4RO module cannot be used independently and always requires a main module WS0-CPU0/1, see the MELSEC-WS Setting and monitor tool configuration software.

Every input/output extension module has to be connected to an external voltage supply in order to supply the outputs.

4.2 Display elements



4.2.1 Displays

Display	Meaning
PWR (green)	Supply voltage via safety bus is applied
K1/K2 (green)	Relay K1/K2 – safety contacts closed
K3/K4 (green)	Relay K3/K4 – safety contacts closed

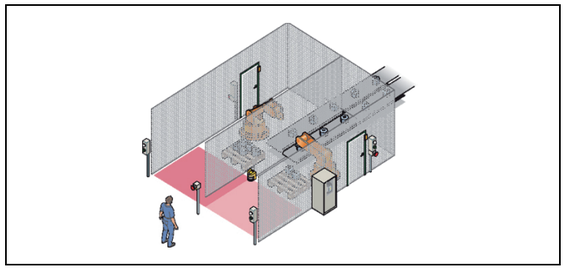
4.3 Terminal assignment
Affectation des bornes

Assignment *Affectation*	Description *Description*
B1	Circuiting relay K1/K2 *Relais de mise en circuit K1/K2*
B2	Circuiting relay K3/K4 *Relais de mise en circuit K3/K4*
13/14 and 23/24 *13/14 et 23/24*	Safety contacts for switch-off circuit outputs K1/K2 *Contacts de sécurité pour sorties de circuit de coupure K1/K2*
33/34 and 43/44 *33/34 et 43/44*	Safety contacts for switch-off circuit outputs K3/K4 *Contacts de sécurité pour sorties de circuit de coupure K3/K4*
Y1/Y2	Feedback EDM K1/K2 NC contact *Contact NC de feedback EDM K1/K2*
Y3/Y4	Feedback EDM K3/K4 NC contact *Contact NC de feedback EDM K3/K4*
Y14	NO safety contact K1/K2, current-limited (see "Technical data") *Contact de sécurté NO K1/K2, à limitation de courant (voir "Données techniques")*
Y24	NO safety contact K3/K4, current-limited (see "Technical data") *Contact de sécurté NO K3/K4, à limitation de courant (voir "Données techniques")*

4.4 Wiring example

Application example

- Simultaneous protection from danger (Use of a laser scanner)



Function

Two independent robots are protected with one laser scanner (S3000).

An operator can access the dangerous area through the protective area or the side gates.

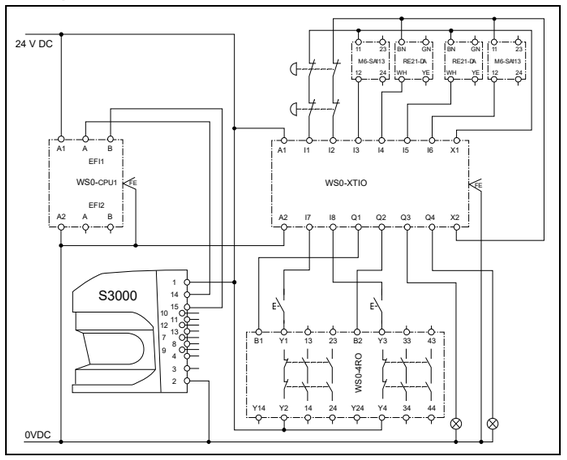
When the operator opens the side gate or crossing the laser-protected area, the robots stop their operation. Both robots stop when any one of the emergency stop switches is activated.

Reset the safety device after activation.

Safety

This system meets the performance level d in accordance with EN/ISO13849-1.

- Wiring



*: The WS0-4RO cannot be used alone. The WS0-4RO performs the ON/OFF control via the WS0-XTIO.
Connect the output terminals (Q1 to Q4) of the WS0-XTIO to the input terminals (B1 and B2).

**: Le WS0-4RO ne peut être utilisé seul. Le WS0-4RO exécute les contrôles ON/OFF via le WS0-XTIO.*
Raccorder les bornes de sortie (Q1 à Q4) du WS0-XTIO aux bornes d'entrée (B1 et B2).

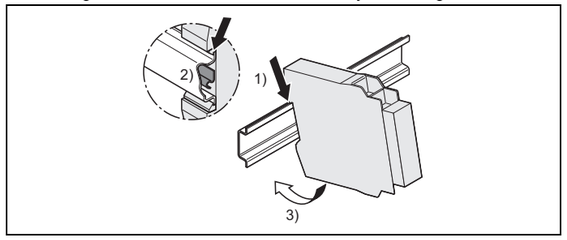
5 Mounting/Dismantling

ATTENTION

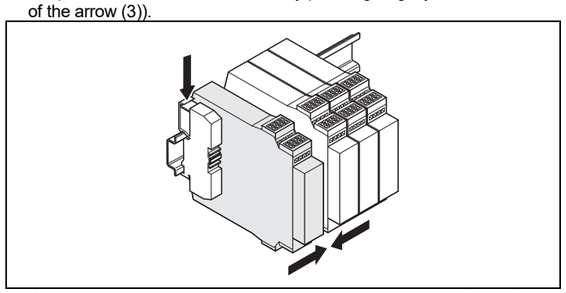
The MELSEC-WS system is only suitable for mounting in a control cabinet with at least IP 54 degree of protection.
While supply voltage is applied, modules must not be plugged to nor be removed from the MELSEC-WS system.
To ensure full electromagnetic compatibility (EMC), the DIN mounting rail must be connected to functional earth (FE).
Le système MELSEC-WS ne peut être installé que dans une armoire de commande avec un degré de protection IP 54 ou mieux.
Quand la tension d'alimentation est appliquée, les modules ne doivent pas être enfichés sur ou retirés du système MELSEC-WS.
Pour garantir totalement la compatibilité électromagnétique (EMC), le rail de fixation DIN doit être raccordé à la terre fonctionnelle (FE).

5.1 Steps for mounting the modules

- In a MELSEC-WS system the CPU module WS0-CPU0 or WS0-CPU1 is positioned at the extreme left, the two optional gateways follow directly. Only then do the safety I/O modules follow. The relais modules WS0-4RO have to be mounted at the extreme right.
- The modules are located in a 22.5mm wide modular system for 35mm DIN rails to EN 60715.
- Mount the module in accordance with EN 50274
- The connection between the modules is effected by means of the plug connection integrated in the housing.
- Ensure that suitable ESD protective measures are also taken during mounting. Otherwise the FLEXBUS+ bus may be damaged.

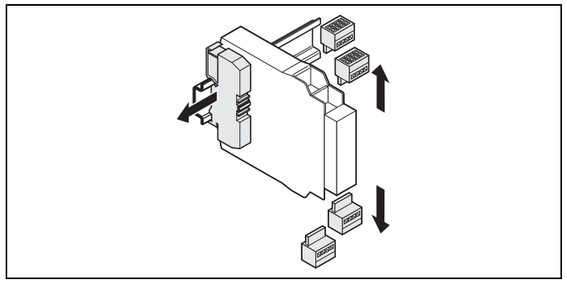


⇒ Make sure that the voltage supply of the MELSEC-WS safety controller is switched off.
⇒ Hang the device onto the DIN rail (1)).
⇒ Ensure that the earthing spring contact is positioned correctly (2)). The earthing spring contact of the module must contact the DIN rail securely to allow electrical conductivity.
⇒ Snap the module onto the DIN rail by pressing it lightly in the direction of the arrow (3)).

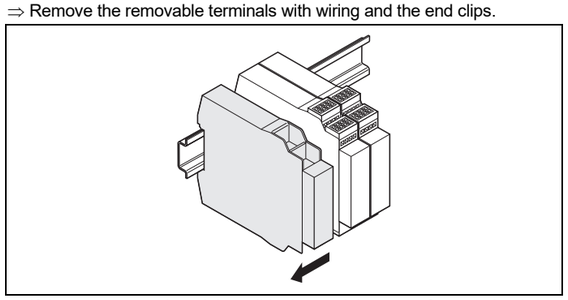


⇒ If there are several modules, slide the modules together individually in the direction of the arrow until the side plug connection latches in.
⇒ Install the end clips on the left and right.

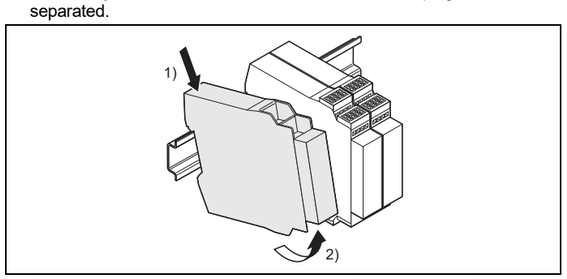
5.2 Steps for dismantling the modules



⇒ Remove the removable terminals with wiring and the end clips.



⇒ If there are several modules, slide the modules away from each other individually in the direction of the arrow until the side plug connection is separated.



⇒ Press the module downwards at the rear (1)) and remove it from the DIN rail in the direction of the arrow while keeping it pressed down (2)).

6 Electrical installation

ATTENTION

De-energize the entire system!
Mettez le système entièrement hors tension!
The system could start up unexpectedly while you are connecting the devices.
Le système pourrait être mis en marche par inadvertance pendant qu'on connecte les dispositifs.

Observe the relevant safety standards!
Observez les normes de sécurité pertinentes!
All safety related parts of the installation (cabling, connected sensors and actuators, configuration settings, EDM) must be according to the relevant safety standards (e.g. IEC 62061 or EN/ISO 13849-1).
Tout matériel ou logiciel ayant des implications de sécurité (câblage, capteurs et actionneurs à raccorder, paramétrages de configuration, EDM) doivent être conformes aux normes de sécurité applicables (par exemple, IEC 62061 ou EN/ISO 13849-1).

- The MELSEC-WS safety controller fulfils the EMC requirements in accordance with the basic specification IEC 61000-6-2 for industrial use.
- Electrical installation in accordance with IEC 60204-1
- To ensure full electromagnetic compatibility (EMC), the DIN rail has to be connected to functional earth (FE).
- The voltage supply of the devices must be capable of buffering brief mains voltage failures of 20ms as specified in IEC 60204-1.
- The voltage supply has to fulfil the regulations for extra-low voltages with safe separation (SELV, PELV) in accordance with IEC 60664 and EN 50178 (equipment of electrical power installation with electronic devices).
- You must to connect all the modules of the MELSEC-WS safety controller, the connected protective devices as well as the voltage supply/ies with the same 0VDC (GND).
- All connected pick-ups and downstream controllers as well as wiring and installation have to fulfil the required safety characteristics.
- If a module is replaced the correct terminal assignment has to be guaranteed, for example by labelling or suitable cable routing.
- For further information that is to be taken into consideration when the MELSEC-WS safety controller is used, refer to the "Safety Controller User's Manual" and "Safety Controller Setting and Monitoring Tool Operating Manual".

7 Configuration and commissioning

ATTENTION

Do not commission without a check by qualified safety personnel!
Ne pas procéder à la mise en service sans qu'un personnel de sécurité qualifié ait effectué un contrôle!
Before initial commissioning of a system using a MELSEC-WS safety controller, it must be checked and released by qualified personnel. Document the result of the safety check.
La première mise en service d'un système utilisant un contrôleur de sécurité MELSEC-WS ne doit être effectuée qu'après contrôle et sur autorisation délivrée par un personnel qualifié. Les résultats du contrôle de sécurité doivent être dûment documentés et suivis.

The MELSEC-WS safety controller can be configured by the Setting and Monitoring Tool connected to the RS-232 interface of a CPU module or the port of an Ethernet interface module.

Note
- The Setting and Monitoring Tool version 1.3.0 or higher is required to configure and commission the MELSEC-WS safety controller.
- The system configuration of the complete MELSEC-WS safety controller is stored in the memory plug. The system does not have to be reconfigured when a module is replaced.

8 Technical data

Supply circuit (via WS0-CPUx)

Power consumption	Max. 3.2W

Input circuit B1, B2

Input voltage ON	18 … 30VDC

Output circuit (13-14, 23-24, 33-34, 43-44, Y1-Y2, Y3-Y4)

Number of N/O contacts	4 (13-14, 23-24, 33-34, 43-44)
Number of N/C contacts	2 (Y1-Y2, Y3-Y4)
Switching voltage	230VAC (5 … 253VAC) 230VDC (5 … 253VDC)
Switching current	10mA … 6A
Mechanical endurance	Min. 10×10^6
Electrical endurance	See the "Safety Controller User's Manual".
Minimum contact load with U_n = 24VDC	50mW
Total current	8A
Response time	30ms
Type of output	Potential-free N/O contacts, positively guided
Contact material	$AgSnO_2$ with 1µ Au
Output circuit fusing	6 A (gG), per current path
Usage category	AC-15: U_e 250V, I_e 3A
	DC-13: U_e 24V, I_e 3A

Output circuit (Y14, Y24)

Type of output	N/O contact, connected to internal 24VDC, positively guided, current-limited
Number of N/O contacts Y14/24	2
Output voltage	24VDC (16 … 30VDC)
Output current	Max. 75mA
Load capacity	200nF

General data

Electrical isolation	Supply circuit-input circuit: No Supply circuit-output circuit: Yes Input circuit-output circuit: Yes
Weight (without packaging)	186g (±5%)

Operating data

Ambient operating temperature *Température ambiante de fonctionnement*	-25°C … 55°C *-25°C … 55°C*
Storage temperature	-25°C … 70°C
Air humidity	10% to 95%, non-condensing
Climatic conditions	IEC 61131-2, No corrosive gases

Mechanical strength

Vibration	IEC 61131-2
Vibration resistance	5-500Hz/3grms (IEC 60068-2-64)

Electrical safety IEC 61131-2

Impulse voltage withstand level (Uimp)	4kV
Overvoltage category	II
Contamination level	2 inside, 3 outside
Rated voltage	300VAC
Enclosure rating housing/terminals	IP40/IP20 (IEC 60529)
Electromagnetic compatibility	IEC 61131-2, EN 61000-6-2, EN 61000-6-4, EN 55011 class A

Terminal and connection data

Single or fine stranded wire *Fil monobrin ou torsade fine*	1 × 0.14mm² to 2.5mm² or 2 × 0.14mm² to 0.75mm² *1 × 0,14mm² à 2,5mm² ou* *2 × 0,14mm² à 0,75mm²*
Fine stranded wire with terminal crimps to EN 46228 *Fil torsade fine avec bornes serties selon EN 46228*	1 × 0.25mm² to 2.5mm² or 2 × 0.25mm² to 0.5mm² *1 × 0,25mm² à 2,5mm² ou* *2 × 0,25mm² à 0,5mm²*
Insulation stripping length	8 mm
Maximum break-away torque	0.6 Nm

Safety specific characteristics

Safety integrity level	SIL3 (IEC 61508, IEC 62061)
Category	Category 4 (EN/ISO 13849-1)
Performance Level	PLe (EN/ISO 13849-1)
PFD	1.6×10^{-7}
PFHd at l = 0.75A, switching frequency = h^{-1}	1.2×10^{-9}
B10d value, switching frequency = h^{-1}	0.75A (AC 15)/4,150,000
SFF	99.6%
DC	99%
T_M (mission time)	Depending on PFHd value, ambient temperature, load and switching operations
No. of mechanical switching operations	Min. 200,000

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