0ACST052.1

1 General information

The TSN switch makes it possible to easily implement modular machine concepts and Ethernet TSN networks, for example in conjunction with the vendor-independent communication solution OPC UA over TSN. The TSN switch enables star, tree, ring or meshed topologies in OPC UA over TSN networks. It enables cycle times under 50 µs and fits into the B&R portfolio in terms of design and form factor.

Ethernet network stations with or without TSN functionality can be integrated into the network equally easily with the TSN switch. The TSN switch works in all Ethernet and Ethernet TSN networks and supports the following TSN standards:

- IEEE 802.1Q
- IEEE 802.1AS-2020 - Precision Time Protocol (PTP)
- IEEE 802.1Qbv
- IEEE 802.1Qav
- IEEE 802.1Qbu

1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Document name	Title
TSN switch	TSN switch user's manual

2 Order data

Order number	Short description	Figure
	Switch	
0ACST052.1	5-port 100/1000 Mbit Ethernet layer 2 industrial switch, 4-port TSN, 1-port Ethernet uplink (RJ45, layer 2), 24 VDC, terminal block 0TB2103.9110 included	

Table 1: 0ACST052.1 - Order data

For details about the included terminal block, see 12 "0TB2103.9110".

Optional accessories

Order number	Short description
Connection cables	
X20CA0E61.xxxxx	POWERLINK/Ethernet connection cable, RJ45 to RJ45, 0.2 to 20 m
X20CA0E61.xxxx	POWERLINK/Ethernet connection cable, RJ45 to RJ45, 20 m and longer

End clamp set for installation on vertical top-hat rail

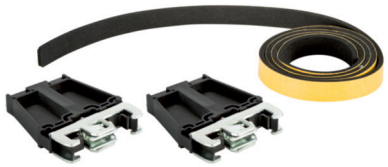
Order number	Short description	Figure
	End clamp set	
X20AC0RF1	X20 end clamp set for high vibrations	

Table 2: X20AC0RF1 - Order data

3 Technical data

Order number	0ACST052.1
General information	
B&R ID code	0x1404
Status indicators	Module status, network status
Diagnostics	
Module status	Yes, using LED status indicator and software
Network status	Yes, using LED status indicator and software
Power consumption	6.3 W
Certifications	
CE	Yes
UKCA	Yes
UL	cULus E115267 Industrial control equipment
Interfaces	
Type	4x OPC UA over TSN 1x Ethernet
Standard (compliance)	IEEE 802 (standard Ethernet), IEEE 802.1Q (TSN), OPC UA
Variant	5x RJ45 shielded
Line length	Max. 100 m between 2 stations (segment length)
Transfer rate	100 Mbit/s and 1 Gbit/s
Transfer	
Physical layer	100BASE-TX/1000BASE-T
Half-duplex	No
Full-duplex	Yes
Autonegotiation	Yes
Auto-MDI/MDIX	Yes
Power supply	
Nominal voltage	24 VDC, SELV/PELV
Voltage range	20.4 to 28.8 VDC
Fuse	3 A slow-blow
Reverse polarity protection	Yes
Electrical properties	
Electrical isolation	Ethernet isolated from each other and from power supply
Operating conditions	
Mounting orientation [1]	
Horizontal	Yes
Vertical	Yes
Installation elevation above sea level	
0 to 2000 m	No limitation
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m
Maximum	4000 m
Pollution degree per EN 60664-1	2
Overvoltage category per EN 60664-1	2
Degree of protection per EN 60529	IP20 [2]
Operating position	Indoor use only
Ambient conditions	
Temperature	
Operation [1]	
Horizontal mounting orientation	-25 to 60°C
Vertical mounting orientation	-25 to 50°C
Derating	See section "Mounting orientations and derating".
Storage	-40 to 85°C
Transport	-40 to 85°C
Relative humidity	
Operation	5 to 95%, non-condensing
Storage	5 to 95%, non-condensing
Transport	5 to 95%, non-condensing

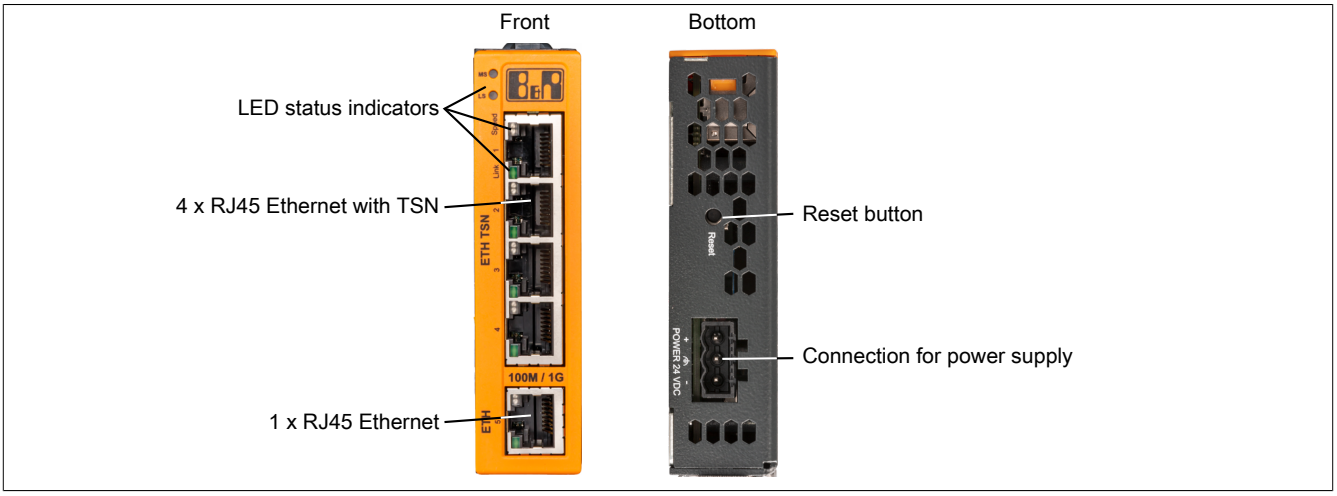
Table 3: 0ACST052.1 - Technical data

Order number	0ACST052.1
Mechanical properties	
Dimensions	
Width	25 mm
Length	100 mm
Height	100 mm
Weight	280 g

Table 3: 0ACST052.1 - Technical data

1) See section "Mounting orientations and derating" for additional mounting orientations.
2) Not tested by UL.

4 Operating and connection elements



4.1 Status LED

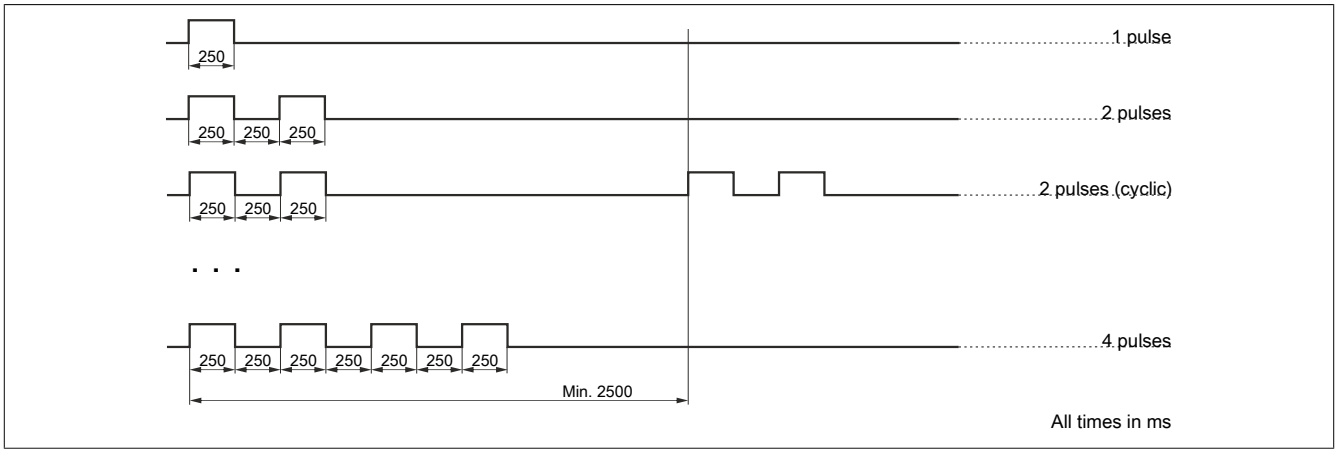
The following table describes the LED status indicators for the TSN switch. Exact blink times are specified in the timing diagram in the next section.

The LEDs flash red immediately after switching on. This is not an error message.

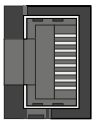
Figure	LED	Color	Status	Description
	MS[1]	-	Off	No power to module or mode RESET [2]
		Green	2 pulses	Firmware update
			On	Module OK
		Red	1 pulse	Mode RESET: Restart
			2 pulses	Mode RESET: Deletes the configuration
			3 pulses	Mode RESET: Deletes the safety configuration
			4 pulses	Mode RESET: Resets to the factory settings
			On	Error state
		Green + Red	On	Mode RESET: Confirmation of the deletion procedure
	LS[3]	Green	1 pulse	Waiting for IP configuration
			2 pulses	Waiting for PTP synchronization
			3 pulses	Waiting for NTP synchronization
			On	Network OK
		Red	1 pulse	IP configuration timeout [4]
			2 pulses	PTP synchronization timeout [5]
			3 pulses	NTP synchronization timeout
			4 pulses	PTP status error [6]
			On	IP address conflict
	Speed[7]	Yellow	On	Transfer rate: 1 Gbit/s
		Green	On	Transfer rate: 100 Mbit/s
		Yellow + Green	Off	The transfer rate of the remote station does not correspond to 1 Gbit/s or 100 Mbit/s.
	Link	Green	Off	No link to remote station
			On	The link to the remote station is established.
			Flickering	The link to the remote station is established. The LED blinks if Ethernet activity is taking place.

1) Module status "MS": This LED is a green/red dual LED.
2) See "Reset button" on page 5.
3) LAN status "LS": This LED is a green/red dual LED.
4) The TSN switch has not yet been assigned an IP address.
5) The TSN switch was configured as a PTP slave, but one of the following errors occurred:
   - No PTP grandmaster can be detected.
   - The synchronization offset to the PTP grandmaster is outside of the specification.
6) The TSN switch was configured as a PTP grandmaster, but it is a PTP slave.
7) Network speed: This LED is a green/yellow dual LED.

LED status indicators - Blink times



4.2 Ethernet connection

Interface	Pinout		
	Pin	Ethernet	
 Shielded RJ45 port	1	D1+	Data 1+
	2	D1-	Data 1-
	3	D2+	Data 2+
	4	D3+	Data 3+
	5	D3-	Data 3-
	6	D2-	Data 2-
	7	D4+	Data 4+
	8	D4-	Data 4-

4.3 Reset button

A reset button (red circle) is located on the bottom of the module.



Reset during startup

Indication of startup: LED "MS" is not yet permanently lit up green or red.

> **Information:**
>
> **Pressing the reset button during startup is not permitted.**

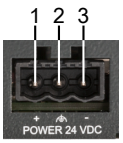
Reset during operation

During operation, the function triggered depends on the length of time the reset button is pressed.

Function	Time pressed	LED status indicator[1)]	Confirmation
Setting a default IP address [2)]	1 s	LED "MS": Off	-
Restart	5 s	LED "MS": 1 pulse after 5 seconds	-
Delete configuration	10 s	LED "MS": 2 pulses after 10 seconds	If the reset button is pressed again within 5 s, the action is executed and the TSN switch is then restarted.
Delete security configuration	15 s	LED "MS": 3 pulses after 15 seconds	
Reset to factory settings	20 s	LED "MS": 4 pulses after 20 seconds	

1) See "LED status indicators - Blink times" on page 4.
2) Default IP address 192.168.1.1, see "Setting the IP address" on page 6.

4.4 24 VDC power supply



Terminal	Pinout
1	24 VDC
2	Functional ground
3	0 V / GND

5 Power supply of the TSN switch

A power supply unit with output voltage between 20.4 and 28.8 V is required to supply the TSN switch.

The use of a B&R 24 VDC power supply unit is recommended. B&R power supply units ensure that the TSN switch is reliably supplied even during temporary power failures (≤10 ms).

Information:

The power supply cables must be suitable for at least 75°C.

Notice!

Primary circuits, from which the connected secondary voltages are derived, must be limited to overvoltage category II and may have a maximum system voltage of 300 V.

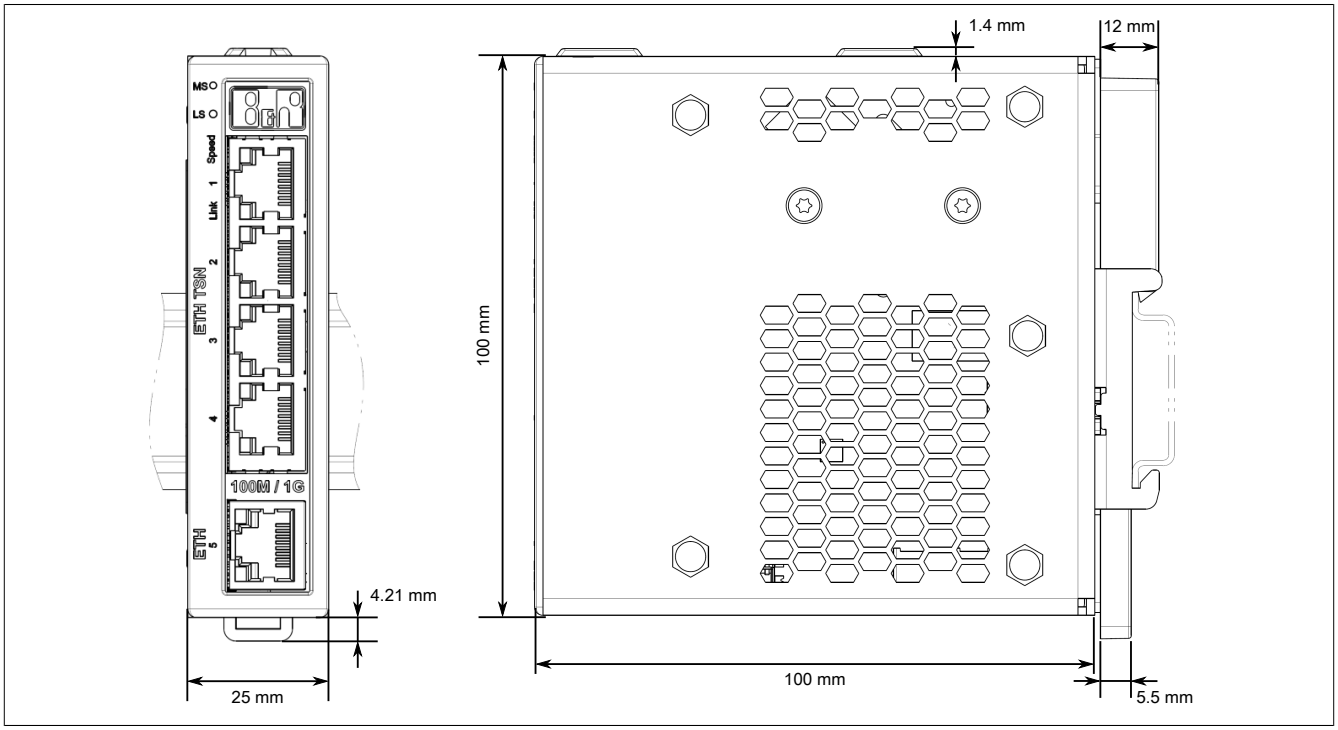
All connected circuits must meet the requirements for SELV/PELV circuits (Class III) according to UL/CSA/IEC 61010-1, 61010-2-201.

6 Setting the IP address

Depending on the type of application used, an IP address can be assigned to the TSN switch in various ways.

- Automatic assignment via DHCP server
  By default, the TSN switch is configured for automatic IP address assignment via a DHCP server. In machine networks with a B&R controller, the DHCP server function is provided by Automation Runtime. However, PCs or laptops with desktop operating systems such as Windows or Linux usually do not offer a DHCP server.
- Setting the static IP address (192.168.1.1) by actuating the reset button (see section "Reset button" on page 5)
- Configuration via OPC UA server
- Configuration in Automation Studio

7 Dimensions



8 Installation

The TSN switch is installed in the control cabinet with the supplied top-hat rail fastener. The following mounting orientations are possible:

- Horizontal installation
- Vertical installation
- Face-up installation
- Oblique installation

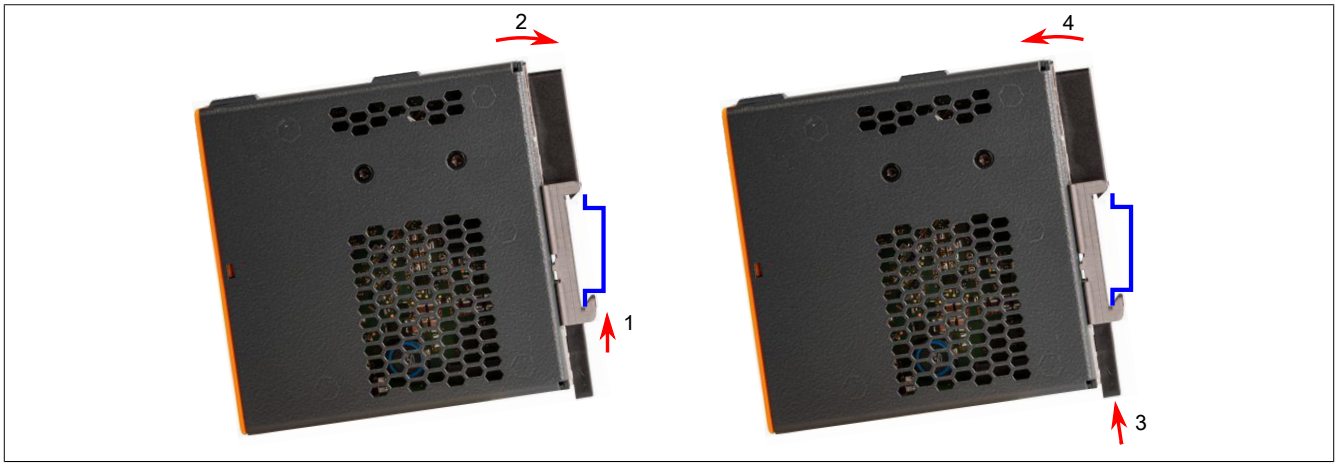
Notice!

The module must be installed in a final safety enclosure that meets UL/CSA/IEC 61010-1 and UL/CSA/IEC 61010-2-201 requirements for a fire enclosure.

In all cases, applicable national and international standards, regulations and safety measures must be taken into account and observed.

Installing/Removing the module

To install, connect the TSN switch to the top-hat rail from below (1) and snap the top side into the top-hat rail (2). To remove, press the unlocking mechanism (3) and remove the TSN switch from the top-hat rail (4).

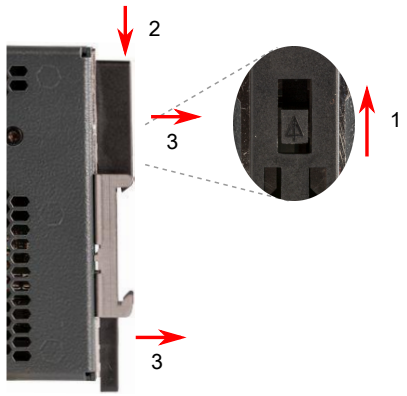
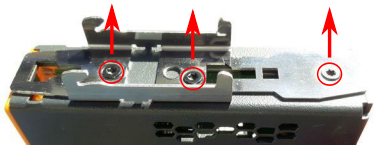
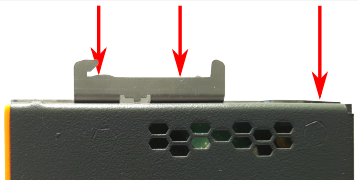
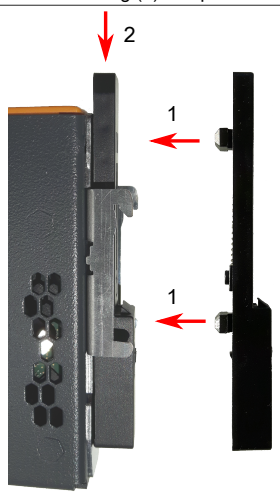


Options

All mounting orientations can use options "Front network connection" and "Bottom or side network connection". The top-hat rail bracket is already pre-assembled for option "Front network connection".

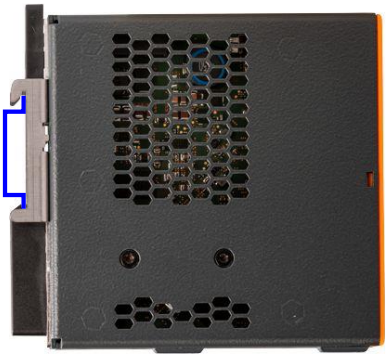
Network connection in front	Network connection underneath
	

8.1 Remounting the top-hat rail bracket

1. Push the safety lever (1) all the way up and then slide the top-hat rail lever down (2). Pull the top-hat rail lever out of the housing (3).	2. Remove the M3 screws and take off the top-hat rail bracket.
	
3. Remove the protective covers on the side.	4. Put the top-hat rail bracket in place and secure the M3 screws with a torque of 0.55 Nm.
	
5. Insert the retaining bolts of the top-hat rail lever into the housing (1) and press down (2).	6. Close the rear openings with the protective covers.
	

8.2 Mounting orientations and derating

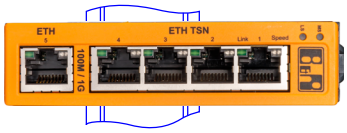
Horizontal installation



Operation is possible up to 60°C. For horizontal installation, the following spacing must be maintained between 2 modules:

- Up to 50°C - 10 mm spacing
- 50°C and higher - 20 mm spacing

Vertical installation



Information:

For vertical installation, the TSN switch must be secured against sliding down with an end clamp.

Operation is possible up to 50°C. For vertical installation, the following spacing must be maintained between 2 modules:

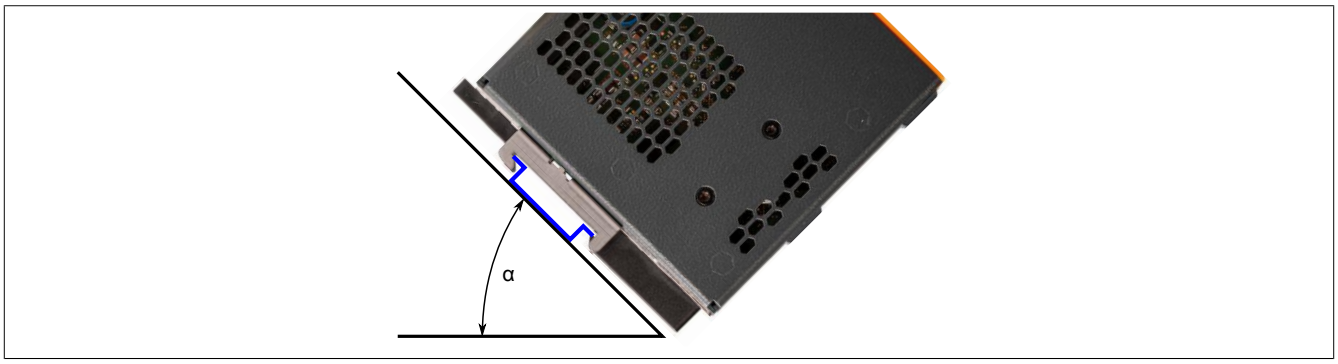
- Up to 40°C - 10 mm spacing
- 40°C and higher - 20 mm spacing

Face-up installation



Operation is possible up to 45°C. For face-up installation, spacing of 10 mm must be maintained between 2 modules.

Oblique installation

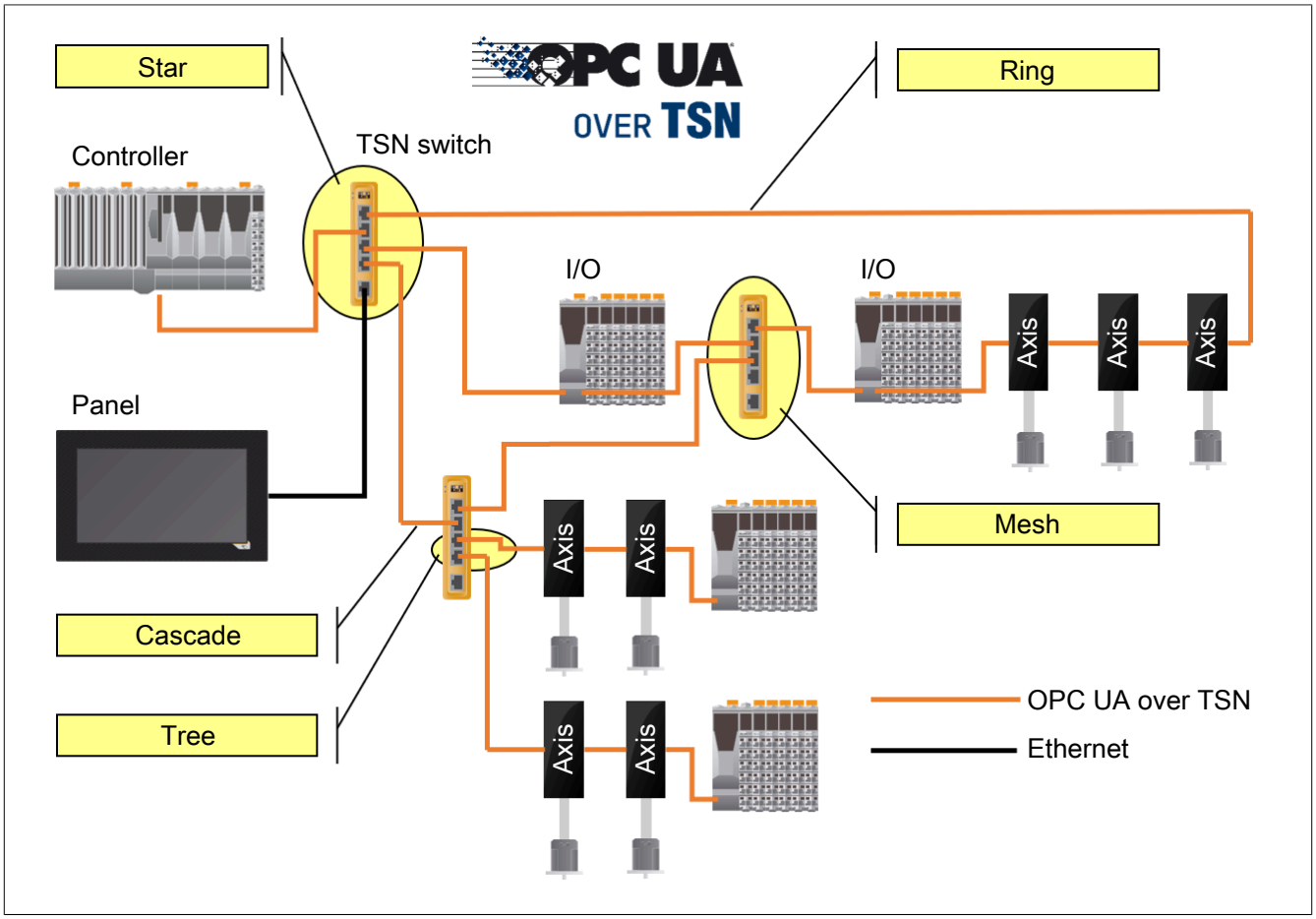


Operation is possible up to 60°C. For oblique installation, the derating to be used depends on angle **α**:

- α < 70°: Corresponds to face-up installation
- α > 70°: Corresponds to horizontal installation

9 Network topologies

The TSN switch enables physical star, tree, ring or meshed topologies in OPC UA over TSN networks. Cascading several TSN switches is also possible.



Information:

Cable or ring redundancy in ring or meshed arrangements is not actively supported by the TSN switch for OPC UA-over-TSN connections.
The Multiple Spanning Tree Protocol (MSTP) algorithm enables appropriate redundancy for best-effort connections only.

10 Configuration

The TSN switch supports the centralized configuration model per the IEEE 802.1Qcc standard. YANG models (IEEE 802.1Qcp) are used to represent the configuration and status parameters. NETCONF is supported as the configuration and query protocol. The YANG models used comply with the most current versions of the corresponding standards such as IEEE 802.1Qcw. The TSN switch can be configured with any network configuration tool that meets these standards.

10.1 Configuration with TTTech Slate XNS

Slate XNS from TTTech is browser-based software for modeling topologies and creating configurations for TSN networks. Offline network configuration is enabled via a user interface that provides a topology view or table-based editor. The network components are configured using open YANG standard models and are transferred via NETCONF.

The evaluation version of TTTech Slate XNS Tool can be used at no cost (maximum 5 network stations). Download access to the TTTech Slate XNS tool can be requested via email address slatexns@tttech-industrial.com.

11 Lightning and surge protection

> ## Information:
>
> **Provide lines at risk of lightning strike with suitable overvoltage protection.**
>
> **The circuits must be limited to overvoltage category II per IEC 60664-1 or according to other information in the module data sheet.**
>
> **For the design of your electrical system, see ABB documentation "Global guide to surge protection".**

11.1 UL/CSA

Electrical installations must comply with the relevant requirements of the National Electrical Code® (ANSI/NFPA-70 (NEC®) and, where applicable, Canadian Electrical Code (CEC), CE Code, or CSA C22.1. This applies specifically to electrical communication lines that are routed outside of a building and are considered to be at risk of lightning strike (see ANSI/NFPA-70 (NEC®) 2020 Edition - Part III Protection 805.90 Protective Devices).

12 0TB2103.9110

12.1 General information

This single-row, 3-pin terminal block is used to connect the power supply.

12.2 Order data

Order number	Short description	Figure
	Terminal blocks	
0TB2103.9110	Accessory terminal block, 3-pin, push-in terminal block 2.5 mm²	

Table 4: 0TB2103.9110 - Order data

12.3 Technical data

Order number	0TB2103.9110
General information	
Certifications	
CE	Yes
UL	cULus E115267 Industrial control equipment
Terminal block	
Note	Nominal data per UL
Number of pins	3
Type of terminal block	Push-in terminal block [1]
Cable type	Only copper wires (no aluminum wires!)
Pitch	5.08 mm
Connection cross section	
AWG wire	24 to 12 AWG
Wire end sleeves with plastic covering	0.25 to 2.50 mm²
Solid wires	0.20 to 2.50 mm²
Fine-stranded wires	0.20 to 2.50 mm²
With wire end sleeves	0.25 to 2.50 mm²
Electrical properties	
Nominal voltage	300 V
Nominal current [2]	10 A / contact
Contact resistance	≤5 mΩ

Table 5: 0TB2103.9110 - Technical data

1) Push-in terminal blocks cannot be used side-by-side.
2) The respective limit data of the devices must be taken into account!

12.4 Access for test probes

Each contact is equipped with 2 additional openings for using a test probe.

Access for test probes at the front of the terminal block	Access for test probes at the top of the terminal block
	