

NUMSafe CTMS2904

Digital outputs terminals

Operating manual

M00035EN-03

Edition 06.2025



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The physical, technical and functional characteristics of the hardware and software products and the services described in this document are subject to modification and cannot under any circumstances be regarded as contractual.

The programming examples described in this manual are intended for guidance only. They must be specially adapted before they can be used in programs with an industrial application, according to the automated system used and the safety levels required.

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1 Foreword

1.1 Notes on the manual

This description is only intended for the use of trained specialists in control and automation technology who are familiar with the applicable national standards. It is essential that the following notes and explanations are followed when installing and commissioning these components.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

1.1.1 Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics.

In the event that it contains technical or editorial errors, we retain the right to make alterations at any time and without warning.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

1.1.2 Trademarks

EtherCAT, Safety over EtherCAT® are registered trademarks of and licensed by Beckhoff Automation GmbH.

Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

1.1.3 Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, DE102004044764, DE102007017835 with corresponding applications or registrations in various other countries.

1.1.4 Copyright

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1.1.5 Delivery conditions

In addition, the general delivery conditions of the company NUM apply.

1.2 Safety instructions

1.2.1 Delivery state

All the components are supplied in particular hardware and software configurations appropriate for the application.

Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of NUM.

1.2.2 Operator's obligation to exercise diligence

The operator must ensure that:

- the NUMSafe products are only used as intended (see chapter Product description).
- the NUMSafe products are only operated in sound condition and in working order.
- the NUMSafe products are operated only by suitably qualified and authorized personnel.
- the personnel is instructed regularly about relevant occupational safety and environmental protection aspects, and is familiar with the operating manual and in particular the safety notes contained herein.
- the instruction manual is in good condition and complete, and always available for reference at the location where the NUMSafe products are used.
- none of the safety and warning notes attached to the NUMSafe products are removed, and all notes remain legible.

1.2.3 Description of safety symbols

The following safety symbols are used in this operating manual. They are intended to alert the reader to the associated safety instructions.

Symbol	Meaning of the symbol
	Serious risk of injury! Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.
	Caution – Risk of injury! Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.
	Personal injuries! Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.
	Damage to the environment or devices Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.
	Tip or pointer This symbol indicates information that contributes to better understanding.

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1.3 Document revisions

Code	Edition	Evolution Index	Meaning of the major documentation evolution points	See chapter
M00035	05.2013	00	First version of the manual.	-
	03.2015	01	New standard IEC 61508:2010	2.2.2 2.2.4 3.1.1
			Technical data: new characteristics	3.3
			New section 3.4: Reliability of the NUMSafe Bus Terminal	3.4
			New section 3.5: Input Characteristics	3.5
			New section 3.6: CTMS2904 block diagram	3.6
			New "Caution" advise	4
			New section 4.1.3.3: Example of temperature measurement configuration	4.1.3.3
			New "Route the signal cable separately" figure and Test pulses outputs note.	4.1.4.5
			"Caution" advise modification	4.3
			Test pulse Parameters note	4.3.5
			Diagnostic objects modification: new FA80 _{hex}	4.4.2
			New Diagnostic message section	4.4.3
			New section Lifetime	4.6
			New Certificates 2015	5.2
	07.2019	02	New Certificates 2019	5.2
	06.2025	03	New Certificates 2025	5.2

1.4 NUM Agencies

The list of NUM agencies is given on <http://www.num.com>

1.5 Index

The [index](#) at the end of the manual facilitates access to information by keywords.

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2 System description

2.1 NUM EtherCAT terminals

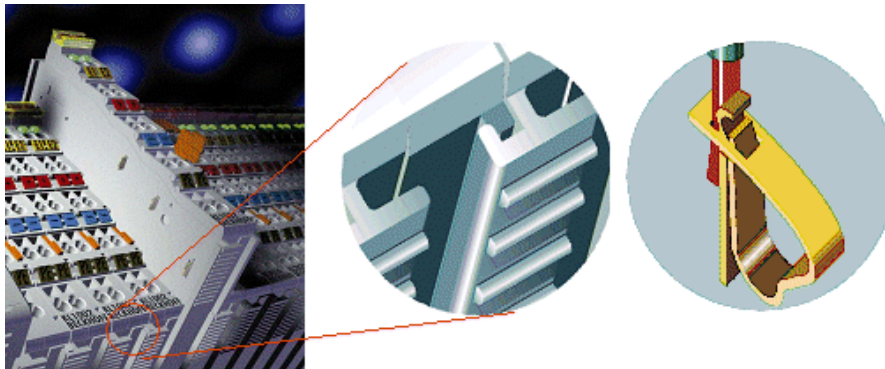
The NUM EtherCAT Terminal system is used for decentralized connection of sensors and actuators to a control system.

The NUM EtherCAT Terminal system components are mainly used in industrial automation. In its minimum configuration, a bus station consists of a NUM EtherCAT Gateway or and NUM EtherCAT Terminals connected to it.

The NUM EtherCAT Gateway forms the communication interface to the higher-level controller, and the terminals are the interface to sensors and actuators. The whole bus station is clipped onto a 35mm DIN mounting rail (EN 50022).

The mechanical cross connection of the bus station is established via a slot and key system at the NUM EtherCAT Gateway and the NUM EtherCAT Terminals.

The sensors and actuators are connected with terminals via the screwless Cage Clamp© connection system.

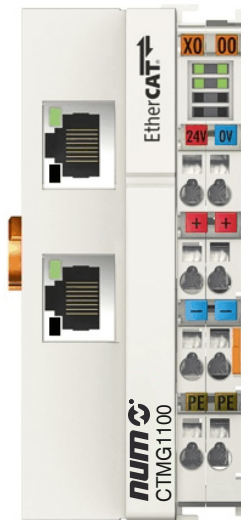


In order to accommodate the wide range of different communication standards encountered in industrial automation, NUM offers NUM EtherCAT Gateways for a number of common bus systems (e.g. CTMG1100 for EtherCAT)

2.1.1 NUM EtherCAT Gateway

Mechanical data

Mechanical data	NUM EtherCAT Gateway
Material	Polycarbonate, polyamide (PA6.6).
Dimensions (W x H x D)	44mm x 100mm x 68mm
Mounting	On 35mm mounting rail (EN50022) with lock
Attachable by	Double slot and key connection



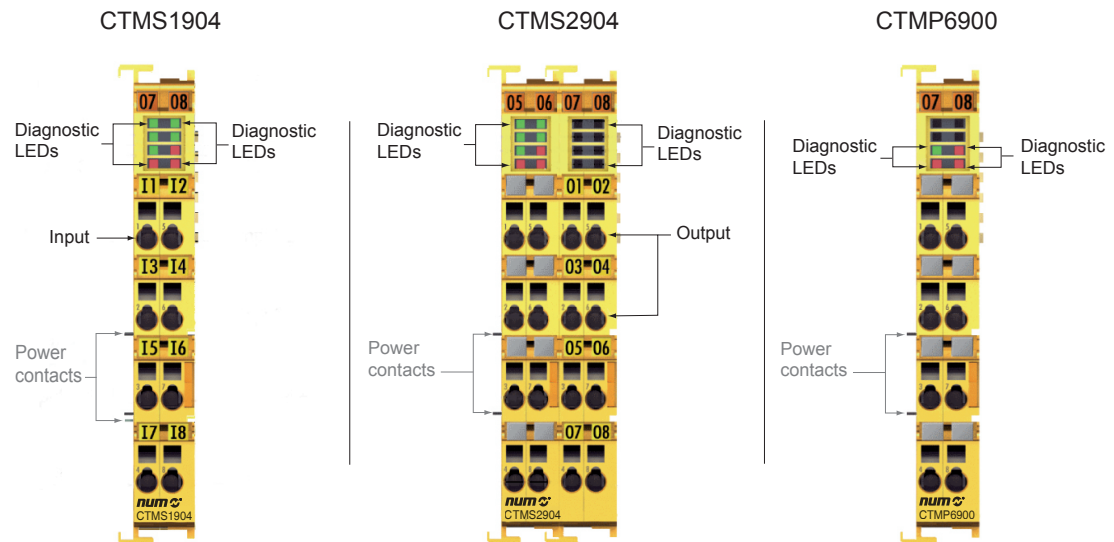
Connection technology

Connection technology	NUM EtherCAT Gateway
Wiring	Cage Clamp® spring-loaded system
Connection cross-section	0.08 mm²... 2.5 mm², stranded wire, solid wire
Fieldbus connection	RJ45
Power contacts	3 spring contacts
Current load	10A
Rated voltage	24VDC

2.1.2 NUMSafe Terminals

Mechanical data

Mechanical data	NUMSafe Terminals
Material	Polycarbonate, polyamide (PA6.6).
Dimensions (W x H x D)	12mm x 100mm x 68mm or 24mm x 100mm x 68mm
Mounting	On 35mm mounting rail (EN50022) with lock
Attachable by	Double slot and key connection



Connection technology

Connection technology	NUMSafe Terminals
Wiring	Cage Clamp® spring-loaded system
Connection cross-section	0.08mm²... 2.5mm², stranded wire, solid wire
Fieldbus connection	E-bus
Power contacts	Up to 3 blade/spring contacts
Current load	10A
Rated voltage	Depends on NUMSafe Terminal type

2.1.3 E-bus

The E-bus is the data path within a terminal strip. The E-bus is led through from the NUM EtherCAT Gateway through all the terminals via six contacts on the terminals' side walls.

2.1.4 Power contacts

The operating voltage is passed on to following terminals via three power contacts. Terminal strip can be split into galvanically isolated groups by means of potential feed terminals as required.

The power feed terminals play no part in the control of the terminals, and can be inserted at any locations within the terminal strip.

2.2 NUMSafe

2.2.1 The I/O construction kit is extended safely

With the NUMSafe Terminals, NUM offers the option of simply expanding the proven EtherCAT Terminal system, and to transfer the complete cabling for the safety circuit into the already existing fieldbus cable.

Safe signals can be mixed with standard signals without restriction. This saves design effort, installation and material. Maintenance is simplified significantly through faster diagnosis and simple replacement of only a few components.

The new CTMxx9xx series EtherCAT terminals include three basic functionalities:

- digital inputs CTMS19xx,
- digital outputs CTMS29xx,
- Safe Logic Terminal CTMP6900.

For a large number of applications, all sensors and actuators can be wired on these EtherCAT terminals.

The required logical link of the inputs and the outputs is handled by the CTMP6900. For small to medium-sized configurations, the tasks of a fail-safe PLC can thus be handled within the EtherCAT terminal system.

2.2.2 Safety concept

NUMSafe: Safety and I/O technology in one system

- Extension of the familiar NUM I/Os system with NUMSafe EtherCAT Terminals
- Freely selectable mix of safe and standard signals
- Logical link of the I/Os in the CTMP6900 NUMSafe Logic Terminal
- Safety-relevant networking of machines via bus systems.

NUMSafe protocol (Fail Safe over EtherCAT - FSoE)

- Transfer of safety-relevant data via any media ("genuine black channel")
- IEC 61508:2010 SIL 3 compliant.

Configuring instead of wiring:

- Configuration of the NUMSafe system via "CODESYS Safety for EtherCAT Safety Module" programming system
- System Manager for editing and displaying all bus parameters
- Certified function blocks such as emergency stop, operation mode, etc.
- Simple handling
- Typical function blocks for machine safety.

NUMSafe Logic Terminal CTMP6900

- Link unit between NUMSafe input and output terminals
- Configuration of a simple, flexible, cost-effective, decentralized safety controller
- No safety requirements for higher-level control system
- NUMSafe Logic Terminal enables networks with up to 65535 NUMSafe devices
- NUMSafe Logic Terminal can establish up to 128 connections (NUMSafe connections).
- Several NUMSafe logic terminals are cascable in a network
- Safety functions such as emergency stop, protective door etc. are already included suitable for applications up to SIL 3 according to IEC 61508:2010 and DIN EN ISO 13849-1:2006 (Cat 4, PL e).

NUMSafe input (CTMS1904) and output terminal (CTMS2904)

- All current safety sensors can be connected
- Operation with a NUMSafe Logic Terminal
- CTMS1904 with 4 fail-safe inputs for sensors (24VDC) with floating contacts
- CTMS2904 with four safe channels for actuators (24VDC, 0.5A per channel)
- conforming to IEC 61508:2010 SIL 3 and DIN EN ISO 13849-1:2006 (Cat 4, PL e) requirements.

2.2.3 CTMS1904, CTMS2904 – NUMSafe Terminals with 4 fail-safe inputs or outputs

The CTMS1904 and CTMS2904 EtherCAT terminals enable connection of common safety sensors and actuators. They are operated with the CTMP6900 NUMSafe Logic Terminal.

The NUMSafe Logic Terminal is the link unit between the NUMSafe input and output terminals. It enables the configuration of a simple, flexible and cost-effective decentralized safety control system.

Therefore, there are no safety requirements for the higher-level controller!

The typical safety functions required for the automation of machines, such as emergency stop, protective door, two-hand etc., are already permanently programmed in the CTMP6900. The user configures the CTMP6900 terminal according to the safety requirements of his application.

2.2.4 CTMP6900 - NUMSafe Logic Terminal

The NUMSafe Logic Terminal is the link unit between the NUMSafe input and output terminals.

The CTMP6900 meets the requirements of IEC 61508:2010 SIL 3, EN 954 Cat. 4 and DIN EN ISO 13849-1:2006 (Cat 4, PL e).

2.2.5 The fail-safe principle (Fail Stop)

The basic rule for a safety system such as NUMSafe is that failure of a part, a system component or the overall system must never lead to a dangerous condition.

The safe state is always the switched off and wattless state.

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3 Product description

3.1 General description

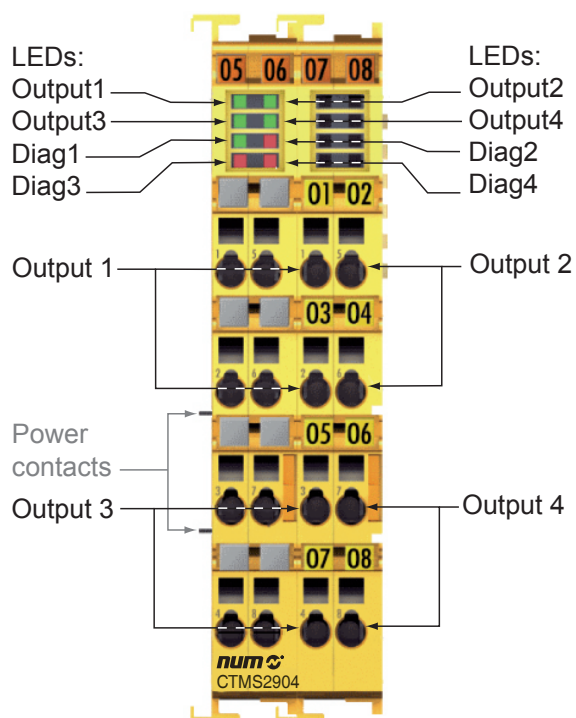
3.1.1 CTMS2904 - NUMSafe Digital outputs four-channel output terminal

The CTMS2904 is a safe output terminal with digital outputs for connecting actuators (contactors, relays, etc.) with a maximum current 0.5 A (24VDC).

The EtherCAT terminal has 4 fail-safe outputs.

The CTMS2904 meets the requirements of IEC 61508:2010 SIL 3, EN 954 Cat 4, DIN EN ISO 13849-1:2006 (Cat 4, PL e), NRTL, UL508, UL1998 and UL991.

The NUMSafe terminal has the typical design of an EtherCAT terminal.



3.2 Appropriate use



Caution – Risk of injury!

NUMSafe terminals may only be used for the purposes described below!

The NUMSafe terminals expand the application range of NUM EtherCAT terminals system with functions that enable them to be used for machine safety applications.

The NUMSafe terminals are designed for machine safety functions and directly associated industrial automation tasks. They are therefore only approved for applications with a defined fail-safe state. This safe state is the wattless state. Fail-safety according to the relevant standards is required.

The NUMSafe terminals enable connection of:

- 24VDC sensors (CTMS1904) such as emergency stop push buttons, pull cord switches, position switches, two-hand switches, safety mats, light curtains, light barriers, laser scanners etc.
- 24VDC actuators (CTMS2904) such as contactors, protective door switches with tumbler, signal lamps, servo drives etc.



Test pulses

When selecting actuators please ensure that the CTMS2904 test pulses do not lead to actuator switching or diagnostic message from the CTMS2904.

The following modules were developed for these tasks:

- The CTMS1904 terminal is an input module with digital inputs.
- The CTMS2904 terminal is an output module with digital outputs.
- The CTMP6900 Logic Terminal module.

These modules are suitable for operation with:

- NUM CTMGxxxx series EtherCAT Gateway.



Follow the machinery directive

The NUMSafe terminals may only be used in machines according to the Machinery Directive.



Ensure traceability

The buyer has to ensure the traceability of the device via the serial number.

3.3 Technical data

Product name	CTMS2904
Number of outputs	4
Status display	4 (one green LED per output)
Fault response time	≤ Watchdog times
Output current per channel	Max. 500mA, min. 20mA with current measurement active
Actuators	When selecting actuators please ensure that the CTMS2904 test pulses do not lead to actuator switching.
Cable length between actuator and terminal	(unshielded) (shielded) Max. 100m
Wire cross section	Min. 0.75mm ²
Input process image	6 bytes
Output process image	6 bytes
CTMS2904 supply voltage (PELV)	From NUM EtherCAT Gateway CTMG1100
Current consumption from the E-bus	Approx. 221mA
Power dissipation of the terminal	Typically 2W
Electrical isolation (between the channels)	No
Electrical isolation (between the channels/E-bus)	Yes
Insulation voltage (between the channels and the E-bus, under common operating conditions)	Insulation tested with 500VDC
Dimensions (W x H x D)	24mm x 100mm x 68mm
Weight	Approx. 100g
Permissible ambient temperature (Service) until SW03	0°C to +55°C (see remarks in the Chapter 4.1.3 mechanical installation)
Permissible ambient temperature (Service) for SW 06 (KW 02/2014)	-25°C to +55°C (see remarks in the Chapter 4.1.3 mechanical installation)
Permissible ambient temperature (transport/storage)	-40°C to +70°C
Permissible air humidity	5% to 95%, non-condensing
Permissible air pressure (operation/storage/transport)	750hPa to 1100hPa
Climate class according to EN 60721-3-3	3K3
Permissible contamination level as stated in EN 60664-1	Contamination level 2 (follow the chapter cleaning)
Unacceptable operating conditions	NUMSafe terminals must not be used under the following operating conditions: • under the influence of ionizing radiation • in corrosive environments • in an environment that leads to unacceptable soiling of the EtherCAT terminal.
Vibration / shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC immunity/emission	Conforms to EN 61000-6-2 / EN 61000-6-4
Shocks	15 g with pulse duration 11ms in all three axes
Protection class	IP20
Permitted operating environment	Control cabinet or terminal box with minimum protection class IP54 according to IEC 60529
Permissible installation position	See chapter 4.1.3.2 <i>Installation position and minimum distances</i>
Approvals	CE, cULus, ATEX, TÜV SÜD

3.4 Reliability of the NUMSafe Bus Terminal

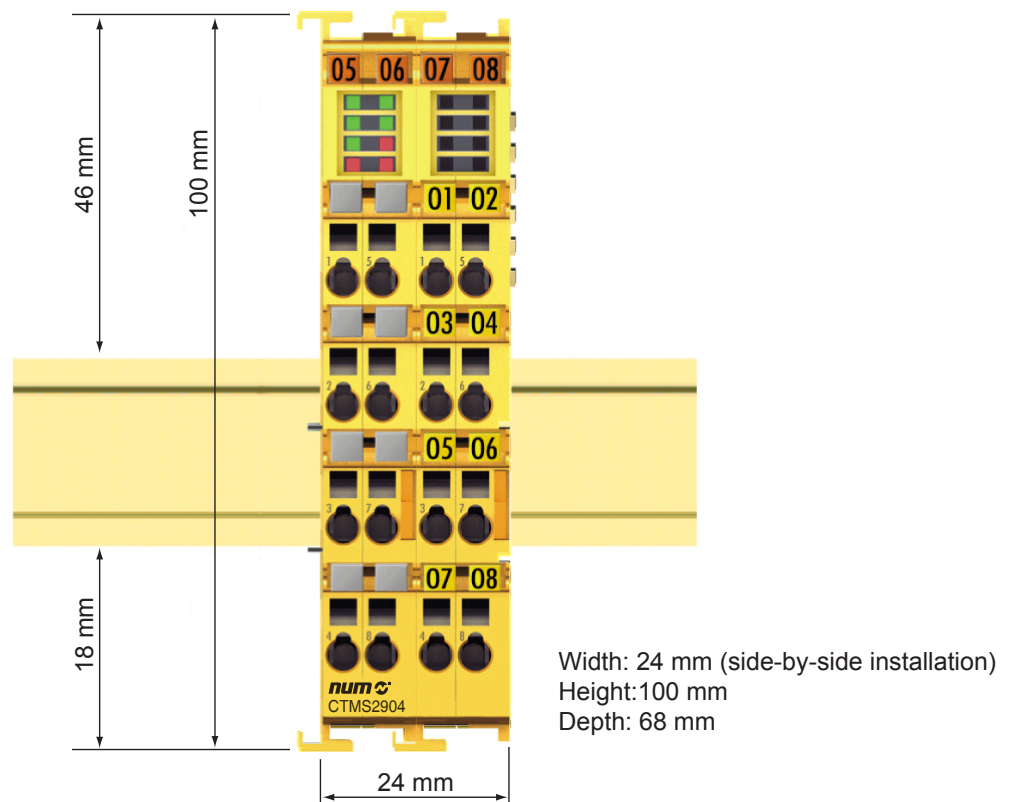
Characteristics	CTMS2904
Lifetime [a]	20
Proof test Interval [a]	not required ¹⁾
PFH	1.25E-09
%SIL3	1.25
PFD	8.45E-05
%SIL3	8.45%
MTTFd [a]	>100
DC	>99%
Performance level	PL e
Category	4
HFT	1
Element Classification*	Typ A

*) Classification as stated in IEC61508:2010

The Ethercat module CTMS2904 can be used for safety related application up to SIL3 (IEC61508:2010) and PLe (Cat 4)(EN ISO13849-1).

¹⁾ Special proof tests during the lifetime of the product CTMS2904 are not necessary.

3.5 Dimensions



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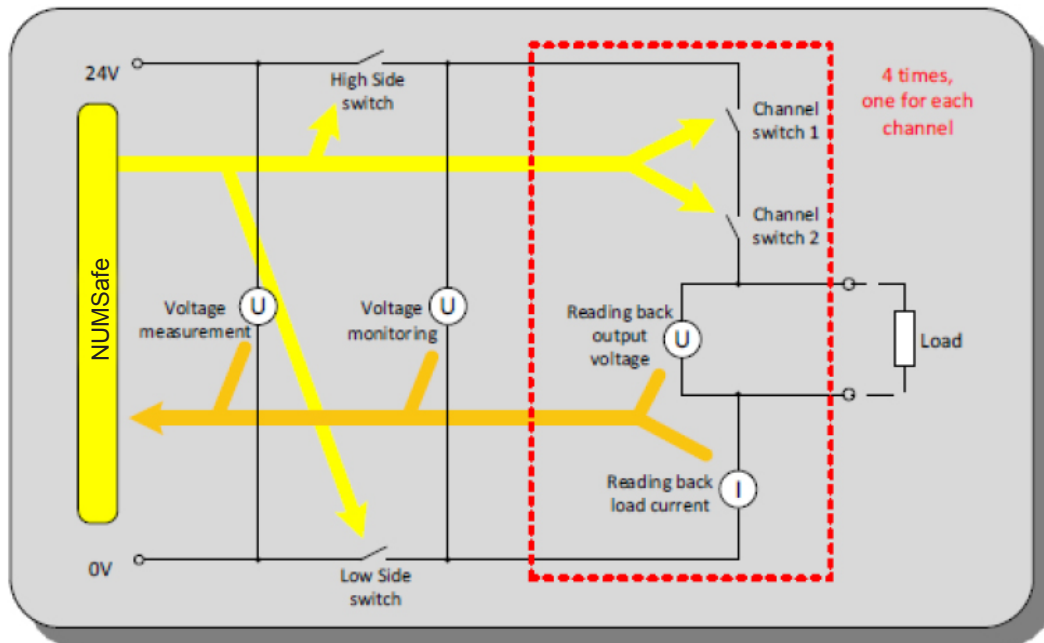
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3.6 CTMS2904 functional diagram



The principle schematic diagram shows the arrangement of one channel of the CTMS2904.

The red surrounded part is 4 x present. The High side and Low-side contactor is only on time present for all channels. Every channel has totally 4 Cut-off paths.

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4 Operation

Please ensure that the NUMSafe terminals are only transported, stored and operated under the specified conditions (see technical data)!

 WARNING	Caution – Risk of injury! The NUMSafe terminals must not be used under the following operating conditions: • under the influence of ionizing radiation • in corrosive environments • in an environment that leads to unacceptable soiling of the EtherCAT terminal.
---	--

 CAUTION	Electromagnetic Compatibility (EMC) The NUMSafe components are compliant to the requirements of the applicable EMC standards regarding emission and immunity. But in presence of radiotelephones, radios, Transmission equipment or Highfrequency systems, the functionality of the NUMSafe components may be disturbed.
---	--

4.1 Installation

4.1.1 Safety instructions

Before installing and commissioning the NUMSafe terminals please read the safety notes in the foreword of this documentation.

4.1.2 Transport / storage

Use the original packaging for transporting or storing the digital NUMSafe terminals.

 CAUTION	Note the specified environmental conditions Please ensure that the digital NUMSafe terminals are only transported and stored under the specified environmental conditions (see technical data).
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4.1.3 Mechanical installation

	Serious risk of injury! Bring the bus system into a safe, de-energized state before starting installation, disassembly or wiring of the EtherCAT terminals!
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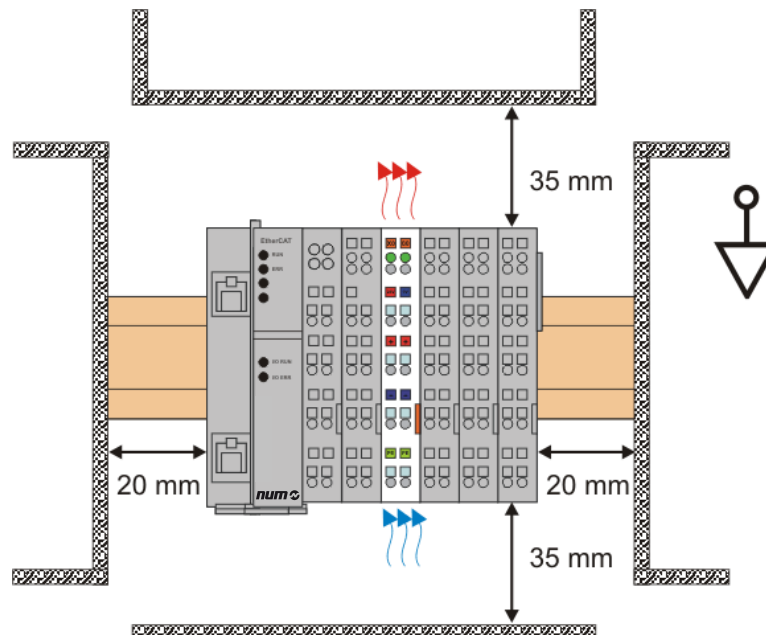
4.1.3.1 Control cabinet

The NUMSafe terminals must be installed in a control cabinet or terminal box with IP54 protection class according to IEC 60529 as a minimum.

4.1.3.2 Installation position and minimum distances

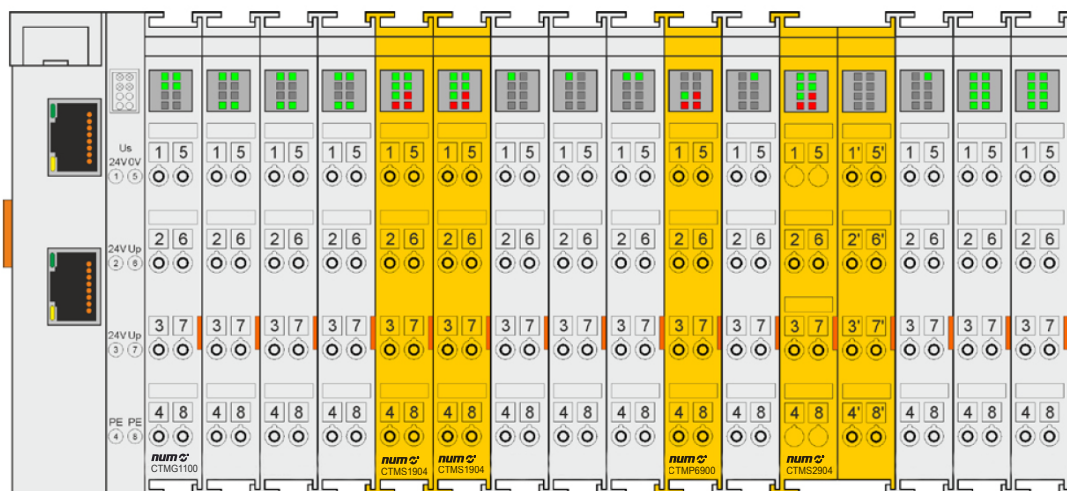
For the prescribed installation position the mounting rail is installed horizontally and the mating surfaces of the CTMx terminals point toward the front (see illustration below).

The terminals are ventilated from below, which enables optimum cooling of the electronics through convection. The direction indication “down” corresponds to the direction of positive acceleration due to gravity.



In order to ensure optimum convection cooling, the distances to neighboring devices and to control cabinet walls must not be smaller than those shown in the diagram.

4.1.3.3 Example of temperature measurement configuration



The example for a temperature measurement consists in a CTMG1100 Ethercat-Coupler plus input modules which correspond to a typical configuration for digital and analog signals of a machine.

On the CTMP6900 is a Safety-Project active, which reads all safety Inputs and which activates the safe Outputs.



Note

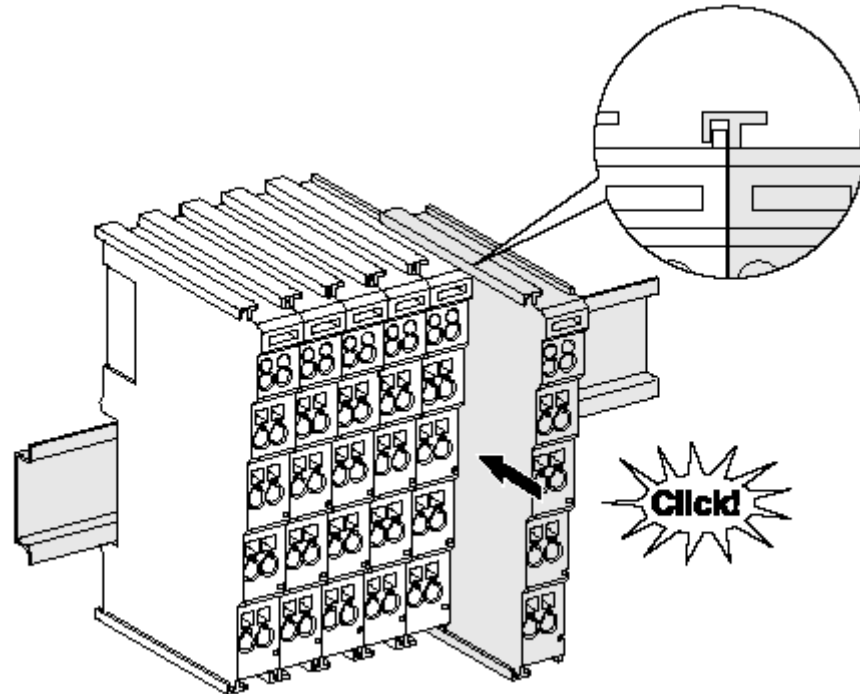
External heating / Heat radiation / Convection disturbed

The maximal permitted ambient temperature of +55°C is measured with the above example configuration. A wrong convection, a unfavorable position, a close up source of heat or a unfavorable combination of the Ethercat Modules may influence negatively the heating of the internal measured temperature of 95°C, after which the NUMSafe Components will signal failure and will switch to the safe state. The internal temperature may be read through a CoE diagnosis object (Chapter 4.4.2).

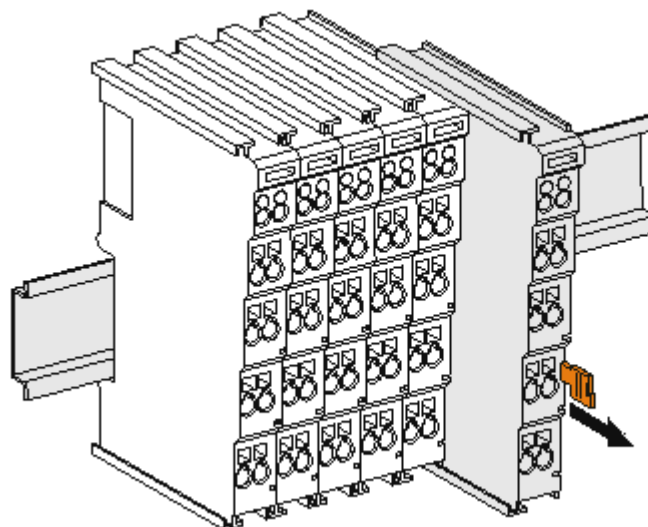
4.1.3.4 Mounting rail installation

Mounting

The NUM EtherCAT Gateway and the NUM EtherCAT Terminals are attached to commercially available 35mm mounting rails (according to EN50022) by applying slight pressure:



1. First attach the EtherCAT Gateway to the mounting rail.
2. The EtherCAT Terminals are now attached on the right-hand side of the EtherCAT Gateway. Join the components with slot and key and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.
If the terminals are clipped onto the mounting rail first and then pushed together without slot and key, the connection will not be operational!
When correctly assembled, no significant gap should be visible between the housings.
3. During the installation of the EtherCAT Terminals, the locking mechanism of the terminals must not come into conflict with the fixing bolts of the mounting rail.

Removal

1. Carefully pull the orange-colored lugs approximately 1cm out of the disassembled terminal, until they protrude loosely. The lock with the mounting rail is now released for this terminal, and the terminal can be pulled from the mounting rail without excessive force.
2. Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal away from the mounting rail.

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4.1.4 Electrical installation

4.1.4.1 Connections within a EtherCAT Terminal block

The electric connections between the EtherCAT Gateway and the EtherCAT Terminals are automatically realized by joining the components:

- The six spring contacts of the E-bus deal with the transfer of the data and the supply of the EtherCAT Terminals electronics.



Note the maximum E-bus current!

Observe the maximum current that your EtherCAT Gateway can supply to the E-bus! Use the CTMT9410 Power supply terminal if the current consumption of your terminals exceeds the maximum current that your EtherCAT Gateway can feed to the E-bus supply.

- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the EtherCAT Terminal block.
The power contacts are supplied via terminals on the EtherCAT Gateway.



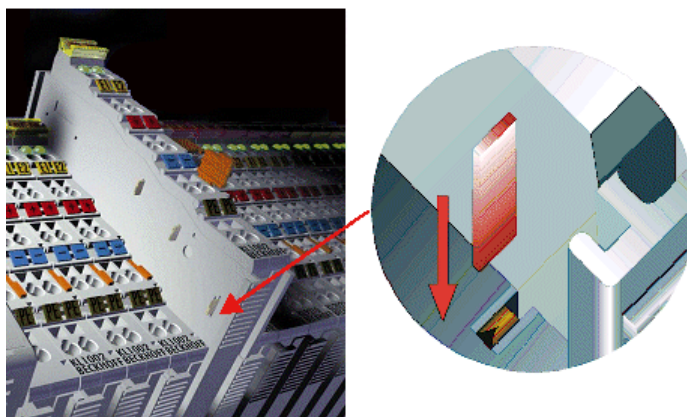
Note the pin assignment of the power contacts!

During the design of a EtherCAT Terminal block, the pin assignment of the individual EtherCAT Terminals must be taken account of, since some types (e.g. analog EtherCAT Terminals or digital 4-channel EtherCAT Terminals) do not or not fully loop through the power contacts.

Power Feed Terminals (CTMT91xx) interrupt the power contacts and thus represent the start of a new supply rail.

PE power contact

The power contact labelled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125A.



CAUTION

Insulation tests

Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a rated voltage of 230V).

For insulation testing, disconnect the PE supply line at the EtherCAT Gateway or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10mm from the group of terminals.



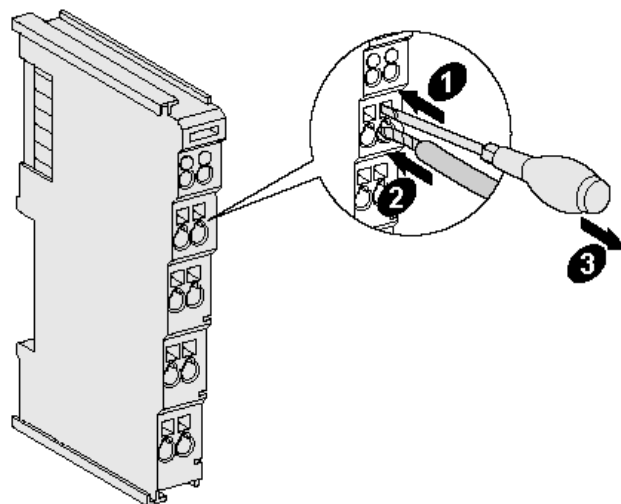
DANGER

Serious risk of injury!

The PE power contact must not be used for other potentials!

4.1.4.2 Overvoltage protection

If protection against overvoltage is necessary in your plant, provide a surge filter for the voltage supply to the EtherCAT Terminal blocks and the NUMSafe terminals.



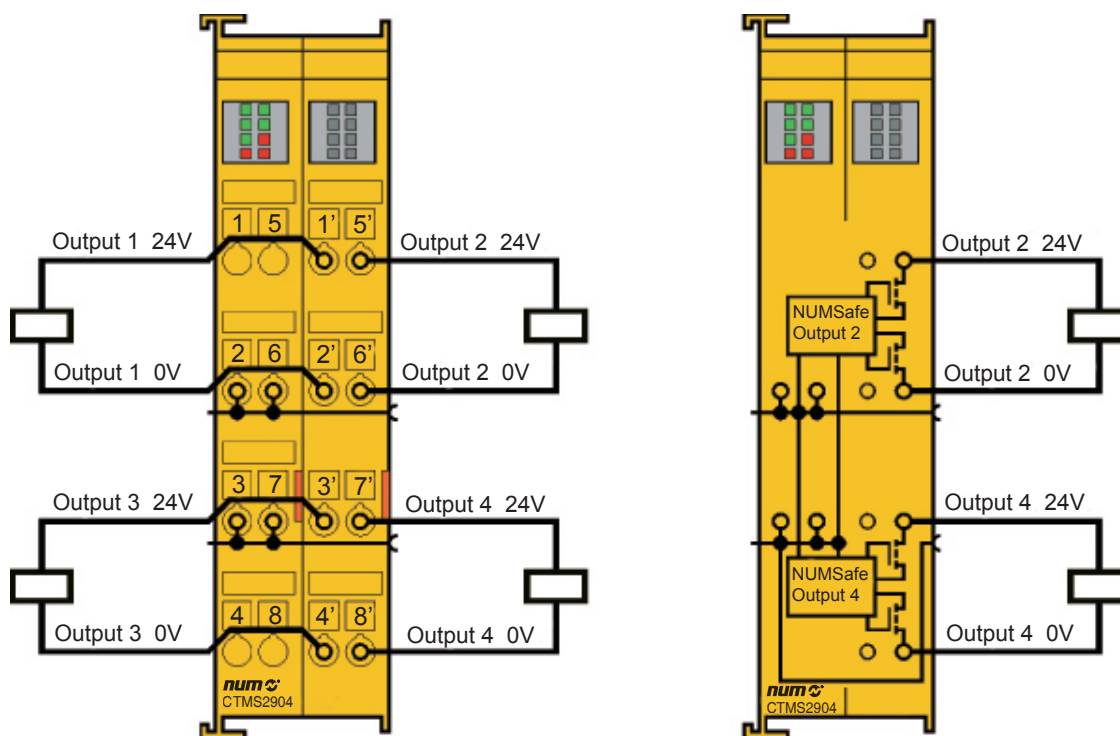
Up to eight connections enable the connection of solid or finely stranded cables to the EtherCAT Terminals. The terminals are implemented in spring force technology.

Connect the cables as follows:

1. Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.
2. The wire can now be inserted into the round terminal opening without any force.
3. The terminal closes automatically when the pressure is released, holding the wire safely and permanently.

Wire cross section	0.08 ... 2.5mm ²
Strip length	8 ...9mm

4.1.4.4 CTMS2904 pin assignment

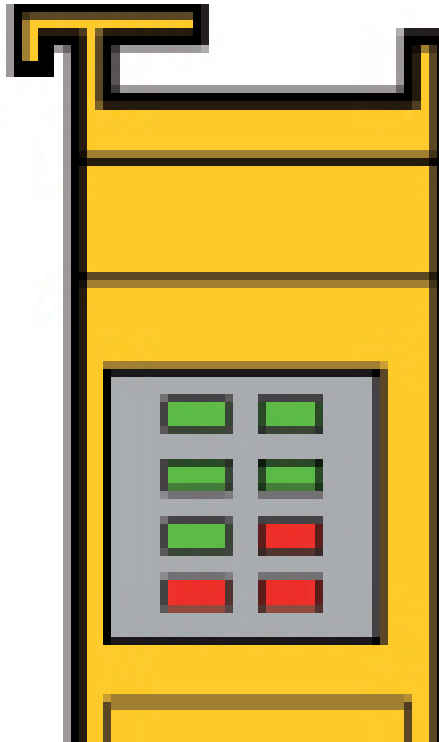


Terminal point	Output	Signal
1	-	Not used, no function
2		Positive power contact
3	-	Negative power contact
4		Not used, no function
5	-	Not used, no function
6		Positive power contact
7	-	Negative power contact
8		Not used, no function
1'	1	Output 1+
2'		Output 1-
3'	3	Output 3+
4'		Output 3-
5'	2	Output 2+
6'		Output 2-
7'	4	Output 4+
8'		Output 4-

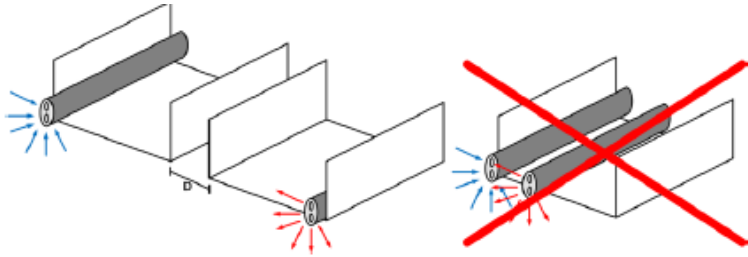
**Test pulses**

When selecting actuators please ensure that the CTMS2904 test pulses do not lead to actuator switching or diagnostic message from the CTMS2904.

4.1.4.5 Permitted cable length



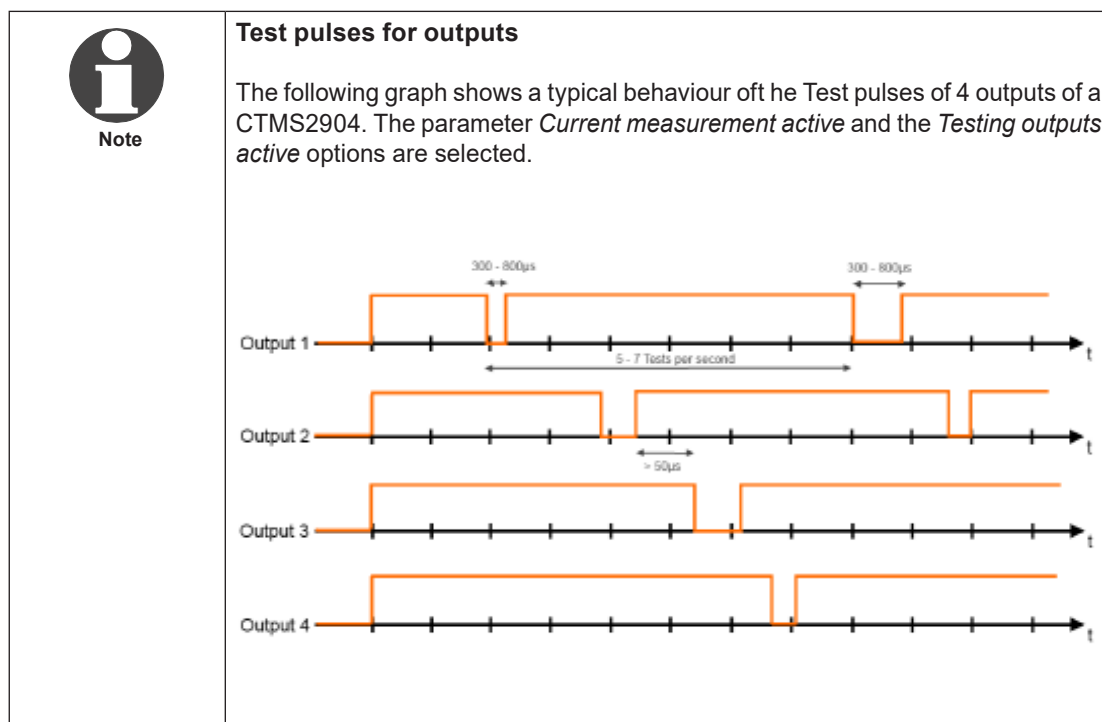
When connecting a single switch contact via its own continuous cabling (or via a non-metallic sheathed cable), the maximum permitted cable length is 100m.

 Warning	Route the signal cable separately The signal cable must be routed separately from potential sources of interference, such as motor supply cables, 230VAC power cables etc.! Interference caused by cables routed in parallel can influence the signal form of the test pulses and thus cause diagnostic messages (e.g. sensor errors).  D : Distance between the wireways as big as possible Blue Arrows : Signalkables Red Arrows : Potential source of disturbances
--	---

The common routing of signals together with other clocked signals in a common cable also reduces the maximum propagation, since crosstalk of the signals can occur over long cable lengths and cause diagnostic messages.

The test pulses can be switched off (sensor test parameter) if the connection of a common cable is unavoidable. However, this then leads to a reduction in the degree of diagnostic cover when calculating the performance level.

The use of contact points, plug connectors or additional switching contacts in the cabling also reduces the maximum propagation. The typical length of a test pulse (switching from 24V to 0V and back to 24V) is 350µs and takes place approx. 250 times per second.



4.1.5 Tested devices

The following list contains devices that were tested together with the CTMS2904 NUMSafe Terminal. The results only apply for the current device hardware version at the time of testing.

The tests were carried out in a laboratory environment. Modifications of these products cannot be considered here. If you are unsure please test the hardware together with the NUMSafe Terminal.

Manufacturer	Type	Comment
Siemens	SIRIUS series S00 3RT1016-1BB42	contactor
Telemecanique	LP1K09	contactor

The tests were carried out as function tests only. The information provided in the respective manufacturer documentation remains valid.

 Note	Recommended protective circuits We recommend R/C or diode-based protective circuits for these devices. Varistor-based protective circuits should not be used.
--	--

4.2 Operation in potentially explosive atmospheres (ATEX)

4.2.1 Special conditions

 WARNING	Observe the special conditions for the intended use of NUM fieldbus components in potentially explosive areas (directive 94/9/EU)! • The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN60529! The environmental conditions during use are thereby to be taken into account! • If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values! • Observe the permissible ambient temperature range of 0 to 55 °C when using NUM fieldbus components in potentially explosive atmospheres! • Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages! • The individual terminals may only be unplugged or removed from the EtherCAT terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! • Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
---	--

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- **EN 60079-0: 2006**
- **EN 60079-15: 2005**

4.2.2 Identification

NUM fieldbus components that are certified for use in potentially explosive atmospheres bear one of the following markings:



II 3 G Ex nA II T4

KEMA 10ATEX0075 X Ta: 0 - 55°C

or



II 3 G Ex nA nC IIC T4

KEMA 10ATEX0075 X Ta: 0 - 55°C

4.2.3 Date code and serial number

The NUMSafe terminals bear a date code, which is composed as follows:

Date code: CW YY SW HW

Legend

CW: Calendar week of manufacture

YY: Year of manufacture

SW: Software version

HW: Hardware version

Example: Date code 29 10 02 01

Calendar week: 29

Year: 2010

Software version: 02

Hardware version: 01

In addition the NUMSafe terminals bear a unique serial number.

4.3 Configuration of CTMS2904 with “CODESYS Safety for EtherCAT Safety Module”



Do not change CoE Objects!

Do not change any of the CoE objects in the NUMSafe terminals. Any modifications (e.g. via “CODESYS Safety for EtherCAT Safety Module”) of the CoE objects would permanently set the terminals to the Fail-Stop state or result in unpredictable behaviour of the Modules.

4.3.1 Configuration requirements

The following system requirements apply to smaller “CODESYS Safety for EtherCAT Safety Module” projects with a maximum of 100 blocks, a maximum of 10 visualisations and a maximum of 8 fieldbus devices:

- 1 GB RAM
- 1 GHz Pentium
- 1 GB free hard disc space
- Screen resolution 1024 x 768.

The “CODESYS Safety for EtherCAT Safety Module” programming system is approved only for the following operating systems:

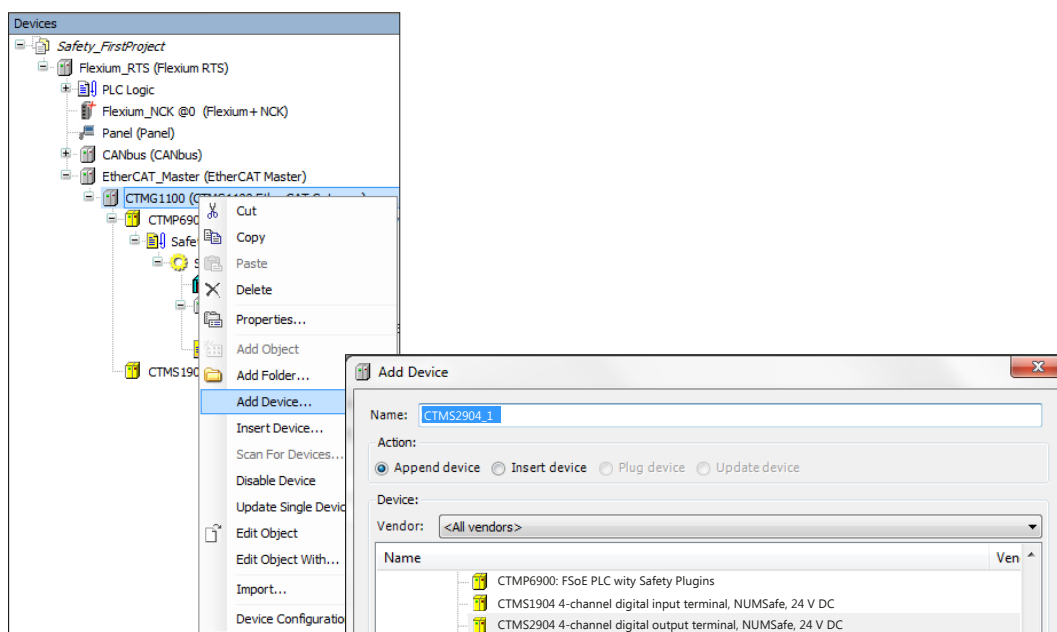
- Windows 7 (32/64 bit).

4.3.2 NUM EtherCAT Gateway

See NUM EtherCAT terminals CTMG and CTMT Operating manual M00032.

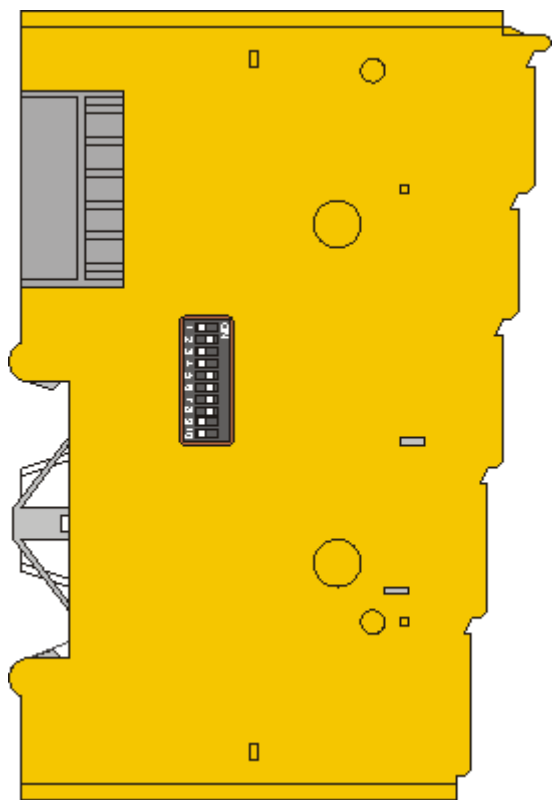
4.3.3 Inserting an CTMS2904

An CTMS2904 is inserted in the same way as any other NUM EtherCAT Terminal. In the list open *EtherCAT Terminals (CTMTx9xx)* and select the CTMS2904.



Inserting an CTMS2904

4.3.4 Address settings of the NUMSafe terminals



The EtherCAT terminal address of the terminal is set via the 10-way dip switches on the left-hand side of the EtherCAT terminal. NUMSafe addresses between 1 and 1023 are available.

DIP switch										Address
1	2	3	4	5	6	7	8	9	10	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	4
ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	5
OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	6
ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	7
...	...	...	...	...	...	...	...	...	...	...
ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	1023

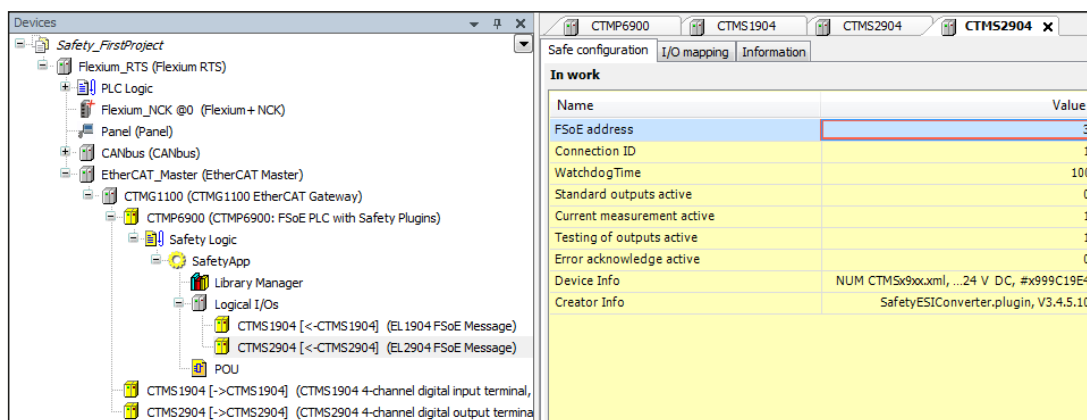


Unique NUMSafe address

Each NUMSafe address may only be used once within a network!

4.3.5 Entering the FSoE addresses and parameters

The FSoE address set at the DIP switch must also be entered under the Safe configuration tab (FSoE_Address entry).



Entering NUMSafe addresses

The CTMS2904 parameters are set under the respective logical I/Os device in the Safe configuration tab.

Parameter overview

PrmName	Meaning	Values
Standard outputs active	In addition the output can be switched off from the standard PLC. The safe output is linked with the standard logic signal AND	True / false
Current measurement active	Current measurement for the outputs is activated	True / false
Testing of outputs active	Test pulses for the outputs are activated	True / false
Error acknowledge active	True: Terminal errors lead to a reset of the NUMSafe connection (error code 14 (0x0E)). This error code is shown in the diagnostic data for the connection until the user acknowledges it via ErrAck in the NUMSafe group. False (Default): Terminal errors can only be reset by switching the power supply off and back on again.	True / false



Testpulse

If the Parameter Current Measurement active or the Parameter Testing of outputs active are set to TRUE, the module will produce on it's outputs test pulses. In the case that no testpulses are required the Current Measurement active and the Testing of outputs active must be set to FALSE.

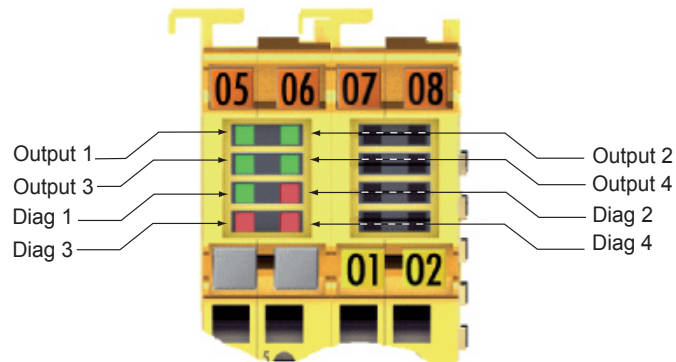
Note that in this case the reachable performance level could be less. Calculation examples for the performance level you can find in the NUMSafe-Application manual.

Setting Testing of outputs active to FALSE while Current Measurement active is set to TRUE make no sense.

4.4 Diagnostics

4.4.1 Diagnostic LEDs

The LEDs Diag 1 to Diag 4 display diagnostic information for the CTMS2904.



4.4.1.1 Diag 1 (green)

The Diag 1 LED indicates the state of the NUMSafe interface (in preparation).

Flashing Code	Meaning
LED illuminated continuously	Diagnostic flashing code in preparation

4.4.1.2 Diag 2 (red)

The Diag 2 LED indicates the state of the digital outputs.

Flashing Code	Meaning
Rapid flickering, alternating with 1 flash pulse	Output 1: Open load or current below minimum value of 20mA or current above maximum value of 500mA
Rapid flickering, alternating with 2 flash pulses	Output 2: Open load or current below minimum value of 20mA or current above maximum value of 500mA
Rapid flickering, alternating with 3 flash pulses	Output 3: Open load or current below minimum value of 20mA or current above maximum value of 500mA
Rapid flickering, alternating with 4 flash pulses	Output 4: Open load or current below minimum value of 20mA or current above maximum value of 500mA
Rapid flickering, alternating with 5 flash pulses	Field potential too low
Rapid flickering, alternating with 6 flash pulses	Field potential too high
Rapid flickering, alternating with 7 flash pulses	Internal terminal temperature too low
Rapid flickering, alternating with 8 flash pulses	Internal terminal temperature too high
Rapid flickering, alternating with 9 flash pulses	Temperature difference error
Rapid flickering, alternating with 10 flash pulses	Error in output circuit through Open Load, external supply or cross-circuit

These errors can only be reset by switching the power supply for the NUMSafe terminal off and back on again.

4.4.1.3 Diag 3 (red) and Diag 4 (red)

If the Diag 3 LED is lit, the Diag 4 LED indicates internal terminal errors.

These errors lead to shutdown of the terminal. The terminal must be checked by NUM.

Flashing Codes

In the case of such an error, the Diag 4 LED on the CTMS2904 displays flashing codes that describe the error in more detail.

A flashing code consists of four sequences, which are interrupted in each case by a short break. After the four sequences there is a long break, following which the flashing code is displayed again. Count the individual sequences of the flashing code.



Note

Note the flashing codes and return the terminal

Note the flashing code displayed and include this information with the terminal when you return it.

4.4.2 Diagnostic objects

The CoE objects 800E_{hex} display further diagnostic information.

	Do not change CoE objects! Do not change any of the CoE objects in the NUMSafe terminals. Any modifications (e.g. via the “CODESYS Safety for EtherCAT Safety Module”) of the CoE objects would permanently set the terminals to the Fail-Stop state or result in unpredictable behaviour of the Modules.
---	---

The CoE Objects FA80_{hex} will contain the internal temperature values of the CTMS2904.

Index FA80_{hex}: Internal temperature

Index	Name	Meaning	Flags	Default
FA80:01	Temperature 1	Temperature measurement 1n.	RO	0 _{bin}
FA80:02	Temperature 2	Temperature measurement 2n.	RO	0 _{bin}
FA80:03	Temperature Outputs	Temperature measurement (Right board) .	RO	0 _{bin}

The CoE objects 800E_{hex} display further diagnostic information.

Index 800E_{hex}: Diagnostic objects

Index	Name	Meaning				Flags	Default
800E:0	Diag	The following subindices contain detailed diagnostic information.				RO	
800E:0C	Error at the output	Bit				RO	
		0	1 _{bin}	Output 1	External supply or cross-circuit*		0 _{bin}
		1	1 _{bin}	Output 2			0 _{bin}
		2	1 _{bin}	Output 3			0 _{bin}
		3	1 _{bin}	Output 4			0 _{bin}
		4	1 _{bin}	Output 1	Open load or current below minimum value of 20mA or current above maximum value of 500mA**		0 _{bin}
		5	1 _{bin}	Output 2			0 _{bin}
		6	1 _{bin}	Output 3			0 _{bin}
		7	1 _{bin}	Output 4			0 _{bin}
800E:0D	Supply error	Bit	Field voltage (power contacts) outside the specification			RO	
		0	1 _{bin}	Field potential too high			0 _{bin}
		1	1 _{bin}	Field potential too low			0 _{bin}
800E:0E	Temperature error	Bit	Terminal temperature outside the specification.				
		0	1 _{bin}	Overtemperature µC1			0 _{bin}
		1	1 _{bin}	Overtemperature µC2			0 _{bin}
		2	1 _{bin}	Overtemperature of the output board			0 _{bin}
		3	1 _{bin}	Temperature too low µC1			0 _{bin}
		4	1 _{bin}	Temperature too low µC2			0 _{bin}
		5	1 _{bin}	Temperature of the output board too low			0 _{bin}
		6	1 _{bin}	Temperature difference on the processor board too large			0 _{bin}
		7	1 _{bin}	Temperature difference between the boards is too large			0 _{bin}

*) These diagnostic messages are displayed only if Current Measurement active = false.

**) These diagnostic messages are displayed only if Current Measurement active = true.



Note

Differing diagnostic messages possible

Due to the variable order or execution of the test series, diagnostic messages differing from those given in the table above are possible.

4.4.3 Possible causes of diagnostic messages

Diagnostic message	Possible cause	Possible remedies
LED Diag 2 Blink-Code 1 to 4 or 10	If Parameter "Testing of Outputs active" or "Current measurement active" is selected:	
	Error in Testpulse generation. Cause: short circuit or external supply.	Eliminate short circuit or external supply.
	Error in Testpulse generation. Cause: parallel wired conductors with a high capacitive coupling and dynamization of signals or also in multi wire cables.	Open cables and distribute separately with shielded wire. Create Distance between the shielded cables.
	Cause: Current is below of the limits of 20mA or higher than 500mA.	Choice of appropriate actuator current value >20mA and <500mA.
	Independent from selection of Parameter "Testing of outputs active" and/or "Current measurement active"	
	The Output voltage is outside of the specified limits of (24V -15%/+20%). Possible cause is a short circuit on the output or e.s. a voltage drop during switch on.	Eliminate the short circuit or correct the dimensioning of the supply. Control Voltage drop of supply.
	EMC Disturbances.	Correct EMC: increase immunity or eliminate disturbances.
	Internal Defect.	Change Module.
LED Diag 2 Blink-Code 5	Supply of the Power contacts is not switched on.	Switch on supply of the power contacts and reset Error indicator with the Reset of the Module.
	The supply is switched on after the supply of the module.	Switch on supply of the Power contacts before or together with the supply of the module and reset the Error indication of the module.
	Voltage on the Power contact is too low.	Increase the voltage of the power contacts and reset the Error indication of the module.
	EMC disturbances.	Correct EMC: increase immunity or eliminate disturbances.
	Internal defect.	Change module.
LED Diag 2 Blink-Code 6	Field voltage too high. Voltage on power contacts too high.	Decrease the Voltage of the power contacts and reset.
	Voltage spike caused by external devices e.s. switch off of power contactors.	Use R/C or diode protection for actuators.
	EMC disturbances.	Correct EMC: increase immunity or eliminate disturbances.
	Internal defect.	Change module.

LED Diag 2 Blink-Code 7	Module temperature too high.	Respect temperature range.
	EMC disturbances.	Correct EMC: increase immunity or eliminate disturbances.
	Internal defect.	Change module.
LED Diag 2 Blink-Code 8	Module temperature too low.	Respect temperature range.
	EMC disturbances.	Correct EMC: increase immunity or eliminate disturbances.
	Internal defect.	Change module.
LED Diag 2 Blink-Code 9	Module temperature differences too high. One of the 3 internal temperature sensors is defect.	Change module.
	Module temperature differences too high. One of the 3 internal temperature sensors has a too high temperature caused by missing convection.	Check mounting position of the module and respect the mounting indication of chapter "Mechanical Installation".
	EMC disturbances.	Correct EMC: increase immunity or eliminate disturbances.
	Internal defect.	Change module.

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4.5 Maintenance

The NUMSafe terminals are maintenance-free!.

	Observe the specified environmental conditions! Please ensure that the NUMSafe terminals are only stored and operated under the specified conditions (see technical data).
---	---

If the terminal is operated outside the permitted temperature range it will switch to *Global Fault* state see the chapter Diagnosis.

4.5.1 Cleaning

Protect the NUMSafe terminal from unacceptable soiling during operation and storage!

If the NUMSafe Bus Terminals were subjected to unacceptable soiling they may no longer be operated!

	Have soiled terminals checked! Cleaning of the NUMSafe terminal by the user is not permitted! Please send soiled terminals to the manufacturer for inspection and cleaning!
---	--

4.6 Lifetime

The NUMSafe terminals are designed for a service life of 20 years.

Due to the high diagnostic coverage within the lifecycle no special proof tests are required.

The NUMSafe modules have a Date Code structured as follows:

Date Code: KW JJ SW HW

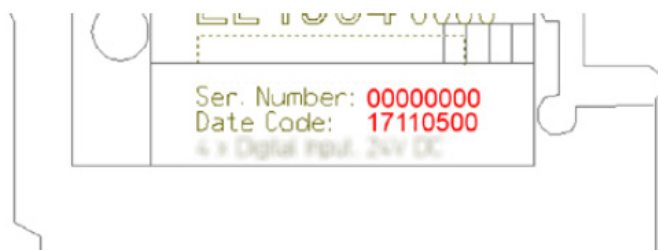
KW : Calendar Week

JJ : Year of manufacturing

SW : S/W Version

HW : HW Version

In addition the NUMSafe modules have a unique serial number.



4.6.1 Shutting down

	Serious risk of injury! Bring the bus system into a safe, de-energized state before starting disassembly of the EtherCAT Terminals!
--	--

4.6.2 Disposal

In order to dispose of the device, it must be removed and fully dismantled.

- Housing components (polycarbonate, polyamide (PA6.6) are suitable for plastic recycling.
- Metal parts can be sent for metal recycling.
- Electronic parts such as disk drives and circuit boards must be disposed of in accordance with national electronics scrap regulations.

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5 Appendix

5.1 NUM Support and Service

NUM and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to NUM products and system solutions.

5.1.1 NUM branches and partner companies NUM Support

Please contact your NUM branch office or partner company for local support and service on NUM products!

The contact addresses for your country can be found in the list of NUM branches and partner companies: www.num.com. You will also find further documentation for NUM components there.

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Product Service

CERTIFICATE

No. Z10 083009 0010 Rev. 01

Holder of Certificate: NUM AG
Battenhusstrasse 16
9053 Teufen
SWITZERLAND

Certification Mark:



Product: Safety components

Model(s): CTMS2904

Parameters: Supply voltage: 24VDC (-15%/+20%)
Power dissipation: 2W
Protection class: IP20

Tested according to: 2006/42/EC
EN 61508-1:2010
EN 61508-2:2010
EN 61508-3:2010
EN ISO 13849-1:2023
EN IEC 62061:2021
EN 61511-1:2017

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. This certificate is valid until the listed date, unless it is cancelled earlier. All applicable requirements of the Testing, Certification, Validation and Verification Regulations of TÜV SÜD Group have to be complied. For details see: www.tuvsud.com/ps-cert

Test report no.: NT105092T

Valid until: 2029-08-22

Date, 2025-06-18

(Peter Weiß)

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