OPERATING INSTRUCTIONS

SSN3501

Safety relay

Auxillary device

GB

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These operating instructions are the original operating instructions.

1 On safety

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

Please read this chapter carefully before working with the SSN3501 or with the machine protected by the SSN3501.

1.1 Qualified safety personnel

The SSN3501 safety relay must only be installed, commissioned and serviced by qualified safety personnel.

1.2 Aplications of the device

The safety functions are designed and validated according to Category 4, PL e in accordance with EN ISO 13849-1 and EN ISO 13849-2, corresponding to SIL CL 3 according to EN 62061. These are only valid by serial connection of ≤ 3 pieces SSN-modules.

The SSN system is usually used in machines and systems where the SSN network functions as a local bus. It is only for industrial use.

The advantage of this safety system is the simple “programming” (with DIP switch) and less elaborate wiring of the systems. Additionally, far less diagnoses functions & error detections are available, which provide clarity in visualizing and for error searches.

1.3 Correct use

The SSN3501 safety relay must be used only as defined in section 1.2 ”Aplications of the device” and only for industrial purposes.
It must be used only by qualified safety personnel and only on the machine where it has been installed and initialised by qualified safety personnel in accordance with the operating instruction. If the device is used for any other purposes or modified in any way, also during mounting and installation, any warranty claim against PAJ EMS ApS shall become void.

1.4 General safety notes and protective measures

! Pay attention to the safety notes and protective measures!

Please observe the following items in order to ensure the correct use of the SSN3501 safety relays.

- Installation, commissioning, use and maintenance shall comply with all applicable national and international regulations and standards.
- Machinery Directive 2006/42/EC
- The low Voltage Directive 2014/35/EU
- The work safety regulations and standards
- Manufacturers and operators of the machine on which the safety relay is used are responsible for obtaining and observing all applicable safety regulations and rules.
- Tests must be carried out by qualified or authorised safety personnel and must be recorded and documented to ensure traceability and reproducibility at any time by third parties.
- The operating instructions must be made available to the operator of the machine where the SSN3501 is used.
- The machine operator must be instructed in the use of the device by qualified safety personnel and must be instructed to read the operating instructions.
- As this product is a component, compliance with the 1ms system level state change requirement depends on the complete safety chain. The system integrator must validate the behaviour of the full safety function under EMC disturbances in accordance with EN IEC 60947-5-1:2017/AC:2020-05

1.5 Environment protection

Unusable or irreparable devices should always be disposed as per the applicable national regulations on waste disposal.

2 Product description

The SSN3501 is a safety relay with 2 safety outputs (normally open contacts) as well as 2 feedback channels for emergency stop buttons and with an integrated SSN network.

The SSN3501 has 2 potential free relay contacts 13/14, 23/24. The contacts may be connected to the load circuit.

The SSN modules are connected with each other using the optical fiber cable (Type 625/125 µm) forming a closed ring network. Within the ring, a token is transmitted to control the behaviour of the connected SSN modules and, consequently, the connected safety relays.

The SSN system allows the formation of safety groups. The network can be divided into up to four zones, enabling selective shutdown of specific parts of a system, for example during maintenance or setup, while the remaining system continues operation. One or more SSN modules can be assigned to each group, allowing independent evaluation of each group.

The SSN-module can operate in 4 different modes:

- Manually monitored reset
- Automatic reset
- Monitored reset
- Network-only reset

The reset button must be installed so that the hazardous area is clearly visible to the operator.

In accordance with IEC/EN 60204-1, Sections 9.2.5.4.2 and 10.8.3, an automatic restart must not occur after an emergency stop. Therefore, in operating modes with automatic restart, an external control system must prevent automatic restart after an emergency stop. Automatic restart is only permitted if it does not lead to a hazardous situation.

Start-up can be initiated via a start button (manual start or manually monitored reset), where the function is monitored by the SSN module, or automatically upon application of the supply voltage (auto-start).

Manually monitored reset

If the SSN module has been deactivated by a protective device, for example by pressing the emergency stop button, the module can only be restarted via a manual start or monitored reset using the start button. In this configuration, after a network failure, the device must always be restarted using the start button. During manually monitored reset, the start button is checked during each start-up sequence. If the start button is already actuated before resetting the emergency stop or applying the supply voltage, start-up is prevented.

Monitored reset

In monitored reset mode, start-up is only initiated after the reset button has been actuated and subsequently released. Apart from this condition, the behaviour is identical to manual monitored reset.

Automatic reset

When the SSN module is configured for automatic reset (auto-start mode), the device starts automatically when the supply voltage is applied, provided that both safety feedback channels (emergency stop circuits) and the feedback circuit T33/T34 are closed.

If one of the monitored channels is interrupted, for example by activating an emergency stop during operation (RUN state), the connected machine is transferred to a safe state, e.g. by opening the safety output contacts.

When the safety circuits are restored (e.g. the emergency stop is reset) and the feedback circuit T33/T34 is closed, the SSN module automatically restarts.

If the SSN module is stopped by a STOP message, it can be restarted by a START message from the network.

In accordance with EN ISO 13849-1:2016, clause 5.2.3, automatic restart of a machine is only permitted if it can be ensured that no hazardous situation is present.

Only network reset

In network-only reset mode, the device can only be started by a START message from the network, provided that the feedback circuit T33/T34 is closed.

Start – Behaviour A (reset)

➢ Case A:
The SSN module detects activation of the connected reset button. Provided that both safety circuits T11/T12 and T21/T22 are closed, the SSN module transmits a START message with the next token to the configured groups/zones.

If no STOP message is received within approximately 600 ms, the safety output contacts close and the machine is allowed to start.

If a STOP message is received within approximately 600 ms, no start action is performed and the safety output contacts remain open.

Start – Behaviour B (reset)

➢ Case B:
The SSN module receives a START message for the group/zone in which it is configured.

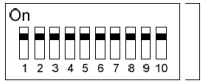
The module verifies that start conditions are fulfilled, i.e. that both safety feedback loops T11/T12 and T21/T22 are closed and that the selected reset mode allows start via the network (Automatic or Network-only reset).

If these conditions are fulfilled, the safety output contacts close and the machine is allowed to start.

If one of the safety feedback loops (T11/T12 or T21/T22) is opened, the SSN module transmits a STOP message with the next token to the configured groups/zones, and the safety output contacts remain open.

If the unit is configured for manual or monitored reset (i.e. local reset required), no start action is performed and the safety output contacts remain open.

2.1 Product configuration



Configuration CPU1



Configuration CPU2

DIP Key	Function description
Key 1	Zone/group select
Key 2	Zone/group select
Key 3	Not in use
Key 4	LA light curtain application
Key 5	Start / Stop signal for zone 0
Key 6	Start / Stop signal for zone 1
Key 7	Start / Stop signal for zone 2
Key 8	Start / Stop signal for zone 3
Key 9	RM Reset mode
Key 10	RM Reset mode

Key 1	Key 2	
Off	Off	SSN belongs to zone 0
On	Off	SSN belongs to zone 1
Off	On	SSN belongs to zone 2
On	On	SSN belongs to zone 3

Key 4	
Off	Default configuration
On	For use with a light curtain

Key 5	START/STOP messages Zone 0
Off	SSN do not react on messages
On	SSN react on messages

Key 6	START/STOP messages Zone 1
Off	SSN do not react on messages
On	SSN react on messages

Key 7	START/STOP messages Zone 2
Off	SSN do not react on messages
On	SSN react on messages

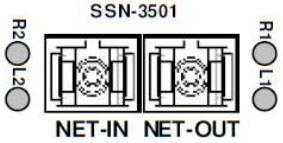
Key 8	START/STOP messages Zone 3
Off	SSN do not react on messages
On	SSN react on messages

Key 9	Key10	
Off	Off	Manual monitored reset
On	Off	Automatic reset
Off	On	Monitored reset
On	On	Only network reset

Configuration of the SSN module is performed using DIP switches located on the side of the housing.

Two rows of DIP switches are provided, as the configuration is duplicated for safety reasons. Both rows must be set identically for correct operation. The SSN module can only be configured when the device is powered off. Changes made during operation will not take effect until the device is restarted.

2.2 Status indicators



R1 and R2	
Green	Relay is activated
Yellow	Relay is not activated
Off	Relay is not activated and E-stop is activated on SSN
Blinking red and green	The SSN module have an Error

L1 and L2	
Green	Optical fiber cable is ok
Red	Missing optical fiber cable
Off	Missing power to SSN

R1	Operating state CPU1
R2	Operating state CPU2
L1	Incoming signal CPU1
L2	Outgoing signal CPU2

3 Mounting

The SSN modules must be attached at a suitable operating location such as a switch cabinet, enclosure, etc. (min. protective class IP54). The device is set to contamination level 2.

After the device has been configured, the SSN module must be placed on the DIN-standardized track (35mm - according to EN 60715). Thereafter, the SSN module must be wired electrically.

It is possible to work with the optical fiber network cables without separating the SSN modules from the supply voltage.

4 Electrical installation

! Before installation, the entire machine or system must be disconnected from the power supply.

Only qualified personnel may perform the electrical installation. During installation, supply and signal cables must be routed separately from power cables.

The supply circuits must be isolated from the mains using a safety isolating transformer (e.g. according to EN 61558-2-6) or an equivalent method. The SSN module includes internal protection (e.g. fuses); however, additional external protection devices are required.

The terminal blocks are removable to facilitate wiring. Before working on the connections, the device must be disconnected from the supply voltage.

The maximum length of the optical fiber cable is 1000 m. Longer cable lengths require the use of a repeater.

The SSN modules are intended for installation in control cabinets or enclosures with a minimum degree of protection of IP54.

The semiconductor signalling outputs are not short-circuit protected. When active (“1”), 24 V DC is present at the output. The load current must not exceed 20 mA.

Terminal	Description
T11 / T12	Test pulse generator and receiver for monitoring the EMERGENCY-Stop function, Channel 1.
T21 / T22	Test pulse generator and receiver for monitoring the EMERGENCY-Stop function, Channel 2.
T33 / T34	Test pulse generator and receiver for monitoring the operating state for the connected reset function.
13 / 14	NO (normally open) safety contacts
23 / 24	NO (normally open) safety contacts The semiconductor outputs are meant for functions that do not require a redundancy check such as display instruments, status signals, etc.
A1	Supply voltage +24 Vdc
A2	Supply voltage – 0 Vdc
SH / SL	Terminal contacts for master device initialization. If these two terminals are short circuited, this SSN-module is a master unit which controls the data transferring in the network. Please note that there can be configured only one master device in a network.

5 Commissioning

! Commissioning must be carried out by qualified personnel and requires a thorough functional check.

Start-up procedure: The device may only be started by qualified personnel familiar with the commissioning and operation of safety components.

- Ensure that no persons are exposed to danger during start-up. Before start-up, verify that all electrical connections and the configuration of the individual SSN modules are correct. Switch on the supply voltage to the SSN modules and associated safety relays.
- If no faults are present, the LEDs indicate the operating and communication states:
  – R1 and R2 light up orange, indicating operating state
  – L1 and L2 light up red, indicating communication initialization
- Once all SSN modules are powered and no errors are detected, communication becomes active (L1 and L2 light up green). After successful self-tests, all units enter the “ready” state.
- The SSN modules perform regular internal tests (self-test, network test, response test of safety relays). If any test fails, the unit switches to the “error” state and the safety outputs are deactivated. This is indicated by LEDs R1 and R2 displaying an error code (red).
- A faulty SSN module can only return to the “ready” state after all errors have been corrected and the supply voltage has been disconnected and re-applied (system restart).
- If emergency stop functions are not actuated for extended periods, their function is not actively verified during that time. Only switching operations are monitored. Therefore, regular functional testing of the emergency stop circuit is strongly recommended and should be included in the system maintenance procedures.
- If changes are made to the machine, protective devices, or the safety controller is modified or repaired, the entire safety function must be thoroughly re-validated.

5.1 Periodic inspection

Periodic inspection of the safety functions must be carried out by qualified personnel, and the system must be inspected in accordance with the inspection intervals specified in applicable national regulations. Each safety function must be verified at intervals defined by the system integrator or operator. If changes are made to the machine or protective devices, or if the SSN3501 has been modified or repaired, the entire safety function must be thoroughly re-validated.
The SSN modules perform regular internal tests (self-test, network test and response test). If a test cycle fails, the unit switches to a safe state and indicates an error condition.

6 Fault conditions

! In the event of a fault or malfunction, operation must be stopped immediately if the cause cannot be clearly identified and safely rectified.
After rectifying a fault, a complete functional test must be performed before the system is returned to operation.

7 Ordering information

Email: PAJ@PAJ-Group.com

8 Conformity

The SSN module has been designed, manufactured and validated in accordance with applicable safety standards. The device complies with the following safety requirements:

Cat 4, PL e according to EN ISO 13849-1:2016

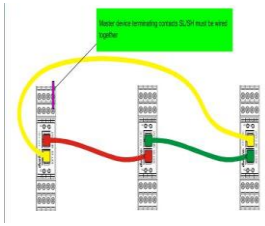
Corresponding to SIL CL 3 according to EN 62061

The complete EU Declaration of Conformity is provided at the end of this document.

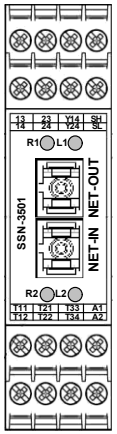
9 Fiber connection

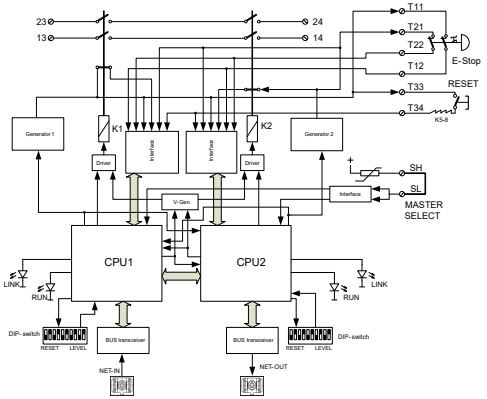
The SSN network is implemented as a ring network. Therefore, the last SSN module must be connected to the first module using an optical fiber cable.To ensure correct network communication, one SSN module must be configured to control communication (virtual master). The master device is defined by connecting the external terminals SL and SH. If more than one master device is present in the network, communication will not be established.

The length of the optical fiber cable between SSN modules must not exceed 1000 m, and no more than 25 SSN modules may be connected within the network.

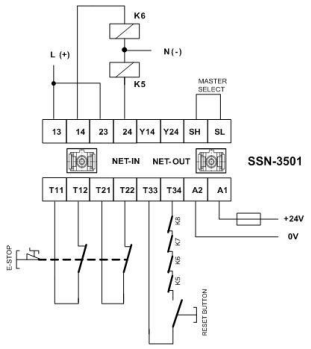


10 Interior wiring diagram

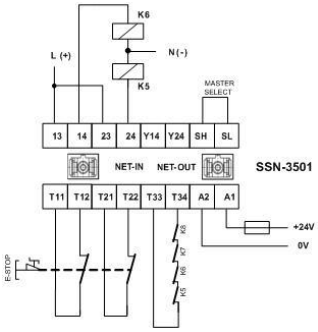




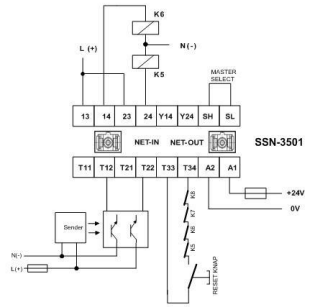
11 Connection examples



Emergency Shut-off 2 channel for
Manually monitored reset or Monitored reset



Emergency Shut-off 2 channel for
Automatic reset or Only network reset



Safety light barrier (LA light curtain application)
The outputs (output signal switching devices – OSSD for short) of the non-contact protective device must be wired to the control contacts T12 and T22 on the safety relay. Only OSSDs with “high side switch” may be used (i.e: Outputs are switched to +24VDC).

12 Technical specifications

Technical data

Input	
Supply nominal voltage UN	24V DC ± 10%
Tension range at max. 5% residual ripple	0,85 ... 1,15 UN
Nominal use	< 130 mA (semi-conductor outputs no load)
Power input	< 3,12 VA for UN
Control voltage through T33/T34, T21/T22, T11/12	DC 23 V for UN
Control circuit through T33/T34, T21/T22, T11/12	a 10 mA for UN
Peak switch-on power	< 3,0 A within 4,8 ms (for UN +10%)
Static current	< 240 mA for UN
Minimum voltage on clips A1 (+)/A2(-) Minimum necessary holding level of the activated status	> 12,0 VDC
Protecting the device	T 400 mA
Cable resistance:	T11-T12: < 300 Ω T21-T22: < 300 Ω T33-T34: < 300 Ω
Output	
Contact assembly	2 x NO
Breaking capacity according to EN 60947-5-1, 13/14, 23/24	AC1: 250 V / 6 A AC15: 230 V / 3 A DC13: 24 V / 5 A / 0,1 Hz
Fuse protection of the safety output contacts	230VAC / TG2A, 24VDC / T5A
Mechanical life (number of activations)	>10 Million
Semi-conductor outputs	
Transistor outputs: Y14 , Y24	2 NPN (24 V DC OFF. Max. 20 mA) not protected against short circuit
Network	
Number of units per network	Max 25 units
Cable length between units	< 1000 m
Network connection	Optical fiber cable: SC/SC 62,5 / 125 µm
Communication bus	Optical fiber cable : 0,5MB/s of Baud rate
SSN system response time	< 60 mS (emergency stop), < ca. 600 mS (start up via reset button)
Response times	
Min. response time at nominal load	< 620 ms
Delay of start-up (configuration time)	< 3,1 s
Switch-off delay during Emergency (Ub = 24 VDC)	< 60 ms
Switch-off delay during network failure (Ub)	< 80 ms
Restart time	> 150 ms
Alarm indication	
Device Failure	Alarm indication via 2 x LEDs (R1/R2) Error code indication (refer to the user manual)
Network Failure	Network failed indication via 2 x LEDs (L1/L2)
Self test	
The self test (POST: Power On Test) is performed at power up the SSN device	- Pulse generator function - Safety inputs - Relays switching - DIP-Board settings - Master selection
The self test during the normal RUN condition	- Pulse generator function - Safety inputs - Relay switching
Miscellaneous	
Insulation coordination according to EN 60664-1 (equivalent to UL 840)	2
Contamination level	2
Ambient Temperature, running / storage	-20 - +55°C / -30 - +70°C
Relative humidity for running and storage	10% upto 95%, no condensation
Insulation coordination (rated impulse withstand voltage)	4 kV (pollution degree 2), according to EN 60664-1
Conditional short circuit current	1kA
Maximum installation altitude	3000 m above sea level according to EN 60664-1
Approvals	
Functinal safety	Safety component according to Machinery Directive 2006/42/EC. Certification reference: ET17075 (DGUV Test valid until 2022)
EMC compliance is supported by existing test data and documented risk analysis. No critical gaps identified.	EN 61000-6-4 (industrial emission) EN 61000-6-2 (industrial immunity)

13 Safety technical information

Safety technical Information	Safety-related control system according to EN ISO 13849-1, Category 4, PL e (corresponding to SIL CL 3)		
	Parameter	**Values**	**Unit**
	$MTTF_d$ (CH1) AC15	65.865	Year's
	$MTTF_d$ (CH2) AC15	65.861	Year's
	$MTTF_{davg}$ AC15	67.226	Year's
	$MTTF_d$ (CH1) DC13	68.587	Year's
	$MTTF_d$ (CH2) DC13	68.583	Year's
	$MTTF_{davg}$ DC13	67.222	Year's
	T_{10d}	6,58	Year's
	B_{10d} (AC15)	1 960 000	Cycle's
	B_{10d} (DC13)	780 000	Cycle's
	n_{op}	12	Cycle's
	d_{op}	365	Day's
	h_{op}	24	Hour's
	t_{cycle}	2 628 000	Sec.
	Category	4	
	Performance Level	e	
	Diagnostic coverage DC $_{avg}$	99	%
	Common Cause Failure CCF	80	
	PFH_d	3.85E-08	

Enclosure

Mechanical	
Dimensions, WxHxD (mm)	22,5 x 90 x 118
Weight:	~ 210 g
Degree of protection, enclosure / terminals	IP40 / IP20
Enclosure material	Technical thermoplastics (PA/PBT/PC)
Installation	Control cabinet installation: Min. IP54
Installation, DIN standard track / screw fastening	EN 60715 / M4 (2 pieces)
Min. / max. connection diameter	0.5 mm2 / 1 x 4 mm2 massive or 1 x 2,5 mm2 strand with sleeve and plastic flange.
Conductor type	Copper conductor. Temperature classification 60 / 75°C
Torque for terminal clips (screws)	< 1 Nm

Operating instructions

SSN Safety relay

Safety Instructions **GB**

These operating instructions are the original operating instructions.

! DANGER

Read these safety instructions and the operating instructions carefully before working with the device. Ensure that the safety instructions are available at all times when working with the device or are present at the machine/system where the device is installed.

The device is intended to be integrated into a machine or system. This device is intended for industrial environments only. These safety instructions do not replace the operating instructions of the machine or system. Information regarding operation is provided in the operating instructions for the device and the machine/system.

⚠ Warning – Optical radiation
This device emits invisible infrared light (820 nm). Do not look into the optical port or the fiber end while the transmitter is powered.

The device is used as a safety component to protect persons at a machine or system. It brings the machine into a safe state and/or prevents unintended start-up. Additional protective devices and measures may be required depending on the application. The safety level of the device must be appropriate for the required safety level of the machine/system.

The device must be installed, commissioned and maintained only by qualified personnel in accordance with these operating instructions. Configuration changes may only be carried out by authorised personnel. The person performing the configuration is responsible for maintaining the safety function.

Installation, commissioning, use and periodic inspection must comply with all applicable national and international regulations and standards, including:

• Machinery Directive 2006/42/EC
• Applicable work safety and accident prevention regulations
• Other relevant safety regulations (see Declaration of Conformity)

The protection device must be installed and commissioned by qualified personnel. After installation, modification or repair, the complete safety function must be verified. Regular inspections must be carried out and documented to ensure traceability.

⚠ ATTENTION – Risk due to configuration changes

The safety function may be impaired if the configuration is modified.

After any configuration change, the correct functioning of the safety device must be verified by qualified personnel. All tests must be documented.

Failure to follow the technical instructions and test procedures may compromise the safety function.

Ergänzende Betriebsanleitung

SSN Sicherheitsrelais

Sicherheitshinweise **DE**

Diese Betriebsanleitung ist eine Original Betriebsanleitung.

! Gefahr

Lesen Sie diese Sicherheitsanweisungen sowie die Betriebsanleitung sorgfältig durch, bevor Sie mit dem Gerät arbeiten. Stellen Sie sicher, dass die Sicherheitsanweisungen jederzeit verfügbar sind, wenn mit dem Gerät gearbeitet wird, oder sich an der Maschine/Anlage befinden, in der das Gerät installiert ist. Das Gerät ist für den Einbau in eine Maschine oder Anlage vorgesehen. Dieses Gerät ist ausschließlich für industrielle Umgebungen bestimmt. Diese Sicherheitsanweisungen ersetzen nicht die Betriebsanleitung der Maschine oder Anlage. Informationen zum Betrieb sind der Betriebsanleitung des Geräts sowie der Maschine/Anlage zu entnehmen.

⚠ Warnung – Optische Strahlung
Dieses Gerät emittiert unsichtbares Infrarotlicht (820 nm). Schauen Sie nicht in die optische Schnittstelle oder das Faserende, solange der Sender aktiv ist.

Das Gerät wird als Sicherheitskomponente zum Schutz von Personen an Maschinen oder Anlagen eingesetzt. Es versetzt die Maschine in einen sicheren Zustand und/oder verhindert ein unbeabsichtigtes Anlaufen. Abhängig von der Anwendung können zusätzliche Schutzeinrichtungen und Maßnahmen erforderlich sein. Das Sicherheitsniveau des Geräts muss mindestens dem erforderlichen Sicherheitsniveau der Maschine/Anlage entsprechen.

Das Gerät darf nur von qualifiziertem Personal gemäß dieser Betriebsanleitung installiert, in Betrieb genommen und gewartet werden. Konfigurationsänderungen dürfen nur von autorisiertem Personal durchgeführt werden. Die für die Konfiguration verantwortliche Person trägt die Verantwortung für die Aufrechterhaltung der Sicherheitsfunktion.

Installation, Inbetriebnahme, Betrieb und wiederkehrende Prüfung müssen in Übereinstimmung mit allen geltenden nationalen und internationalen Vorschriften und Normen erfolgen, einschließlich:
• Maschinenrichtlinie 2006/42/EG
• Geltende Arbeitsschutz- und Unfallverhütungsvorschriften
• Weitere relevante Sicherheitsvorschriften (siehe Konformitätserklärung)

Die Schutzeinrichtung muss von qualifiziertem Personal installiert und in Betrieb genommen werden. Nach Installation, Änderung oder Reparatur muss die gesamte Sicherheitsfunktion überprüft werden. Regelmäßige Prüfungen sind durchzuführen und zu dokumentieren, um die Nachvollziehbarkeit sicherzustellen.

⚠ ACHTUNG – Gefahr durch Konfigurationsänderungen

Die Sicherheitsfunktion kann durch Änderungen der Konfiguration beeinträchtigt werden.

Nach jeder Konfigurationsänderung muss die korrekte Funktion der Schutzeinrichtung durch qualifiziertes Personal überprüft werden. Alle Prüfungen sind zu dokumentieren. Die Nichtbeachtung der technischen Anweisungen und Prüfverfahren kann die Sicherheitsfunktion beeinträchtigen.

CE EU Declaration of Conformity

Manufacturer: PAJ EMS ApS, CVR 34591199, Ellegårdvej 25P, 6400 Sønderborg, Denmark

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Product name: Smart Safety Network (SSN)
Model: SSN-3501, SSN-3504
Description: Safety relay module

The product complies with the following directives:

- Machinery Directive 2006/42/EC
- EMC Directive 2014/30/EU
- RoHS Directive 2011/65/EU (as amended)

The following standards have been applied:

- EN 60947-5-1:2004 + Cor.:2005 + A1:2009
- EN 60947-5-1:2017/AC:2020-05 (used for risk and gap analysis)
- EN ISO 13849-1:2015
- EN ISO 13849-2:2012

The safety functions are designed and validated according to Category 4, PL e in accordance with EN ISO 13849-1 and EN ISO 13849-2, corresponding to SIL CL 3 according to EN 62061.

The conformity assessment for the safety function has been supported by previous third-party evaluation (DGUV Test, Notified Body No. 0340).

Technical documentation is compiled by PAJ EMS ApS Engineering / Compliance

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Signature. Signed for and on behalf of PAJ EMS ApS



Name and signature

Søren J. Laungaard, Managing Director

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