SSN3504

Smart Safety Network

KK User Manual 111627-901 Rev. 1.26

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Contents

Contents 2

Introduction 3

Safety Advice 4

Function 7

DIP Switch information 10

Function description of DIP-switches 12

Reset operating 14

Connection 16

System Start-Up 20

Network and Operating Displays (LEDs) 25

Self test of 1 SSN unit 27

Disposal 28

Technical Safety Documentation 28

Sequence diagram examples 29

Connection examples 30

Connection examples from KK Wind Solutions 32

Specifications 33

Conformity Declaration 37

Introduction

This document describes the physical, electrical and functional characteristics of the Smart Safety Relay SSN3504.

The Smart Safety Network (SSN) is a networked safety relay system designed for monitoring and controlling safety functions, such as switching off protective devices to secure hazardous areas in industrial machinery applications.

This document includes information on device input/output connections, network cabling, wiring and configuration of the SSN system.



Safety Advice

For your safety

The *Smart Safety Network* (SSN for short) was designed as a communication monitoring system of safety relays, as a switch-off function of protective devices to secure hazardous areas in the machine controlled industry.

Before use please read the user manual and carefully store it in a safe place. Install and operate the device only after reading and comprehending the instruction manual, and after you are familiar with the valid rules on work safety and accident prevention.

Please use the device only as specified. For this purpose please also note the values in section “Technical data”.

During transport, storage and operation please adhere to the conditions listed in “Technical data”.

For all capacitive and inductive consumers please make sure that an adequate protective circuit is available.

Please observe all warning signs listed in other sections of this manual. These signs are clearly highlighted!

IMPORTANT

The SSN3504 safety relay must only be installed, commissioned and serviced by qualified safety personnel.

The user manual contains information that enables the proper and efficient use of the SSN monitoring module. PAJ EMS ApS is not liable for damage caused by improper use of this device. This manual is an integral part of the basic knowledge necessary for proper use of the system. It is only for industrial use.

PAJ EMS ApS reserves the right to alter its products without prior notice.

Copying and using the user manual for other purposes is only allowed with the acceptance from PAJ EMS ApS.

PAJ EMS ApS accepts no responsibility for possible errors and deficiencies in brochures, catalogues and other printed material.

PAJ EMS ApS guarantees correct function as well as fulfilment of the safety requirements only when connections are made in accordance with instructions. The SSN safety relay must be used only as defined in ”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.

Safety observations

The comments about safety in this document will not discuss all safety observations of individual machine parts where safety devices (usually safety relays) are applied. Here the respective instruction manuals will be referenced! This document merely describes how to establish a SSN network and how to start it up.

WARNING

The safety function during machine operation cannot be guaranteed if the system is connected incorrectly or not used as specified. This may lead to fatal injuries. Interventions and changes to the SSN-modules are not permitted, unless they are explicitly described in this user manual and in the supporting operating instructions.

Please observe the following to ensure the correct use of the SSN3504 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 SSN3504 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.

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

⚠ 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.

The regional legal regulations and conditions of the liability insurance of the employer must be maintained.

Safety standards

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 above specifications are only valid by serial connection of ≤ 3 pieces SSN-modules.

IMPORTANT

In a risk analysis, the SSN-module may be used to secure hazardous areas, based on its safety category of 4 as a deactivation protective unit.

Conformity statement

The *Smart Safety Network* was developed according to valid European standards and guidelines. The respective conformity statement is found at the end of this user manual.

Residual risks (EN ISO 12100)

The application examples and wiring diagrams provided in this manual are intended as guidance and are based on applicable standards and regulations.

Residual risks may remain, in particular if:

- The recommended wiring design is not followed, resulting in improper integration of safety-related components into the safety circuit.
- The user does not comply with applicable safety regulations, or does not adhere to the specified configuration, inspection and maintenance intervals of the system.
- Inspection and maintenance intervals of the device are not observed.

Area of application

The SSN system is usually used in machines and systems where the SSN network functions as a local bus.

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 and error detections are available, which provide clarity in visualizing and for error searches.

Safety architecture

The SSN module meets the following safety requirements:

- The device is designed with a redundant architecture and self-monitoring.
- The safety function is maintained in the event of a single fault.
- Communication between SSN modules is monitored, and missing or faulty messages are detected.
- The safety outputs are monitored during each switching operation using test pulse signals.

The device is predominantly electronically implemented. The core of the SSN module consists of two microprocessors forming two independent channels.

Both microprocessors evaluate the feedback loop of the safety relay as well as incoming messages from the SSN network. A state machine within the SSN module controls the behaviour of the safety outputs (potential-free changeover relay contacts).

During each switching operation, test pulse signals are used to verify correct switching of the internal relays and to detect potential faults such as short circuits.

Function

Short description of the function

The SSN system enables safe and efficient interconnection of safety devices, such as safety relays, via a network structure. The use of communication technology reduces complex wiring both in the control cabinet and at the installation site.

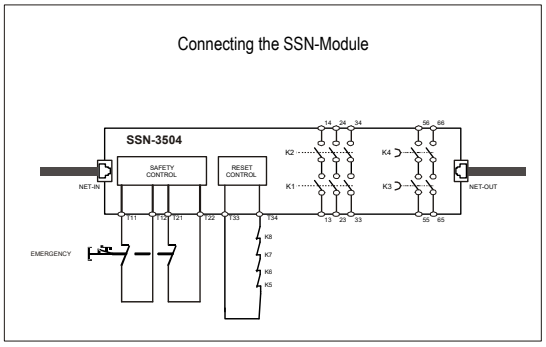
The SSN-3504 is a two-channel safety relay with an integrated SSN network interface. This allows existing safety devices installed in different parts of a machine or system to be interconnected via the SSN network, without the need for additional hardwired connections.

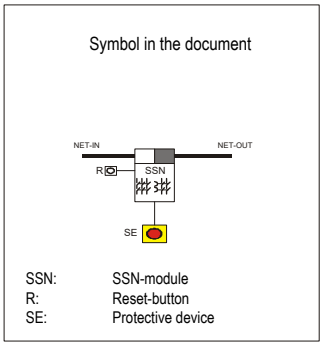
The overall safety level of the system depends on the safety devices integrated into the network.

Warning

The SSN3504 is a safety relay with 2 safety outputs (normally open contacts) and 1 signal output (normally closed contact) and 2 safety feedback channels for emergency stop devices, with an integrated SSN network.

The SSN3504 has 3 potential-free relay contacts 13/14, 23/24, 33/34. The contacts may be connected to the load circuit and 2 delayed potential free relay contacts 65/66, 55/56.





Optical fibre

The SSN modules are connected using the optical fiber cables (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).

Stop – Behaviour

A correctly connected safety relay can now be controlled as follows:

Case A:

The safety circuit is interrupted by the protective device (e.g. EMERGENCY button) and transfers the connected machine into a safe state. The connected SSN-module detects this STOP and sends a STOP message along with the next TOKEN (to the zones that were configured in the SSN-module).

Case B:

The SSN safety relay receives a STOP message for the zone in which the SSN-module is located. Now the SSN-module interrupts the safety circuit by opening the Safety output contacts and transfers the connected machine into a safe state.

Start – Behaviour

Case A:

The SSN-module detects when the T33 and T34 are closed. Provided that the two safety circuits T11/T12 and T21/T22 are not open, the SSN-module sends a START message along with the next TOKEN to the groups/zones which are configured in the SSN-module.

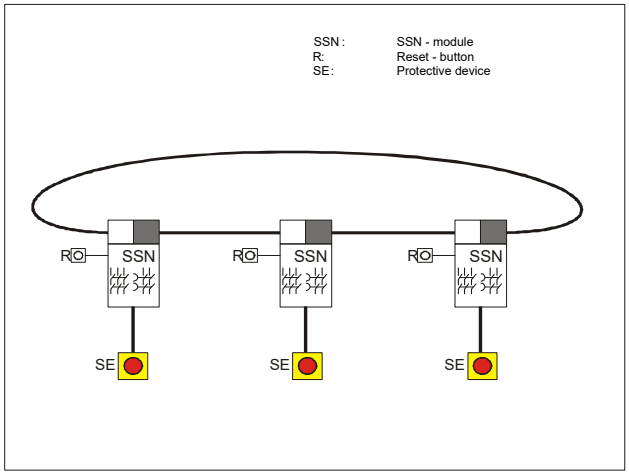
As long as the SSN-safety relay does not receive a start/stop message within approximately 600ms, the output contacts will not be closed and the machine cannot start up.

However, if the SSN-safety relays receive a start/stop message within approximately 600ms, the output contacts will be closed and the machine can start up.

Case B:

The SSN-module receives a START message for the group/zone in which the SSN-module is located. The SSN-module checks that the machine is able to start successfully (the E-Stop buttons feedback coupling loop T11/T12 and T21/T22 should be closed and the T33 and T34 must also be closed, if this has been diagnosed, closes its safety outputs contacts to start up the machine.

When the feedback loop T11/T12 and T21/T22 is broken the SSN-module sends a STOP message along with the next TOKEN to the groups which are configured in the SSN-module. The safety output contacts stay open.



Features of the SSN system

- Optionally connection to EMERGENCY stop device /button, safety switches and safety light curtain/barriers, and to non contact safety switches.
- Cyclical self-test. The SSN device has two micro-processors used for monitoring the safety functions
- The SSN-KK Module operate with 2 modes:
  - automatic reset
  - Network reset – i.e. the unit can be started from the network.
- Setting/configuration via DIP switches
- LEDs for diagnosis
- Removable terminal block (optional)
- Connector for RESET (T33/T34)

DIP Switch information

Comments

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.

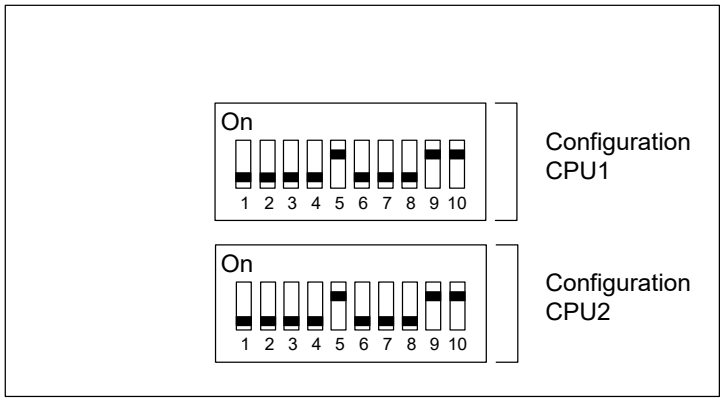
After the device has been configured, the SSN-module must be placed on the DIN-standardized track (35mm - according to EN 60715). Thereafter, the SSN-module must be wired electrically (refer to chapter Connection).

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

Configuration the SSN unit with DIP switches

Via the DIP switches found on a circuit board the various configurations are parameterized. The DIP-switches are found on the side of the housing.

There are 2 rows with DIP switches, since the parameterization according to the safety requirements is doubled. Both rows must therefore be set equally for the device to work.



This shows KK DIP switch setting.
Zone 0 is selected. Start/stop messages are only transmitted to zone 0.
The SSN works in network and automatic reset mode.

Function description of DIP-switches

DIP-Switch	Significant
Key 1	Zone select
Key 2	Zone select
Key 3	Not in use
Key 4	LA Light curtain application
Key 5	SS START/STOP signal for zone 0
Key 6	SS START/STOP signal for zone 1
Key 7	SS START/STOP signal for zone 2
Key 8	SS START/STOP signal for zone 3
Key 9	RM Reset Mode (disabled in KK version)
Key 10	RM Reset Mode (disabled in KK version)

IMPORTANT

The SSN-module can only be configured when the device is turned off. Changes made during operation without turning the power off will not affect the unit!

Zone select

The first 2 switches assign the SSN-module to a specific zone. In a SSN-3504 module up to 4 zones may be set: Zone 0, 1, 2 and zone 3.

DIP- Switch Key 1	DIP- Switch Key 2	Behaviour
0	0	The SSN module belongs to zone 0
1	0	The SSN module belongs to zone 1
0	1	The SSN module belongs to zone 2
1	1	The SSN module belongs to zone 3

Safety Light Curtain Application (LA)

For using a light curtain with the SSN-module the DIP-switch key 4 should be switched in „ON“-position.

DIP-Switch Key 4	Behaviour
0	Default configuration
1	For use with a safety light curtain application

Stop-/Start Signals (SS)

These 4 DIP (key 5, 6, 7 and 8) switches define which zones should be triggered by this SSN-module. The START signal is sent by the SSN-module if the RESET (Start) button of the respective unit was activated. The start signal provides information on which zones will start, unless they are already running.

The STOP signal works the same way as the START signal. The respective SSN-module sends a STOP signal if the safety circuit is interrupted by the protective device (e.g. EMERGENCY switch). The STOP signal provides information about which zones should be stopped if they are not already standing still.

INFORMATION

If Reset Mode is set to “00” or “01” and START/STOP (SS) is set to “0000”, then the SSN-module will react like a stand-alone device. This means the SSN-module does not react to messages from the SSN network and it also does not generate any messages in the network. Only if the communication in the SSN network shows an error or is interrupted, will this SSN-module turn off the safety relay.

DIP-Switch				
Key 5	**Key 6**	**Key 7**	**Key 8**	**Behaviour**
0	0	0	0	The module does not generate any STOP/START messages. Stand-alone mode.
1	0	0	0	The modules generate START/STOP messages for zone 0.
0	1	0	0	The modules generate START/STOP messages for zone 1.
1	1	0	0	The modules generate START/STOP messages for zones 0+1.
0	0	1	0	The modules generate START/STOP messages for zone 2.
1	0	1	0	The modules generate START/STOP messages for zones 0+2.
0	1	1	0	The modules generate START/STOP messages for zones 1+2.
1	1	1	0	The modules generate START/STOP messages for zones 0+1+2.
0	0	0	1	The modules generate START/STOP messages for zone 3.
1	0	0	1	The modules generate START/STOP messages for zones 0+3.
0	1	0	1	The modules generate START/STOP messages for zones 0+1+3.
1	1	0	1	The modules generate START/STOP messages for zones 0+1+3.
0	0	1	1	The modules generate START/STOP messages for zones 2+3.
1	0	1	1	The modules generate START/STOP messages for zones 0+2+3.
0	1	1	1	The modules generate START/STOP messages for zones 1+2+3.
1	1	1	1	The modules generate START/STOP messages for zones 0+1+2+3.

IMPORTANT

You must choose your own zone. Only when choosing the combination “0000” for stand-alone operation, it is allowed not to choosing your own zone.

RESET mode (RM – disabled in KK version)

Reset operating

The E-stop button (Start) must be installed in a manner that the hazardous area can be overseen.

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.

Automatic reset

WARNING

The SSN-module is configured for operating in the auto-start mode the device will automatically turn on when connecting the power supply, but only when the two feedback channel loops (emergency circuit) T11/T12 and T21/T22 are closed and the feedback circuit (Reset) T33/T34 is closed. When (emergency circuit) or (Reset) of the monitored channels are interrupted, for example by pressing the emergency button in the operating mode of the SSN-module (activity state “RUN”), the machine connected to the SSN-module will be transferred in to safety state e.g. the opening of the safety output contacts. By return of the feedback channels / emergency button in the default position e.g. the emergency circuit is closed again the SSN-module will start up automatically (provided that the feedback circuit T33/T34 has been open and closed again).

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

Network reset

The SSN-module is configured for operating in the Network reset mode the device will wait for a start signal from the network before it turn on when connecting the power supply, but only when the two feedback channel loops (emergency circuit) T11/T12 and T21/T22 are closed and the feedback circuit (Reset) T33/T34 is closed. When one of the monitored channels are interrupted, for example by pressing the emergency button in the operating mode of the SSN-module (activity state “RUN”), the machine connected to the SSN-module will be transferred in to safety state e.g. the opening of the safety output contacts. By return of the feedback channels / E-stop button in the default position e.g. the emergency circuit is closed again the SSN-module will wait for a start signal from the network.

Delay settings

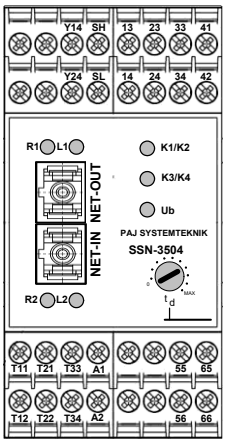
The SSN-module has two integrated positively driven contacts 55/56 and 65/66 (refer to chapter Connection) which can be switched off after the expired delay time. The potentiometer for the delay setting is located/positioned on the front side of the SSN-module. The rotation of potentiometer is divided in to 10 decades, which mean:

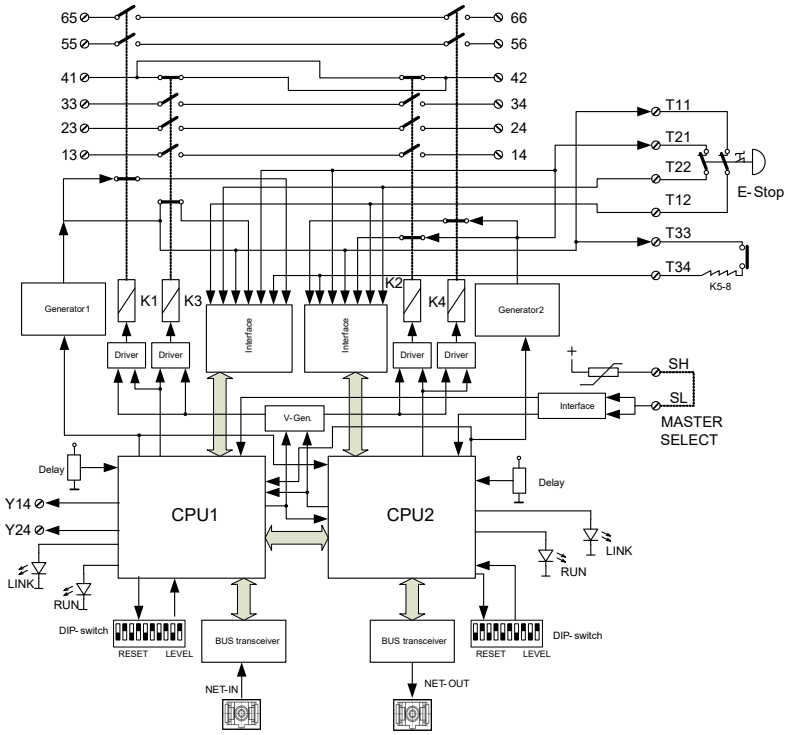
decade	Delay time in sec.
0	Left deflection: default settings, non delay
1	0,5
2	1
3	2
4	4
5	6
6	8
7	10
8	20
9	30

Connection

Wiring diagram

Front view and interior wiring diagram of the SSN device





Description of the terminal clips

Terminal clips	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, 23 / 24, 33 / 34:	N/O safety contacts (non delay)
41 / 42	NC signal outputs (non delay)
55 / 56, 65 / 66	N/O safety contacts (delayed) with adjustable delay-off time (0-30sec.) via the potentiometer on the front side.
Y14 / Y24 :	The semiconductor outputs are meant for functions that do not require a redundancy check such as display instruments, status signals, etc.
A1 / A2:	Supply voltage (+/-). 24VDC.
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 transferring in the network. Please note that there can be configured only one master device in a network.

Description of the LEDs

Terminal clips	Description
R1	Operating state (CPU 1)
R2	Operating state (CPU 2)
L1	Operating state of the incoming signal (CPU 1) (NETIN).
L2	Operating state of the outgoing signal (CPU 2) (NETOUT).

Description of the semi-conductor outputs

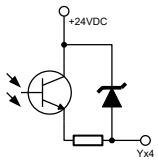
SSN possesses two semi-conductor signalling outputs, Y14 and Y24 that are used to report different operating conditions for example on a PLC.

Semi-conductor output Y14	Description
0VDC	Not activated (SSN all relays are OPEN except for T41/T42)
24VDC	Activated (SSN all relays are CLOSED except for T41/T42)

Semi-conductor output Y24	Description (disabled in KK version)
0VDC	Network or device failure (disabled in KK version)
24VDC	No errors detected (disabled in KK version)

IMPORTANT

The semiconductor signalling outputs do not have a short-circuit protection.
The current load may not be more than 20 mA.
For time-critical measurements there should be used a pull down resistor (from 1K2 to 39K), to reduce the fall time of the outputs from 500 ms down to 10 ms.



Electrical connection

WARNING

Only qualified experts may perform the electrical installation. During installation please note that the supply and signal wires are wired separately from the power supply cables.

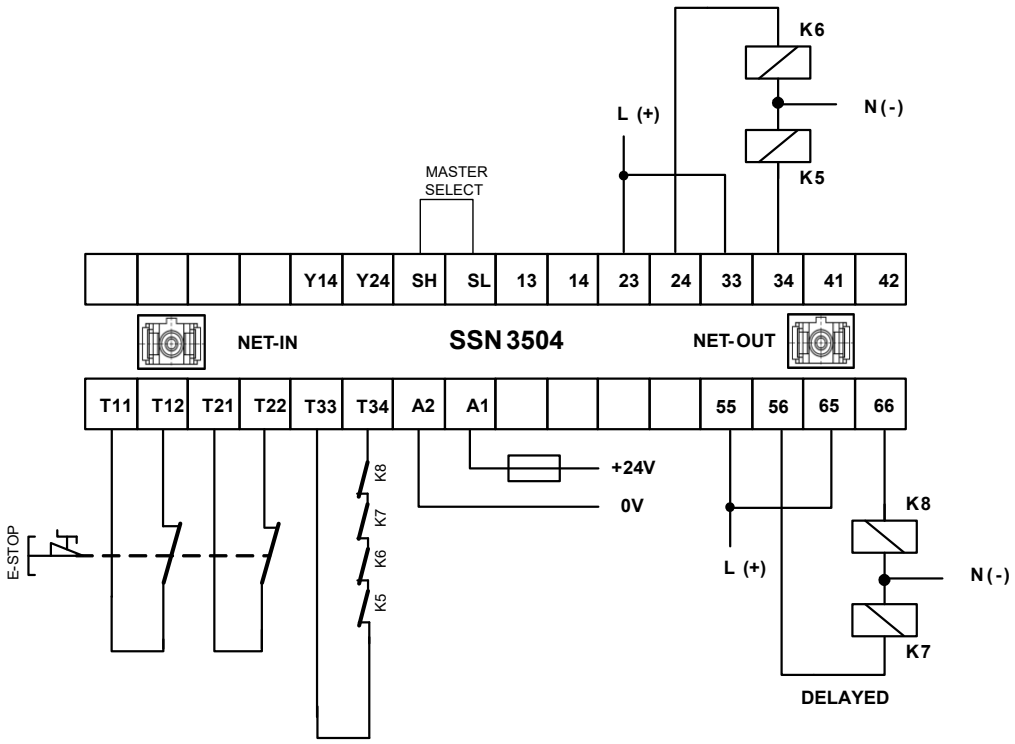
The supply circuits must be isolated from the mains using a safety isolating transformer (e.g. according to EN 61558-2-6) or an equivalent method.

The SSN-module possesses a surge protector (multiple fuses); however, a protection via an external protector is necessary.
The terminal blocks are removable which facilitates the re-inserting. While working on connections, the device may not be connected to the supply voltage.

Please note that the max. length of the optical fibre cable is 1000 meter. Longer cables require using a repeater.

The SSN-modules are only suitable for use in terminal boxes/switch cabinets with a minimum protective class of IP54.

From the following illustration it can be seen that the SSN-module is wired with a safety relay. The figure is only an example not only for any particular area of application.



IMPORTANT

If the Emergency shut-off functions are not activated for a longer period then they are not monitored during this period. Only the switch operations are tested. It is therefore highly recommended to test this function regularly and to include it in the maintenance instructions for this system!

Data connection

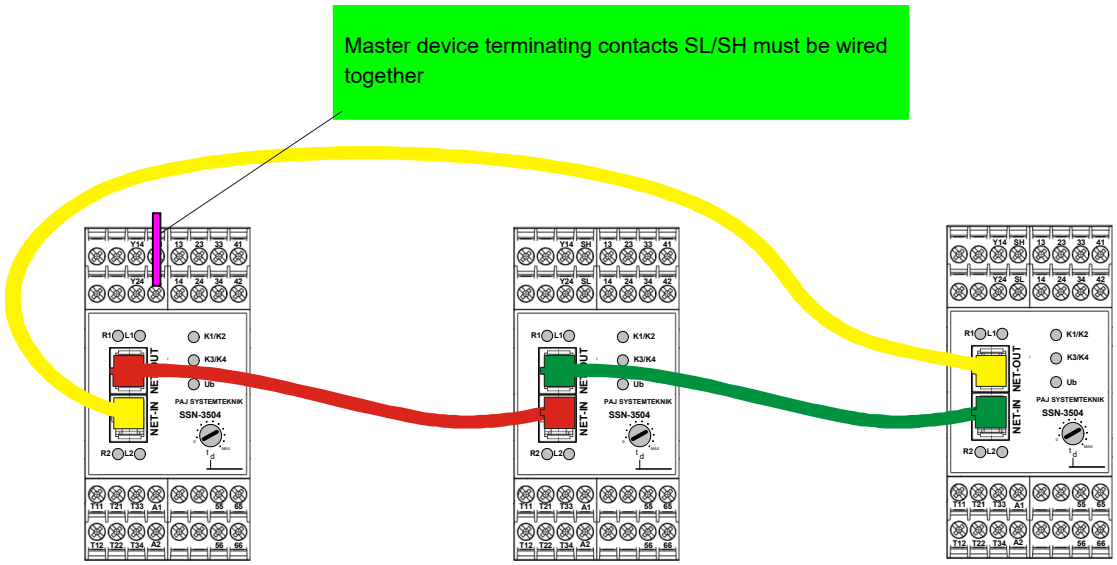
The SSN network is a ring bus network. Therefore, the last SSN-module must be connected to the first unit via optical fibre cable.

To correctly establish the network communication, one SSN-module must control the data transfer (this unit is a virtual master device). To determine the master device the external terminal contacts SL and SH must be wired together. If there is more than one master device present in the network the data transfer will be not established. This is also the case if no master device is present.

The length of the optical fibre cable between the SSN-modules must not be longer than 1000 meter and no more than 25 SSN-modules may be connected to the network.

IMPORTANT

Before plugging cables or scheduling components into the SSN device, ESD remedial measures must be taken.



System Start-Up

WARNING

The device may only be started by authorized technical personnel who are familiar with the proper start-up of safety components.

Switching the system on

1. Make sure that during start-up no individuals are at risk.
2. Before start-up, please check if all connections and the configuration of the individual SSN-modules are correct.
3. Switch on the supply voltage of the individual SSN-modules and applicable safety relays.

   ⇒ If there is no error, R1 and R2 will light up orange to show the operating state and both L1 and L2 will light up red to show the communication state.

   ⇒ Once the last SSN-module has been switched on and no errors are apparent then each SSN-module will show that communication is in operation (both LEDs L1 and L2 light up in green). Once all units have run through a self test without any errors and the network is active, then all units are in a “ready” state.

The SSN-modules conduct various tests regularly (self test, network test, response test for safety relays). If one test run is unsuccessful, the unit will switch to the “error” state and is turned off. This is shown by the LEDs R1 and R2 are no longer orange (or green), but show an error code in red.

IMPORTANT

A faulty SSN unit switches only to the “ready” status once all errors have been corrected AND the supply voltage has been removed (system reboot).

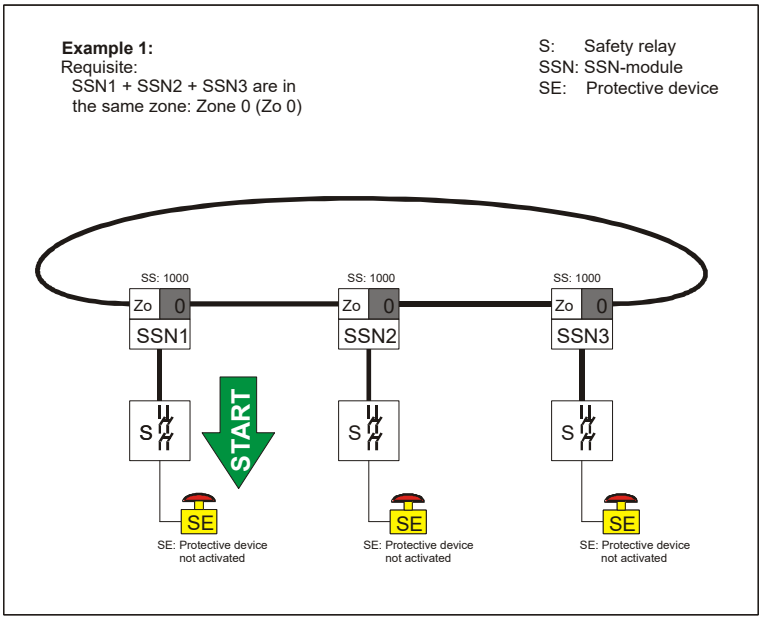
Start behaviour of the system

Now the system is ready for actual operation.

Start-up scenario 1

In the event, that all protective devices are set to the standard position in the zones to be started (that means all safety relays are ready to start), then the following start process is generated:

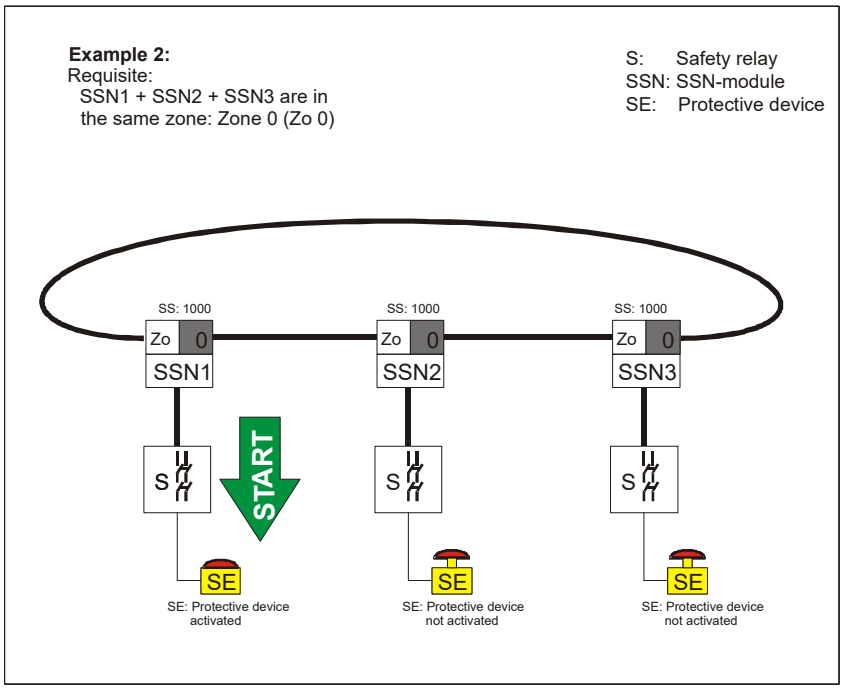
- After release the E-stop button, the safety relay will attempt to start the machine partial system that is connected to SSN1.
- The SSN-module (SSN1) now sends a start signal/message to the zone 0, which are configured in the SSN-module (here SS= “1000” = zone 0).
- Once SSN2 and SSN3 receive the message also these machine parts are started under the condition that the feedback loop T33/T34 has been open and closed again, and the feedback loop T11/T12 and T21/T22 are closed.



Start-up scenario 2:

In the event that the protective device of the SSN-module is not in the normal position (that the safety relay is not ready to be started), then you will receive the following start process:

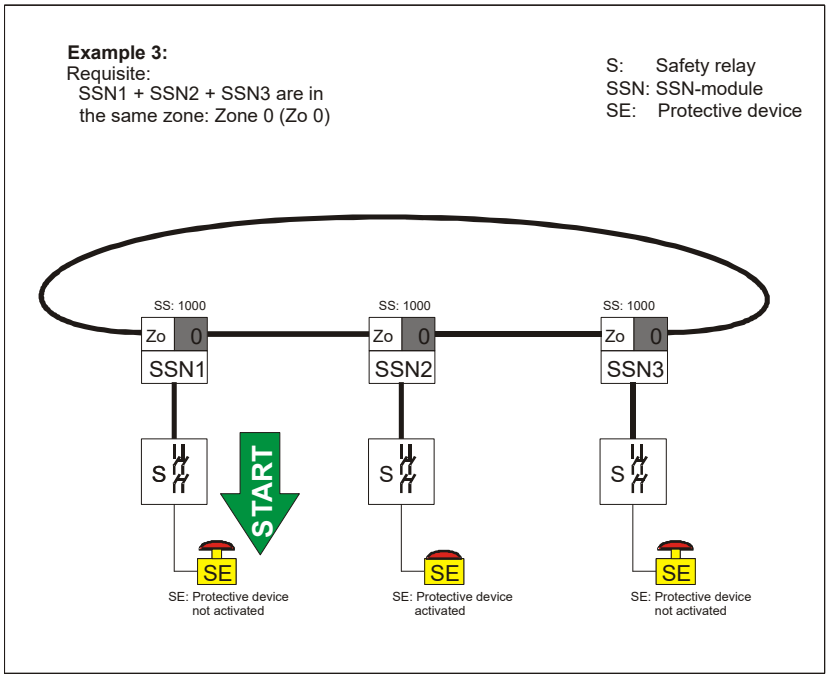
- After release the E-stop button (Start) the safety relay will attempt to start the machine partial system. Since this is not possible (i.e. T11/T12 and T21/T22 are open), nothing happens. Therefore, no start signals are send to the configured SSN-modules.



Start-up scenario 3:

In the event that the protective device of one of the other SSN-modules (e.g. SSN2) in the group/zone is not in the normal position (that is the safety relay is not ready to be started), then you will receive the following start process:

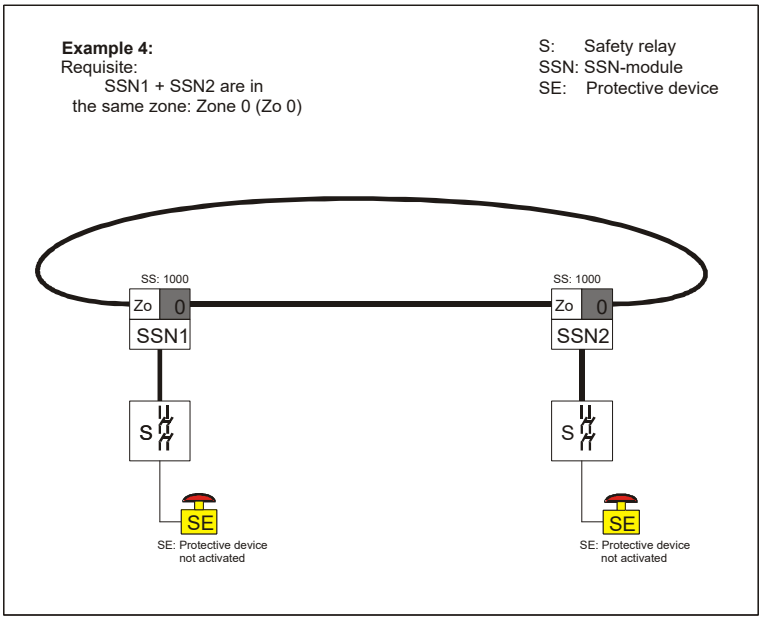
- After release the E-stop button (Start), the SSN-module (SSN1) sends a START-command with the next token to the groups/zones, which are configured in the SSN-module; here SS = “1000” = Zone 0.
- The SSN-modules SSN2 and SSN3 receives this message and checks the reset conditions for starting the machine. The SSN2-module detects that it is not ready for a reset (Start) and immediately sends a STOP-command into the network. This causes an abort of the current start attempt. At this time the safety output contacts are still open and the machine is not yet started.
- The system has detected that a start was not possible. The fail condition for a secure reset was also detected by the system.



Start-up scenario 4 with different power up times

In the event, that all protective devices are set to the normal position in the zones to be started (that means all safety relays are ready to start), then the following start process is generated:

- After power up the SSN1 will attempt to start the machine partial system that is connected to SSN1 and there is no power on SSN2.
- The SSN1 now sends a start signal/message to the zone 0, which are configured in the SSN-module (here SS= “1000” = zone 0).
- SSN2 is not powered up, and SSN1 will wait until SSN2 is powered up. After power up on SSN2, the SSN1 can receive the start signal/message from SSN2 and machine parts are started under the condition that the feedback loop T33/T34 is closed and the units have been configured as “Network only” RESET.
- The same start up scenario will happen if SSN2 first powered up.
- In this scenario the SSN3501 must be the Master unit.



Network and Operating Displays (LEDs)

In operation, 4 LEDs (R1, R2, L1 and L2) show the operating state and possible system errors. The LEDs R1 and L1 obtain their impulse form the CPU1. The LEDs R2 and L2 receive their impulse from CPU2. The LEDs can display the following three colors: Red, green and orange.

The LEDs R1 and R2 (RUN1 & RUN2) are assigned to the SSN-module and the connected safety relay as a status display.

The LEDs L1 and L2 (Link1 & Link2) are assigned to the network as a status display.

Errors are displayed by way of a blinking LED signal. The following table explains the significance of the LEDs.

LEDs R1 and R2 (operating display)

Color	Type	Description
Off	Continuous off	The monitored emergency stop channels T21, T22 and T11, T12 are open. The device is not turned on.
Orange	Continuous light	The safety output contacts of the SSN-module are open. There are no internal system faults present. Furthermore, the LEDs indicate the current status of the monitored emergency stop channels T21, T22 and T11, T12. The continuous light means that the emergency channel T21, T22 and T11, T12 are closed. Missing Master unit, short circuit between SH and SL is missing. SSN unit is waiting for Reset (Start) signal. Wrong power-up sequence by KK version. Missing network only if L1 and L2 indicates by red light.
Orange	Blinking	Both inputs T21, T22 and T11, T12 must be identical, either both open or both closed, otherwise the error is shown by R1 and R2. R1 blinking orange and R2 is off, then the inputs T11 and T12 are open, and the inputs T21 and T22 are closed. R2 blinking orange and R1 is off, then the inputs T11 and T12 are closed, and the inputs T21 and T22 are open.
Red	Continuous light or blinking	There is an error. The error code is displayed by a number of red blinking signals. See Error overview.
Green	Continuous light	The safety output contacts are closed and the safety relay is in a “RUN” condition.

LEDs L1 and L2 (communication display)

Color	Type	Description
Off	Continuous	The device is not turned on.

Green	Continuous light	Network ready Data packages are transferred.
Red	Continuous light	Network crash / error – data packages are being received.
Red	Blinking	Network crash / error – data packages are NOT being received.

IMPORTANT

During an optical fibre cable failure or optical fibre cable error, all communication LEDS (L1 and L2) will blink red of those SSN devices that are rear-mounted to the error source, while the remaining LEDs will light continuously!

Error overview

If an error is detected in the SSN device, then the LED R1 and R2 show an error code by blinking. The error code is equal to the number of red blinking signals between two green blinking signals. For example green-red-red-red-red-green is equal to the error code 4.
R1 indicates errors detected by CPU1. R2 indicates errors detected by CPU2. Therefore, there can be a difference in number of blinking signals on R1 and R2.

Error code	Description
Continuous light	Check sum error / software error
1	The test impulse generator is not working properly, therefore no stepping is registered. To assure that it is not a short-circuit of the feedback contacts, please set the delay of the relay contacts 55/56, 65/66 on min. 0,5 sec. After a renewed turn on of the SSN device, the error must be confirmed through the LED-status output.
2	There is measured an internal error on K3 in the SSN relay, the SSN relay is faulty. Relay output must be open, but is closed. See wiring diagram on page 16
3	There is measured an internal error on K2 the SSN relay, the SSN relay is faulty. Relay output must be open, but is closed. See wiring diagram on page 16
4	There is measured an internal error on K1 in the SSN relay, the SSN relay is faulty. Relay output must be closed, but is open. See wiring diagram on page 16
5	There is measured an internal error on K4 in the SSN relay, the SSN relay is faulty. Relay output must be closed, but is open. See wiring diagram on page 16
6	Internal network error message received. This means that the **other** CPU has detected a fault, and its error code must be read instead of this.
7	Error in the contact monitor for the (E-stop) feedback path.
8	Error in the contact monitor for the reset (Start) button.
9	Communication between the CPUs is interrupted. This means that the **other** CPU has detected a fault, and its error code must be read instead of this.
10	Faulty setting of the DIP switch. Either the two DIP switch rows are not identical or in the START/STOP group setting the group of the unit is not included (unless, all switches are deactivated = "0000").
11	The two CPU are not in the same operating status! The cause may be a hardware or software problem. Note: If an error is registered by a CPU it will switch to the "device error“ condition. The other CPU remains in the operating condition (e.g. "ready" or „running“). After a

	short time this CPU registers which one did not recognize the problem that the operating conditions are different. If a CPU shows this error notice, however, the other one deviating from this, then the error cause will be found in the latter.
12	The feedback path is blocked, even though the safety relay (output) is open.
13	Batch overload. This indicates a software problem.
14	Incorrect wiring (cross over) of the feedback channels T21, T22 and T11, T12 on the EMERGENCY stop device or an error on the EMERGENCY stop circuit.
15	Short circuit failure on the two channel T21, T22 and T11, T12 EMERGENCY-stop.
16	Incorrect settings of the delay time. Please check the position of the potentiometer. If the potentiometer is positioned between two settings.
17	Master device initialization error. Caused by the hardware.
Continuous orange light	Missing Master unit, short circuit between SH and SL is missing. Wrong power-up sequence by KK version. SSN unit is waiting for Reset (Start) signal.
Blinking orange light	Both inputs T21, T22 and T11, T12 must be identical, either both open or both closed, otherwise the error is shown by R1 and R2. R1 blinking orange and R2 is off, then the inputs T11 and T12 are open, and the inputs T21 and T22 are closed. R2 blinking orange and R1 is off, then the inputs T11 and T12 are closed, and the inputs T21 and T22 are open.

Self test of 1 SSN unit

When troubleshooting SSN devices in a network, there is an opportunity to troubleshoot the individual SSN unit. The SSN unit to be debugged on, must have shorted SH and SL inputs, then 1 optical cable must be connected to NET-IN and NET-OUT, so it will be a closed communication loop. In this way the SSN device is not in the network and will work as a standalone device.

Replacing defect SSN-modules

The SSN-module may be replaced in case of an error. The configuration of the defect SSN-module must be noted. The same configuration is completed in the new device so that it can be connected. There must be made a renewed function test after replacing a SSN unit.

WARNING

When removing safety modules during operation, there will be a loss of the safety function. Individuals may be put at risk and cause damage to the device or system. Separate the system from the power supply and protect the system from switching back on before you begin the work.

IMPORTANT

Only qualified personnel may assemble start-up and maintain the unit when it is in a zero voltage state. Only qualified electricians may work on electrical installations.

Disposal

Electronic waste is hazardous waste! Please observe the local rules for disposing these products.

The SSN unit does not contain any batteries that need to be removed before disposing of the product. The SSN unit meets the requirements of the RoHS standard.



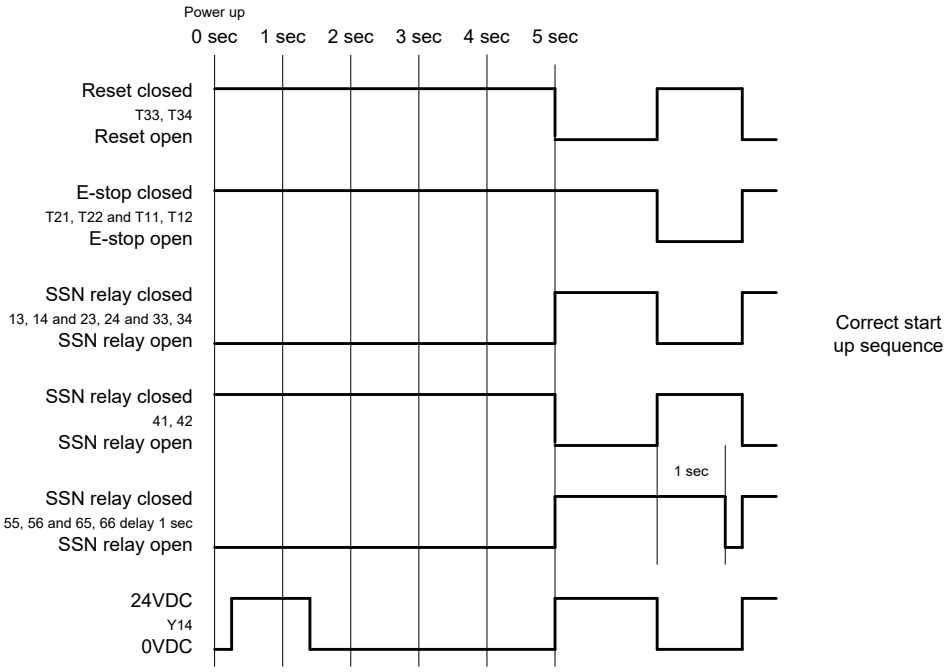
Technical Safety Documentation

To ensure that qualified personnel can reinstall a new SSN unit or maintain the system, the following procedure shall be followed.

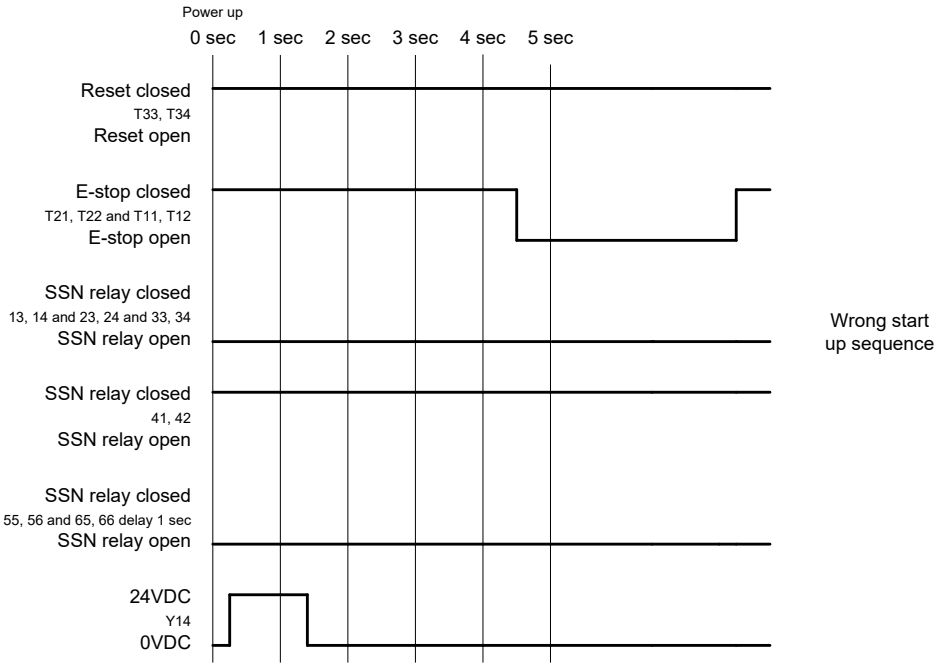
Procedure:

- Prepare configuration for the device
- Confirm configuration (completed only by qualified personnel)
- Sign configuration labels
- Create and sign log about the configuration
- Archive log along with other technical documentation about the device (machine documentation) and store in a safe place

Sequence diagram examples



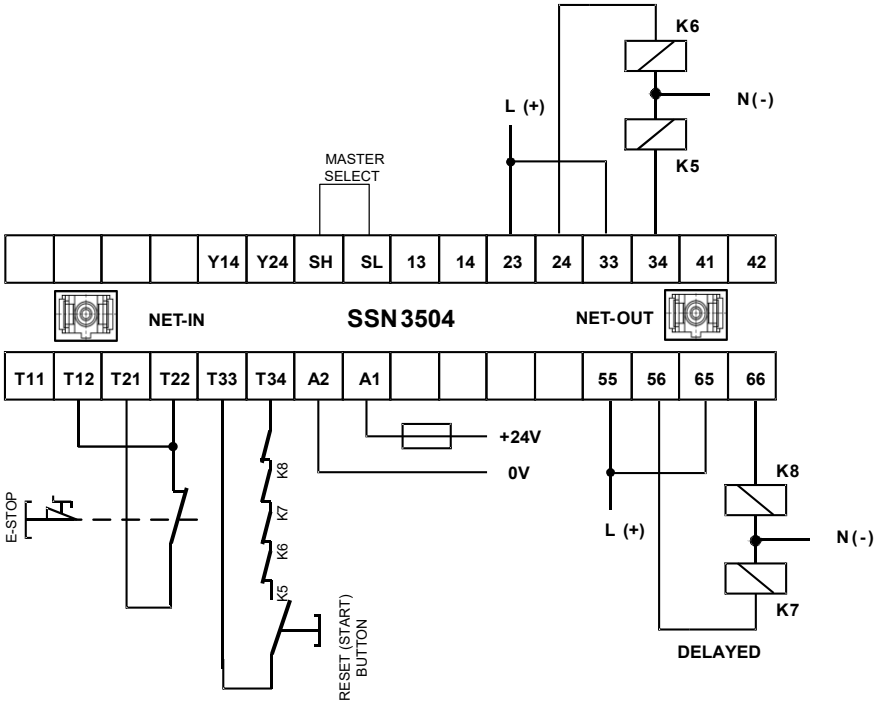
The input signals are correctly closed before 5 seconds have passed. Y14 is shown with 39K pull down resistor.



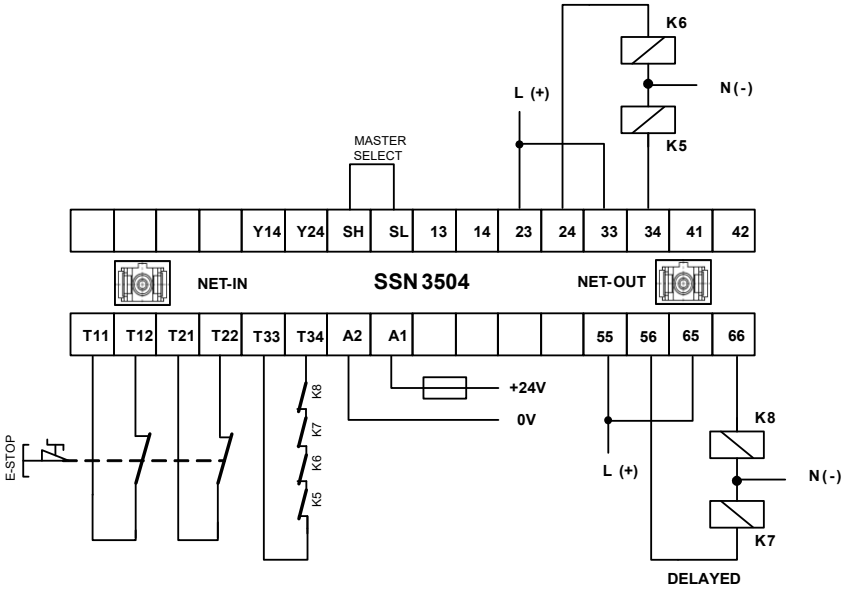
The input signals are not closed before 5 seconds have passed. And therefore the SSN relay will not turn on. A restart must be made, and ensure a correct start-up sequence is followed. Y14 is shown with 39K pull down resistor.

Connection examples

Emergency Shut-Off 1 channel (only if the Safety light barrier is configured, the DIP-Switch key 4 is set to "high") also it is not possible to use the SSN-module in 1 channel operation.

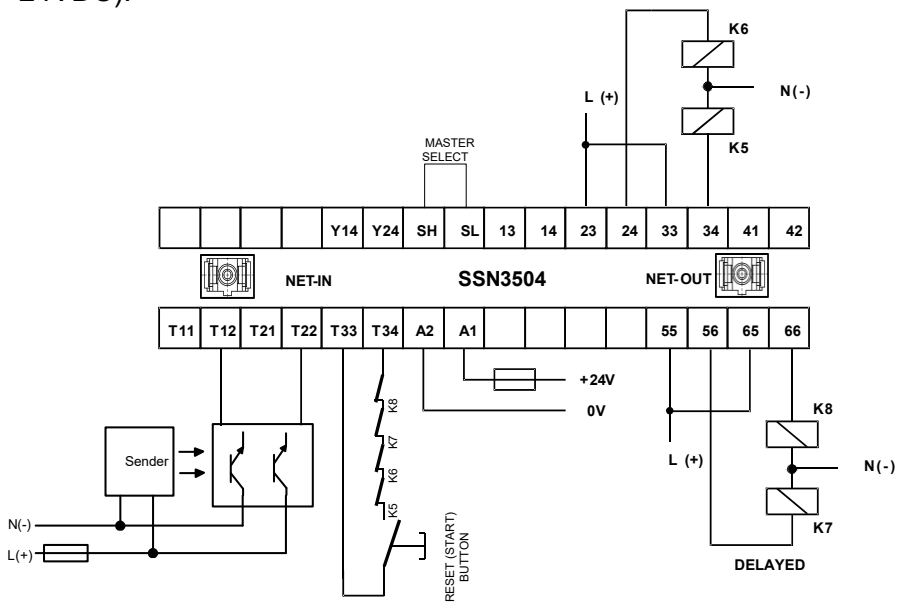


Emergency Shut-Off 2 channel (Automatic RESET or Network only RESET)

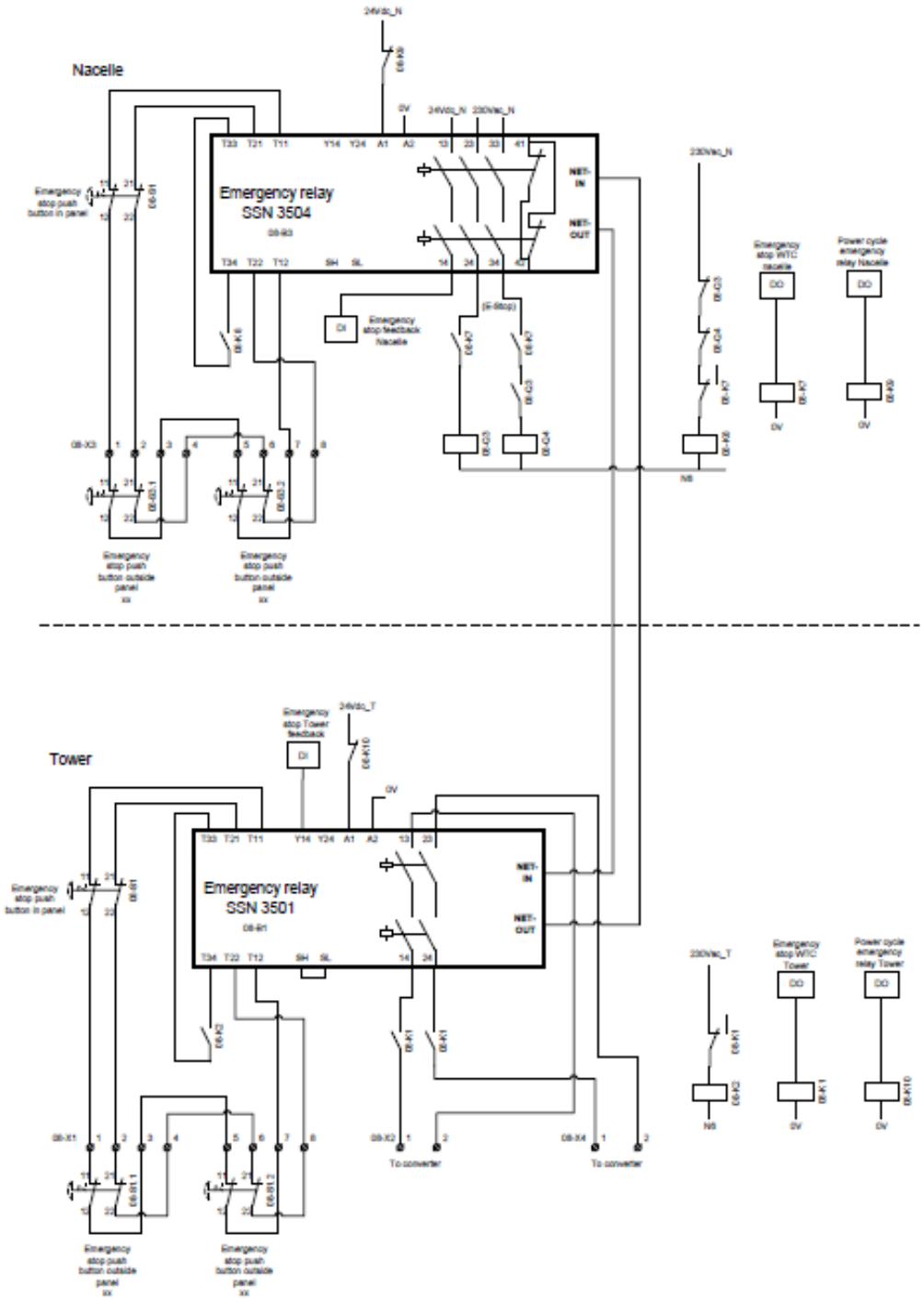


Safety light barrier

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).



Connection examples from KK Wind Solutions



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	< 260 mA (semi-conductor outputs no load)
Power input	< 6,24 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	3 x NO, 1 x NC (non delay), 2 x NO (delayed)
Breaking capacity according to EN 60947-5-1, 13/14, 23/24, 33/34, 41/42, 55/56, 65/66	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
Adjustable deactivation delay [sec]	0 / 0,5 / 1 / 2 / 4 / 6 / 8 / 10 / 20 / 30
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 - Delay settings
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	
Functional 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)

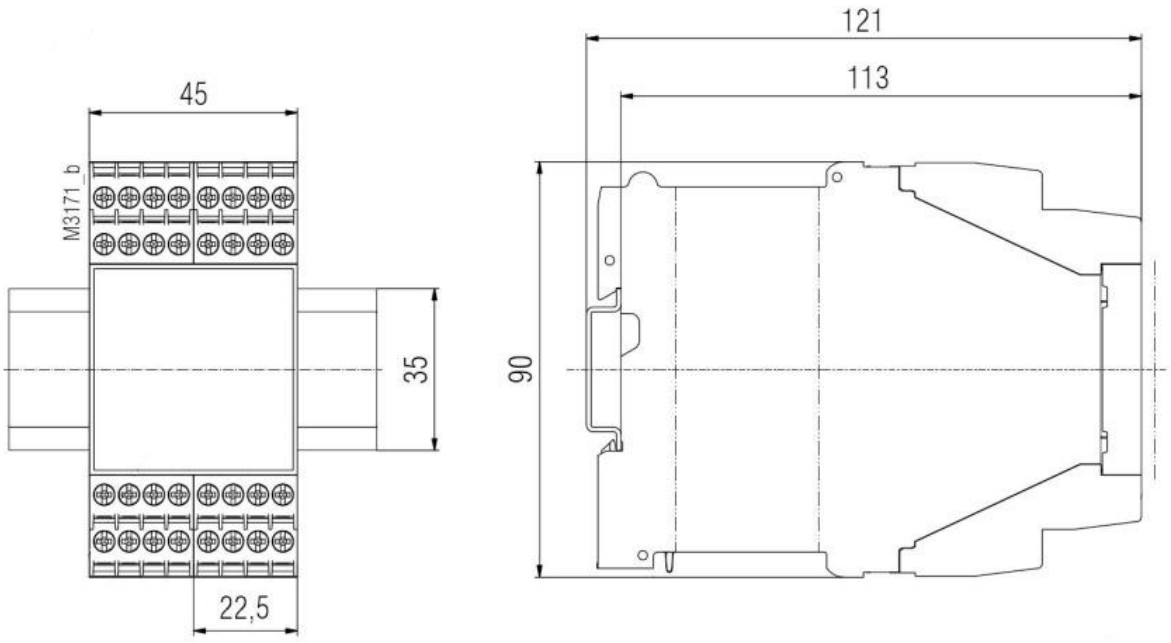
Safety technical Information	Safety-related control system according to EN ISO 13849-1, Category 4, PL e (corresponding to SIL CL 3)		
	Parameter	**Values**	**Unit**
	$MTTF_d$ (CH1) AC15	56,71	Year's
	$MTTF_d$ (CH2) AC15	56,92	Year's
	$MTTF_{davg}$ AC15	56,81	Year's
	$MTTF_d$ (CH1) DC13	56,7	Year's
	$MTTF_d$ (CH2) DC13	56,93	Year's
	$MTTF_{davg}$ DC13	56,81	Year's
	T_{10d}	5,68	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	4.66E-08	

Enclosure

Mechanical	
Dimensions, WxHxD (mm)	45 x 90 x 118
Weight:	~ 400 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	DIN rail (35 mm) according to 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

Scale drawing

Enclosure with pluggable screw clamps



Recommended minimum clearance around the SSN-module:

Top: 15 mm
Below: 15 mm

Between the devices: 2-3 mm distance.
Recommendation for surrounding temperatures greater than + 40° C / +104°F.

Installation

IMPORTANT

Install the SSN device in a switch cabinet equipped with a protective type of at least IP54.

- Make sure that the device is disconnected from the power supply when you are working on the device.
- Attach the device, with help from the snap element, to the back of a standard track (DIN 35 mm).
- Secure the device on a vertical standard track (35 mm) using a holding element (e.g. terminal holder of final angle)
- For dismounting of the SSN-module, loosen the snap element using a screwdriver and tilt the SSN-module upwards of the DIN track.

Conformity Declaration

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

Date of issue: 31/3-2026

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