

NUMSafe CTMS1904

Digital inputs terminals

Operating manual

M00034EN-00

Edition 05.2013



The reproduction, distribution and utilization of NUM documents as well as the communication of its contents to others without express authorization are prohibited. Offenders will be held liable for the payment of damages.
All rights reserved in the event of the grant of a patent, utility model or design.

Despite the care taken in the preparation of this document, NUM cannot guarantee the accuracy of the information it contains and cannot be held responsible for any errors therein, nor for any damage which might result from the use or application of the document.

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.

Summary

1	Foreword	7
1.1	Notes on the manual	7
1.1.1	Disclaimer	7
1.1.2	Trademarks	7
1.1.3	Patent Pending.....	7
1.1.4	Copyright.....	7
1.1.5	Delivery conditions.....	7
1.2	Safety instructions	8
1.2.1	Delivery state	8
1.2.2	Operator's obligation to exercise diligence.....	8
1.2.3	Description of safety symbols	9
1.3	Document revisions	10
1.4	NUM Agencies.....	10
1.5	Index	10
2	System description	15
2.1	NUM EtherCAT terminals	15
2.1.1	NUM EtherCAT Gateway.....	16
2.1.2	NUMSafe Terminals	17
2.1.3	E-bus.....	18
2.1.4	Power contacts	18
2.2	NUMSafe	19
2.2.1	The I/O construction kit is extended safely.....	19
2.2.2	Safety concept.....	19
2.2.3	CTMS1904, CTMS2904 – NUMSafe Terminals with 4 fail-safe inputs or outputs.....	21
2.2.4	CTMP6900 - NUMSafe Logic Terminal	21
2.2.5	The fail-safe principle (Fail Stop)	21
3	Product description	25
3.1	General description	25
3.1.1	CTMS1904 - NUMSafe Digital inputs four channel input terminal	25
3.2	Appropriate use	26
3.3	Technical data.....	27
3.4	Dimensions	28
4	Operation	33
4.1	Installation.....	33
4.1.1	Safety instructions	33
4.1.2	Transport / storage.....	33
4.1.3	Mechanical installation.....	34
4.1.3.1	Control cabinet.....	34
4.1.3.2	Installation position and minimum distances	34
4.1.3.3	Mounting rail installation	35
4.1.4	Electrical installation	37
4.1.4.1	Connections within a EtherCAT Terminal block.....	37
4.1.4.2	Overvoltage protection	38
4.1.4.3	Wiring.....	39
4.1.4.4	CTMS1904 pin assignment.....	40
4.1.4.5	Permitted cable length	41
4.1.5	Tested devices	42
4.2	Operation in potentially explosive atmospheres (ATEX)	43

4.2.1	Special conditions	43
4.2.2	Identification	44
4.2.3	Date code and serial number	44
4.3	Configuration of CTMS1904 with "CODESYS Safety for EtherCAT Safety Module"	45
4.3.1	Configuration requirements	45
4.3.2	NUM EtherCAT Gateway	45
4.3.3	Inserting an CTMS1904	46
4.3.4	Address settings for CTMS1904	47
4.3.5	Entering the FSoE addresses	48
4.3.5.1	CTMS1904 configuration for light barriers, light grids, light curtains etc.	49
4.3.5.2	Configuration of the CTMS1904 for safety switching mats	49
4.4	Diagnostics of the CTMS1904	50
4.4.1	Diagnostic LEDs	50
4.4.1.1	Diag 1 (green)	50
4.4.1.2	Diag 2 (red)	50
4.4.1.3	Diag 3 (red) and Diag 4 (red)	51
4.4.2	Diagnostic objects	52
4.5	Maintenance	53
4.5.1	Cleaning	53
4.6	Service life	54
4.6.1	Shutting down	54
4.6.2	Disposal	54
5	Appendix	59
5.1	NUM Support and Service	59
5.1.1	NUM branches and partner companies NUM Support	59
5.2	Certificates	60

Summary

1	Foreword	7
1.1	Notes on the manual.....	7
1.1.1	Disclaimer	7
1.1.2	Trademarks	7
1.1.3	Patent Pending.....	7
1.1.4	Copyright.....	7
1.1.5	Delivery conditions.....	7
1.2	Safety instructions	8
1.2.1	Delivery state	8
1.2.2	Operator's obligation to exercise diligence.....	8
1.2.3	Description of safety symbols	9
1.3	Document revisions	10
1.4	NUM Agencies	10
1.5	Index	10

1

2

3

4

5

Page deliberately empty.

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

The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization are prohibited. Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.

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

1

2

3

4

5

1.3 Document revisions

Code	Edition	Evolution Index	Meaning of the major documentation evolution points	See chapter
M00034	05.2013	00	First version of the manual.	-

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.

Page deliberately empty.

1

2

3

4

5

Page deliberately empty.

Summary

2	System description	15
2.1	NUM EtherCAT terminals	15
2.1.1	NUM EtherCAT Gateway	16
2.1.2	NUMSafe Terminals	17
2.1.3	E-bus.....	18
2.1.4	Power contacts	18
2.2	NUMSafe	19
2.2.1	The I/O construction kit is extended safely.....	19
2.2.2	Safety concept	19
2.2.3	CTMS1904, CTMS2904 – NUMSafe Terminals with 4 fail-safe inputs or outputs	20
2.2.4	CTMP6900 - NUMSafe Logic Terminal	20
2.2.5	The fail-safe principle (Fail Stop)	20

1

2

3

4

5

Page deliberately empty.

2 System description

2.1 NUM EtherCAT terminals

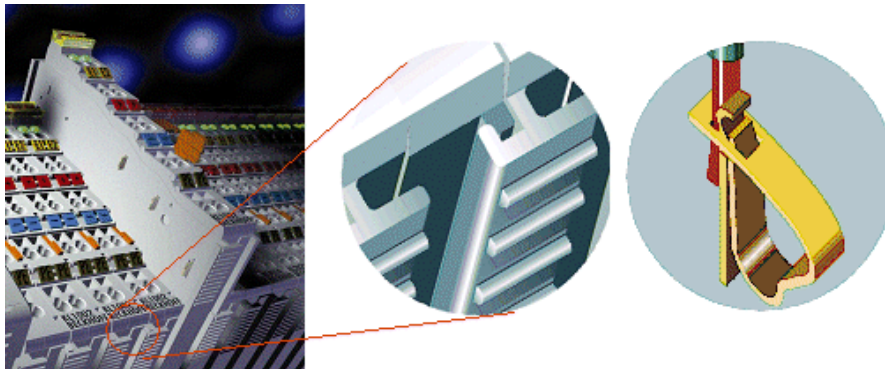
The NUM EtherCAT Terminal system is used for decentralized connection of sensors and actuators to a control system.

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.

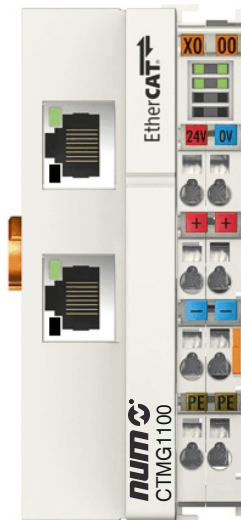


In order to accommodate the wide range of different communication standards encountered in industrial automation, NUM offers NUM EtherCAT Gateways for a number of common bus systems (e.g. CTMG1100 for EtherCAT)

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



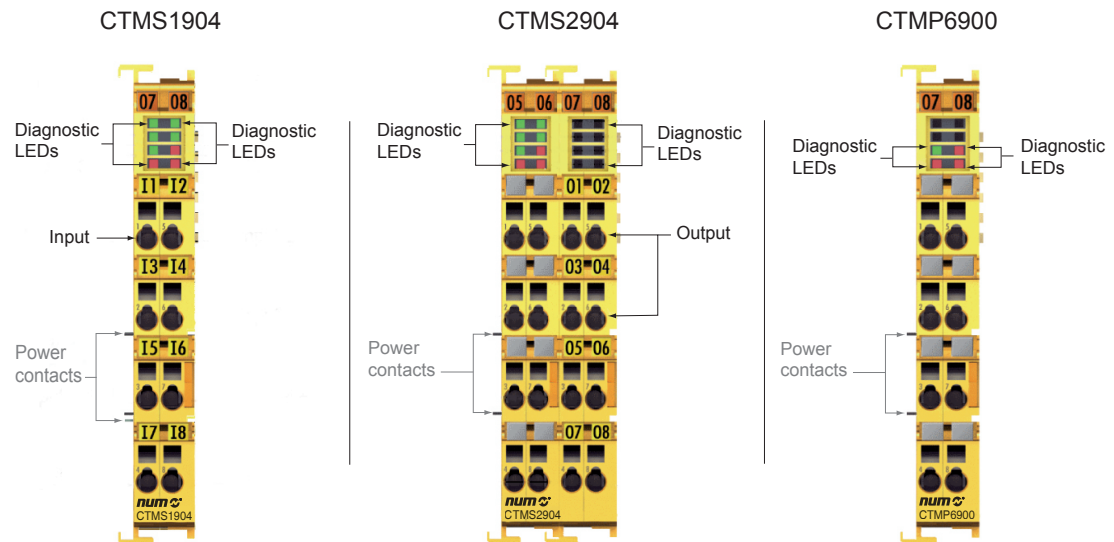
Connection technology

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 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 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 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 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.

Page deliberately empty.

1

2

3

4

5

Page deliberately empty.

Summary

3	Product description	25
3.1	General description	25
3.1.1	CTMS1904 - NUMSafe Digital inputs four channel input terminal	25
3.2	Appropriate use	26
3.3	Technical data	27
3.4	Dimensions	28

1

2

3

4

5

Page deliberately empty.

3 Product description

3.1 General description

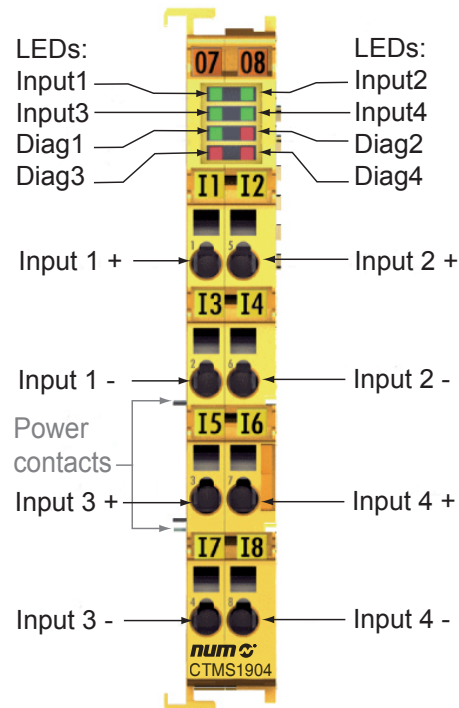
3.1.1 CTMS1904 - NUMSafe Digital inputs four channel input terminal

The CTMS1904 is a digital input terminal for encoder with floating contacts for 24VDC.

The EtherCAT terminal has 4 fail-safe inputs.

With two-channel connection, the CTMS1904 meets the requirements of IEC 61508 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.



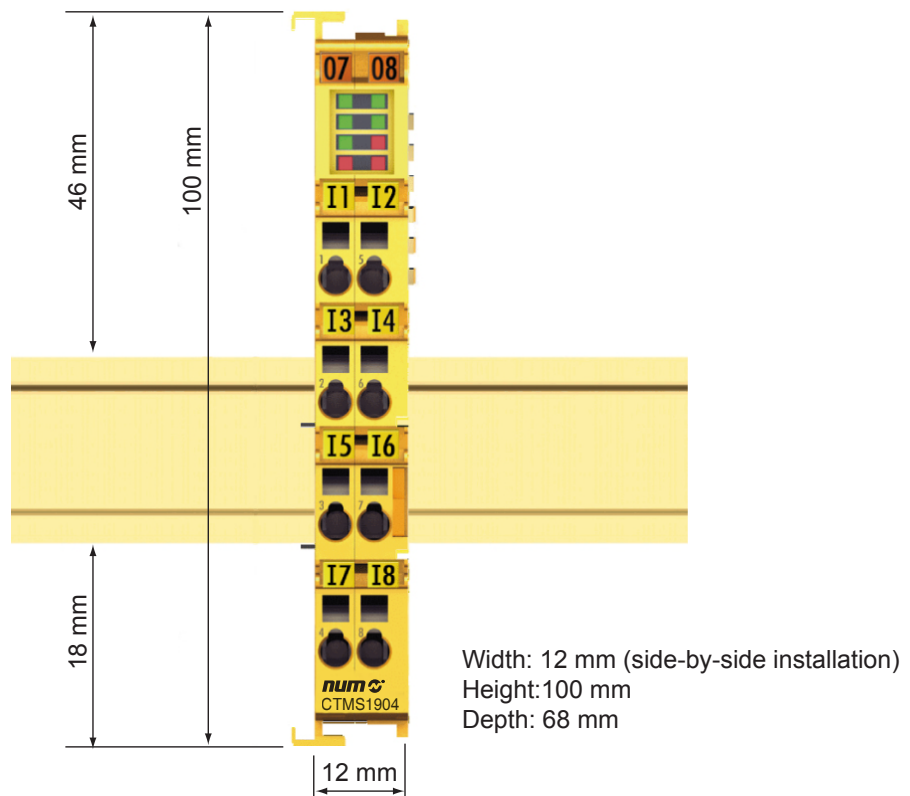
Ensure traceability

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

3.3 Technical data

Product name	CTMS1904
Number of inputs	4
Number of outputs	0
Response time (read input / write to E-bus)	Typically: 4ms, maximum: see fault response time
Fault response time	≤ Watchdog time
Cable length between actuator and terminal	(unshielded) (shielded) 100m max.(at 0.75 or 1 mm ²)
Input process image	6 bytes
Output process image	6 bytes
CTMS1904 supply voltage	From NUM EtherCAT Gateway CTMG1100
Current consumption of the modular electronics at 24V (without current consumption of sensors)	4 channels occupied: typically 12mA 0 channels occupied: typically 1.4mA
Current consumption from the E-bus	4 channels occupied: approx. 200mA
Power dissipation of the terminal	Typically 1W
Electrical isolation (between the channels)	No
Electrical isolation (between the channels and the 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)	12mm x 100mm x 68mm
Weight	Approx. 50g
Permissible ambient temperature (operation)	0°C to +55°C
Permissible ambient temperature (transport/storage)	-25°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	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

3.4 Dimensions



Page deliberately empty.

1

2

3

4

5

Page deliberately empty.

Summary

4	Operation	33
4.1	Installation.....	33
4.1.1	Safety instructions	33
4.1.2	Transport / storage.....	33
4.1.3	Mechanical installation.....	34
4.1.3.1	Control cabinet.....	34
4.1.3.2	Installation position and minimum distances	34
4.1.3.3	Mounting rail installation	35
4.1.4	Electrical installation	37
4.1.4.1	Connections within a EtherCAT Terminal block.....	37
4.1.4.2	Overvoltage protection	38
4.1.4.3	Wiring.....	39
4.1.4.4	CTMS1904 pin assignment.....	40
4.1.4.5	Permitted cable length	41
4.1.5	Tested devices	42
4.2	Operation in potentially explosive atmospheres (ATEX)	43
4.2.1	Special conditions	43
4.2.2	Identification.....	44
4.2.3	Date code and serial number.....	44
4.3	Configuration of CTMS1904 with "CODESYS Safety for EtherCAT Safety Module"	45
4.3.1	Configuration requirements	45
4.3.2	NUM EtherCAT Gateway	45
4.3.3	Inserting an CTMS1904.....	46
4.3.4	Address settings for CTMS1904.....	47
4.3.5	Entering the FSoE addresses	48
4.3.5.1	CTMS1904 configuration for light barriers, light grids, light curtains etc.	49
4.3.5.2	Configuration of the CTMS1904 for safety switching mats	49
4.4	Diagnostics of the CTMS1904	50
4.4.1	Diagnostic LEDs	50
4.4.1.1	Diag 1 (green)	50
4.4.1.2	Diag 2 (red)	50
4.4.1.3	Diag 3 (red) and Diag 4 (red)	51
4.4.2	Diagnostic objects.....	52
4.5	Maintenance	53
4.5.1	Cleaning	53
4.6	Service life	54
4.6.1	Shutting down	54
4.6.2	Disposal	54

Page deliberately empty.

4 Operation

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

	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.
---	--

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.

	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).
---	--

4.1.3 Mechanical installation

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

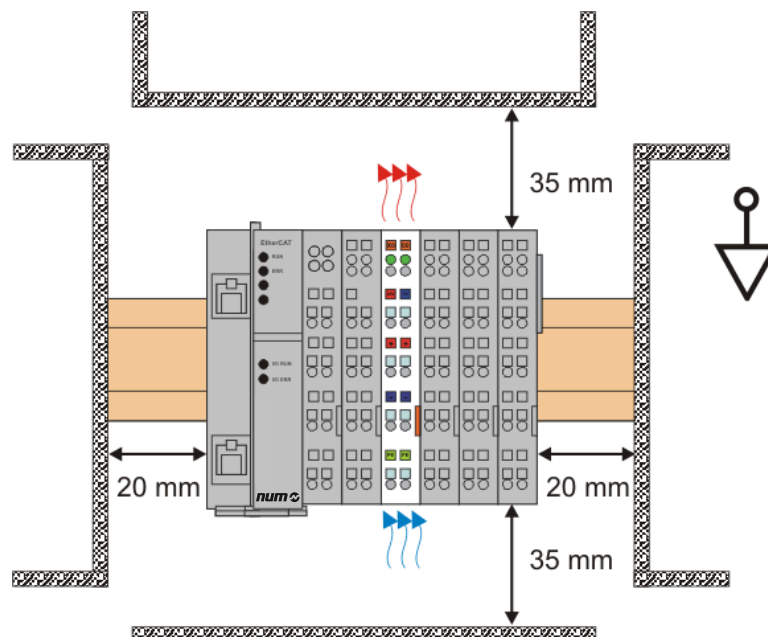
4.1.3.1 Control cabinet

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.

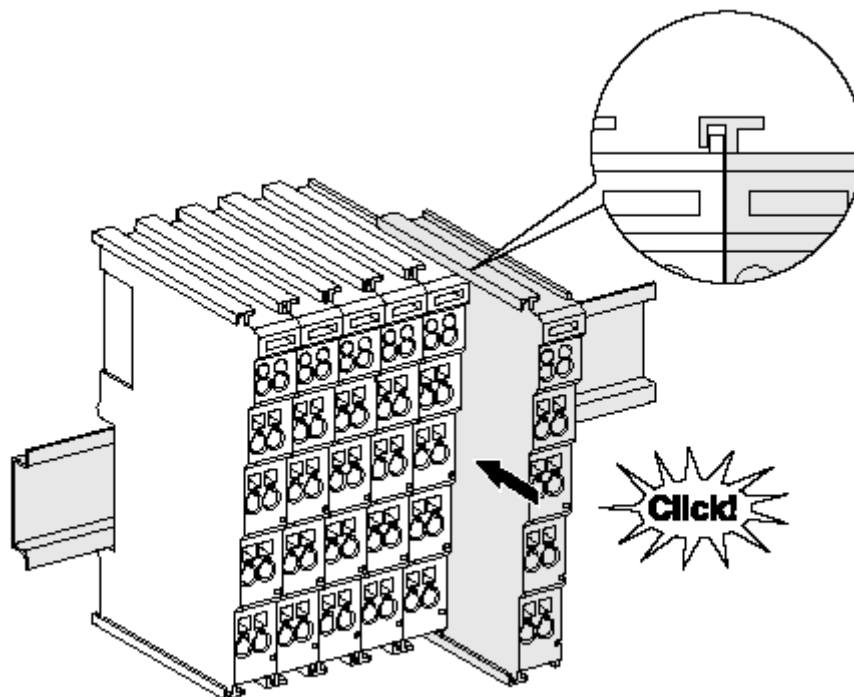


In order to ensure optimum convection cooling, the distances to neighboring devices and to control cabinet walls must not be smaller than those shown in the diagram.

4.1.3.3 Mounting rail installation

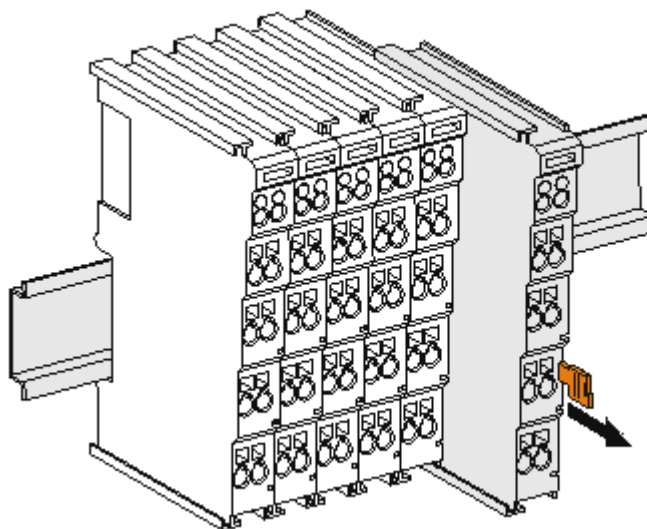
Mounting

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.

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

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.



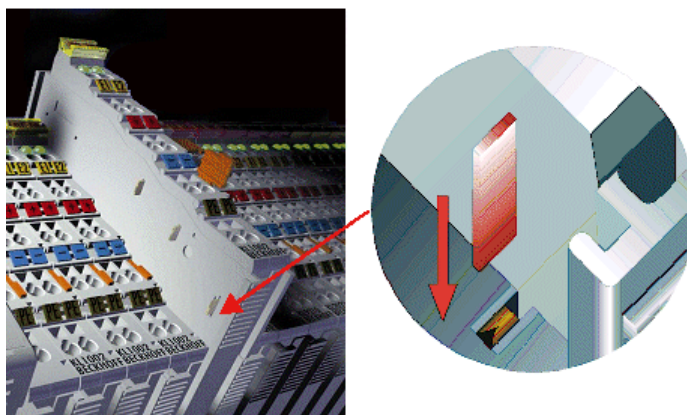
Note

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.



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.



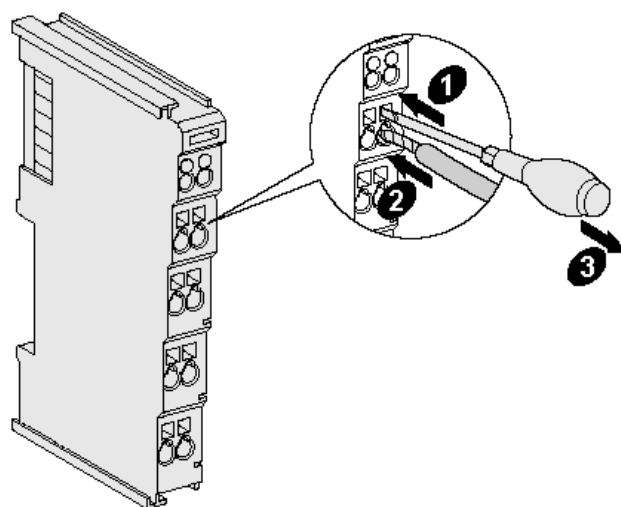
Serious risk of injury!

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.

4.1.4.3 Wiring



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

1

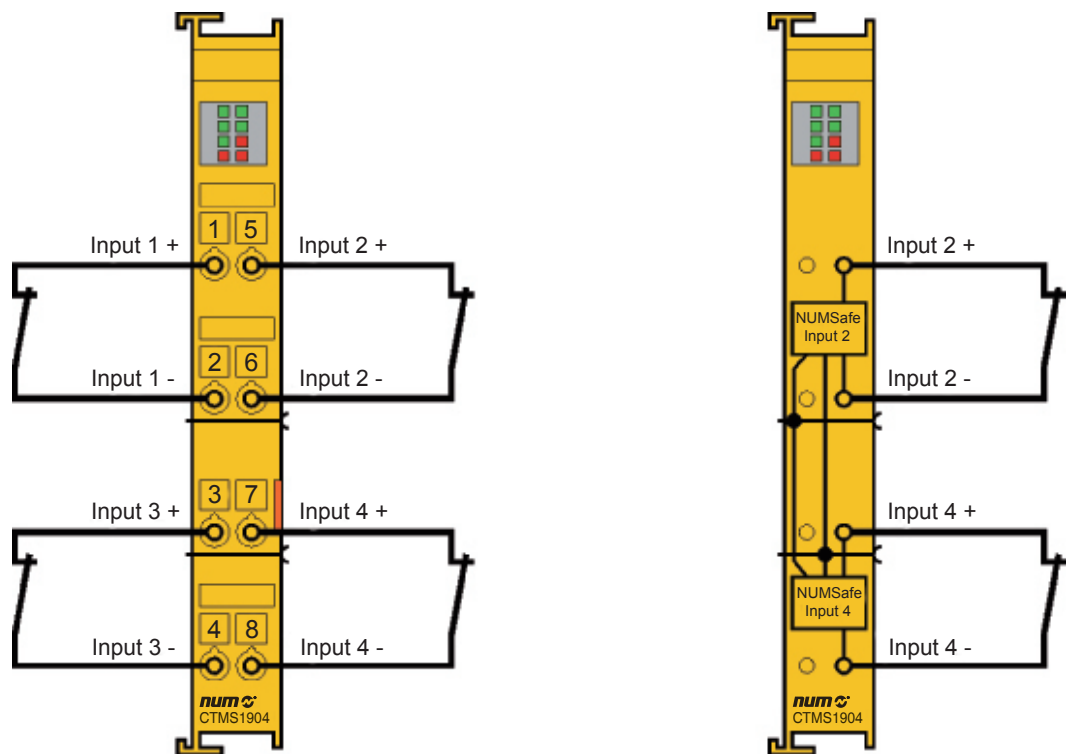
2

3

4

5

4.1.4.4 CTMS1904 pin assignment



Terminal point	Output	Signal
1	1	Input 1+
2		Input 1-
3	3	Input 3+
4		Input 3-
5	2	Input 2+
6		Input 2-
7	4	Input 4+
8		Input 4-

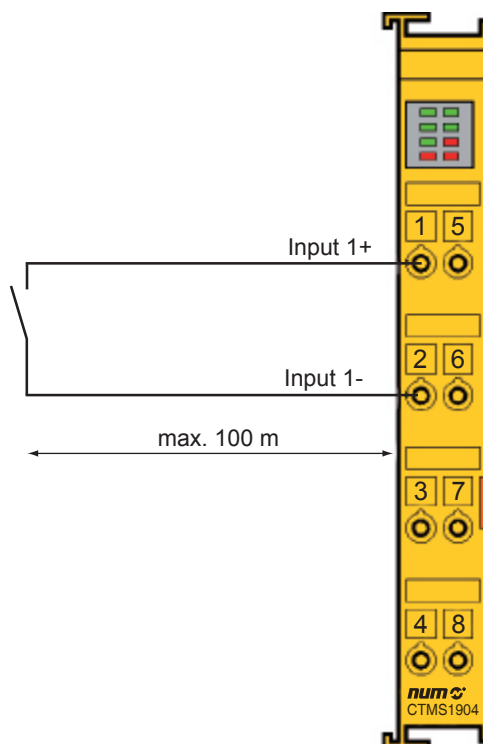


Note

Configurable inputs

The inputs 1 to 4 can be occupied as you want with normally closed contacts or normally open contacts. The corresponding analysis is carried out in the safety PLC.

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).
---	--

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 CTMS1904 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
SICK	C4000	Safety light curtain
SICK	S3000	Safety laser scanner
Wenglor	SG2-14ISO45C1	Safety light grids
Leuze	lumiflex ROBUST 42/43/44	Safety light barriers
Schmersal	BNS250-11ZG	Safety switch
ifm	GM701S	Inductive safety sensor
Keyence	SL-V (with PNP cable set)	Safety light curtain

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

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 CTMS1904 with “CODESYS Safety for EtherCAT Safety Module”



Do not change the register values!

Do not change any of the CoE objects in the NUMSafe terminals. Any modifications (e.g. via the System Manager) of the CoE objects would permanently set the terminals to the Fail-Stop state.

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:

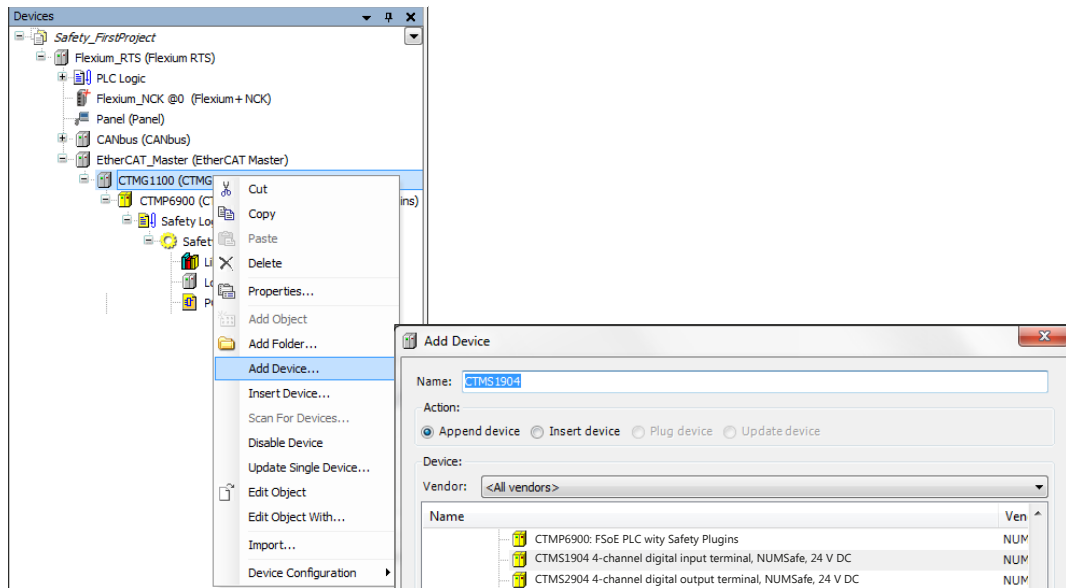
- Windows 7 (32/64 bit).

4.3.2 NUM EtherCAT Gateway

See NUM EtherCAT terminals CTMG and CTMT Operating manual M00032.

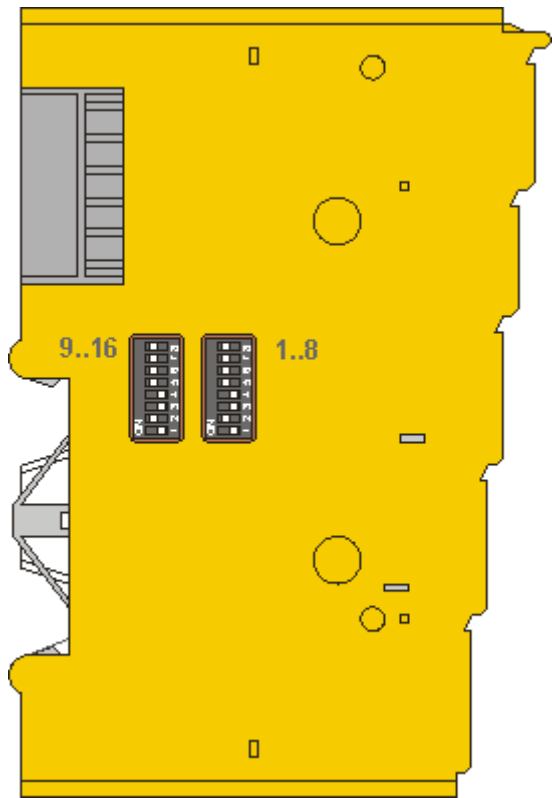
4.3.3 Inserting an CTMS1904

An CTMS1904 is inserted in the same way as any other NUM EtherCAT Terminal. In the list open *EtherCAT Terminals (CTMTx9xx)* and select the CTMS1904.



Inserting an CTMS1904

4.3.4 Address settings for CTMS1904



Set the EtherCAT terminal address for the terminal using the two dip switches (with 8 setting options) on the left-hand side of the CTMS1904 EtherCAT terminal. NUMSafe addresses between 1 and 65535 are available.

DIP switch																Address
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	4
ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	5
OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	6
ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	7
OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	8
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	65535

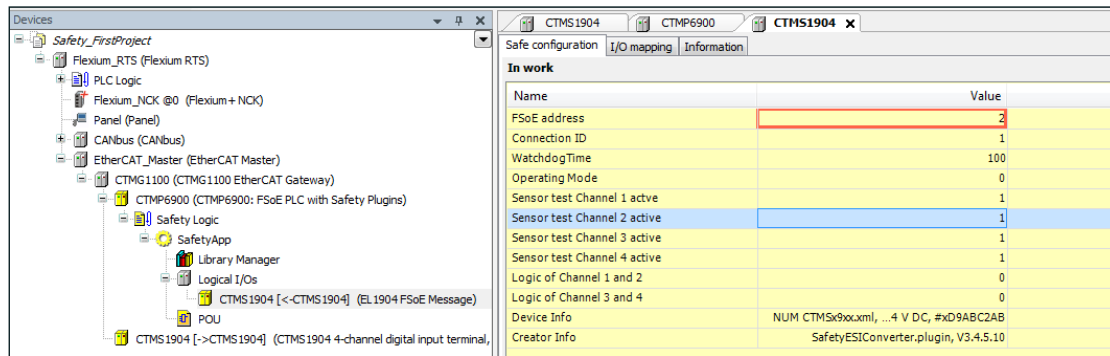


Unique NUMSafe address

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

4.3.5 Entering the FSoE addresses

The NUMSafe address set at the DIP switch must also be entered in tab Safe configuration under the CTMS1904 logical device.



Entering NUMSafe addresses

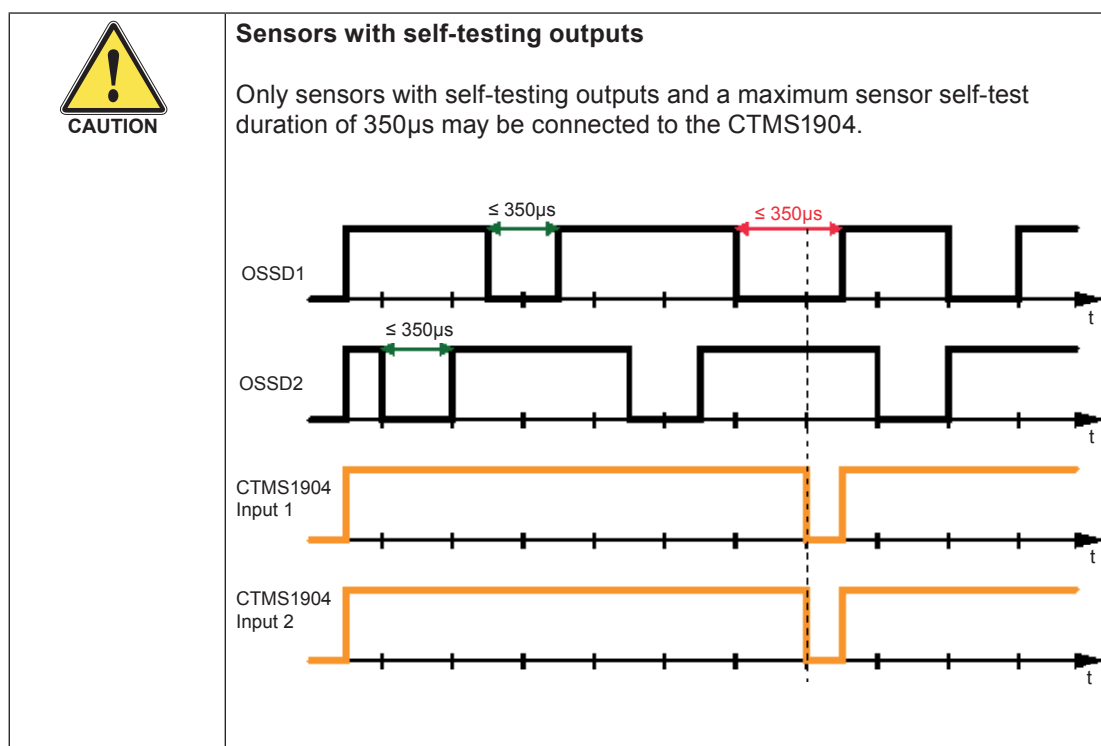
The CTMS1904 parameters are set under the respective logical I/Os device in the Safe configuration tab.

Parameter overview

PrmName	Meaning	Values
FSoE_Address	DIP switch address	1 to 65535
Operating Mode	Digital / standstill monitoring 1 and 2	Digital / standstill 1 and 2
Sensor test channel 1 active	The clock signal for connection Input1+ is checked at connection Input1-.	True / false
Sensor test channel 2 active	The clock signal for connection Input2+ is checked at connection Input2-.	True / false
Sensor test channel 3 active	The clock signal for connection Input3+ is checked at connection Input3-.	True / false
Sensor test channel 4 active	The clock signal for connection Input4+ is checked at connection Input4-.	True / false
Logic channel 1 and 2	Logic of channels 1 and 2	- Single logic - Asynchronous repetition OSSD (sensor test must be switched off) - Any pulse repetition OSSD (sensor test must be switched off) - Short cut is no module fault
Logic channel 3 and 4	Logic of channels 3 and 4	- Single logic - Asynchronous repetition OSSD (sensor test must be switched off) - Any pulse repetition OSSD (sensor test must be switched off) - Short cut is no module fault

4.3.5.1 CTMS1904 configuration for light barriers, light grids, light curtains etc.

The CTMS1904 also supports direct connection of contact-free protective devices with two self-testing outputs such as light barriers, light grids, light curtains, laser scanners, etc.



Parameter

To connect these sensors please set the following parameters for the CTMS1904 in the “CODESYS Safety for EtherCAT Safety Module”:

- Connect the two sensor signals either to channels 1 and 2 or channels 3 and 4 and activate *asynchronous repetition OSSD or any pulse repetition* for the two inputs used under parameter *Logic for channel x and y*. The difference between these settings is that with *any pulse repetition* simultaneous tests of the OSSD signals up to 350µs are allowed.
- For the two inputs used set the sensor test for the CTMS1904 to *false*.

4.3.5.2 Configuration of the CTMS1904 for safety switching mats

The CTMS1904 also supports direct connection of safety switching mats.

Parameter

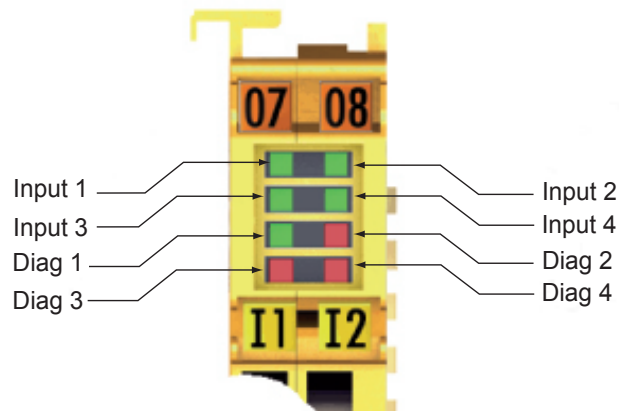
To connect these switching mats please set the following parameters for the CTMS1904 in the “CODESYS Safety for EtherCAT Safety Module”:

- Connect the two sensor signals either to channels 1 and 2 or channels 3 and 4 and activate *short cut channel x/y is no module fault* for the two inputs used under parameter *Logic for channel x and y*.

4.4 Diagnostics of the CTMS1904

4.4.1 Diagnostic LEDs

The LEDs Diag 1 to Diag 4 display diagnostic information for the CTMS1904.



4.4.1.1 Diag 1 (green)

The Diag 1 LED indicates the state of the NUMSafe interface.

Flashing Code	Meaning
LED illuminated continuously	Normal operation: NUMSafe communication OK
Rapid flickering, alternating with 1 flash pulse	Error in S parameter (NUMSafe parameter)
Rapid flickering, alternating with 2 flash pulses	Error in I parameter (Individual parameter)
Rapid flickering, alternating with 3 flash pulses	Waiting for S and I parameter
Rapid flickering, alternating with 4 flash pulses	S- and I-parameter correct: waiting for first host message
Rapid flickering, alternating with 5 flash pulses	Watchdog error
Rapid flickering, alternating with 6 flash pulses	CRC error
Rapid flickering, alternating with 7 flash pulses	Sequence number error
Rapid flickering, alternating with 8 flash pulses	Communication error in the NUMSafe protocol

4.4.1.2 Diag 2 (red)

The Diag 2 LED illuminates red if the terminal detects an external supply or cross-circuit. Once the error has been rectified the LED goes out

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.

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.

The errors displayed by the following flashing codes are reversible. After the cause of error is eliminated you can launch the terminal again by a reboot.

Diag 3 LED	Diag 4LED		
	Flashing-Code	Meaning	Corrective
Lit	6-1-1-1	Max. internal temperature exceeded	Ensure the adherence of permissible ambient temperature range.
	7-1-1-1	Min. internal temperature undercut	
	2-1-2-1	Max. supply voltage μ C1 exceeded	Check the supply voltage.
	3-1-2-1	Max. supply voltage μ C2 exceeded	
	4-1-2-1	Min. supply voltage μ C1 undercut	
	5-1-2-1	Min. supply voltage μ C2 undercut	
	8-1-1-1	Temperature difference between measuring points exceeded	Check the installation position and the ambient temperature

If another flashing code is displayed, an internal terminal error has occurred that leads to shutdown of the terminal. In this case the must be checked by NUMspa.



Note flashing codes, return the terminal

Make note of the error code and the error argument shown and enclose 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 TwinCAT System Manager) of the CoE objects would permanently set the terminals to the Fail-Stop state.
---	---

Index 800E_{hex}: Diagnostic objects

Index	Name	Meaning		Flags	Default
800E:0	Diag	The following subindices contain detailed diagnostic information.		RO	
800E:0A	Sensor test error	Bit	Error during the sensor test		RO
		0	1 _{bin}	Error at input 1	0 _{bin}
		1	1 _{bin}	Error at input 2	0 _{bin}
		2	1 _{bin}	Error at input 3	0 _{bin}
		3	1 _{bin}	Error at input 4	0 _{bin}
800E:0B	Error during two-channel evaluation	Bit	Error during the contiguous evaluation of two channels, i.e. the two channels contradict each other.		RO
		0	1 _{bin}	Error in the first input pair	0 _{bin}
		1	1 _{bin}	Error in the second input pair	0 _{bin}
800E:0C	Error in the safety mat operating mode: input pair disagree	Bits	Error in the input pair.		RO
		1, 0	11 _{bin}	Error in the first input pair	00 _{bin}
		3, 2	11 _{bin}	Error in the second input pair	00 _{bin}
800E:0D	Error in the safety mat operating mode: External supply	Bit	Error in the test pulses in the safety mat operating mode; i.e. the terminal has detected an external supply		RO
		0	1 _{bin}	Error at input 1	0 _{bin}
		1	1 _{bin}	Error at input 2	0 _{bin}
		2	1 _{bin}	Error at input 3	0 _{bin}
		3	1 _{bin}	Error at input 4	0 _{bin}

	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.
---	--

4.5 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 Service life

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.

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.

Page deliberately empty.

1

2

3

4

5

Page deliberately empty.

Summary

5	Appendix.....	59
5.1	NUM Support and Service.....	59
5.1.1	NUM branches and partner companies NUM Support	59
5.2	Certificates.....	60

1

2

3

4

5

Page deliberately empty.

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.

1

2

3

4

5

ZERTIFIKAT ♦ CERTIFICATE ♦ CERTIFICADO ♦ CERTIFICAT
 認 証 証 書


 Product Service

CERTIFICATE

No. Z10 12 11 83009 001

Holder of Certificate: **NUM AG**
 Battenhusstrasse 16
 9053 Teufen
 SWITZERLAND

Factory(ies): 62386

Certification Mark:



Product: **Safety components**

Model(s): **CTMS1904**

Parameters:

Supply voltage:	24VDC (-15%/+20%)
Power dissipation:	540mW
Protection class:	IP 20

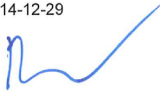
Tested according to:

2006/42/EC
 EN 61508-1:2001 (SIL1-3)
 EN 61508-2:2001 (SIL1-3)
 EN 61508-3:2001 (SIL1-3)
 EN 954-1:1996 (Cat 4)
 DIN EN ISO 13849-1:2008 (Cat 4, PL e)
 DIN EN 81-1:2000
 EN 13243:2004
 DIN EN 61000-6-2:2006
 DIN EN 61000-6-4:2007

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. See also notes overleaf.

Test report no.: BV82168T

Valid until: 2014-12-29


 Date, 2012-12-04
 Page 1 of 1

(Matthias Ramold)



TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TUV®

Reliability of the NUMSafe Bus Terminal			
	CTMS1904	CTMS2904	CTMP6900
Proof test interval (a)	20	20	20
PFH	1.11E-09	1.25E-09	1.03E-09
%SIL3	1.11%	1.25%	1.03%
PFD	8.29E-05	8.45E-05	8.23E-05
%SIL3	8.29%	8.45%	8.23%
MTTFd (a)	>100	>100	>100
B10d (cycles)	-	-	-
DC	>99	>99	>99
Category	4	4	4
PL	e	e	e

1

2

3

4

5

Page deliberately empty.

Symbol

%SIL3 61

A

Address 47
 air humidity 27
 ambient temperature 27
 Appendix 59
 Appropriate use 26
 Approvals 27
 ATEX 43

B

bus station 15

C

Cable length 27
 Cage Clamp® 15
 connection system 15
 CE, cULus, ATEX 27
 Cleaning 53
 CoE objects 52
 common bus 15
 Configuration 45
 Address settings 47
 dip switches 47
 Inserting an CTMS1904 46
 protective devices 49
 requirements 45
 safety switching mats 49
 consumption 27
 Current 27
 E-bus 27
 contamination level 27
 Control cabinet 34
 convection cooling 34
 Current consumption 27

D

Diagnostics 50
 Diagnostic objects 52
 Flashing Code 50
 LEDs 50
 Dimensions 28
 DIN EN ISO 13849-1:2006 19
 dip switches 47
 Disposal 54
 Document revisions 10

E

E-bus 18
 E-bus current 37
 Electrical installation 37
 cable length 41
 E-bus 37
 Overvoltage protection 38
 PE power contact 38
 pin assignment 37, 40
 Terminal block 37
 Wiring 39
 Electrical isolation 27
 EMC immunity 27
 emergency stop 21
 EN 954 Cat. 4 21
 EN 50022 15
 EN50022 35
 EN 60079-0: 2006 43
 EN 60079-15: 2005 43

F

fail-safe inputs 25
 Fail Stop 21
 fieldbus cable 19
 Flashing Code 50
 FSoE 48

I

Identification 44
 IEC 60529 34
 IEC 61508 19
 IEC 61508 SIL 3 21
 Installation 33
 Control cabinet 34
 convection cooling 34
 Mechanical installation 34
 Mounting rail 35
 position and distances 34
 Removal 36
 Insulation tests 38
 IP20 27

K

key system 15
 keywords 10

L

LEDs 50

lifecycle 54
lock clicks 35
locking mechanism 35

M

Maintenance 53
 Cleaning 53
Mounting rail 35

N

NUM Agencies 10
NUM EtherCAT Gateway 15, 16
 Connection technology 16
 Mechanical data 16
NUM EtherCAT terminals 15
NUMSafe input 20
 CTMS1904 20
 CTMS2904 20
NUMSafe Logic Terminal 19
NUMSafe Terminals 17
 Connection technology 17
 fieldbus cable 19
 I/O construction 19
 Mechanical data 17
NUM Support 59

O

operating conditions 27
Operation 33
Operator's obligation 8
Overvoltage protection 38

P

Patent Pending 7
PE power contact 38
pin assignment 40
Power contacts 18
 galvanically isolated 18
Power dissipation 27
process image 27
Proof test 61

R

Reliability 61
response time 27

S

Safety 8
 instructions 8
 Operator's obligation 8
 safety symbols 9
Safety concept 19
 Configuring 19
 I/O technology 19
 Logic Terminal 19
 NUMSafe input and output 20
 protocol 19
Safety instructions 33
sensors and actuators 19
serial number 44
Service life 54
short-circuit currents 38
Shutting down 54
Special conditions 43
 ambient temperature 43
 suitable housing 43
 temperatures 43
spring contacts 37
Strip length 39
symbols 9

T

Technical data 27
Terminal point 40
Tested devices 42
Trademarks 7
Transport / storage 33

W

Watchdog time 27
wattless state 21
Wire cross section 39

Published by NUM Spa

Via F. Somma 62
20012 Cuggiono (MI) (Italy)
Tel. : +39 02 979 691
website: www.num.com

Printed May 2013