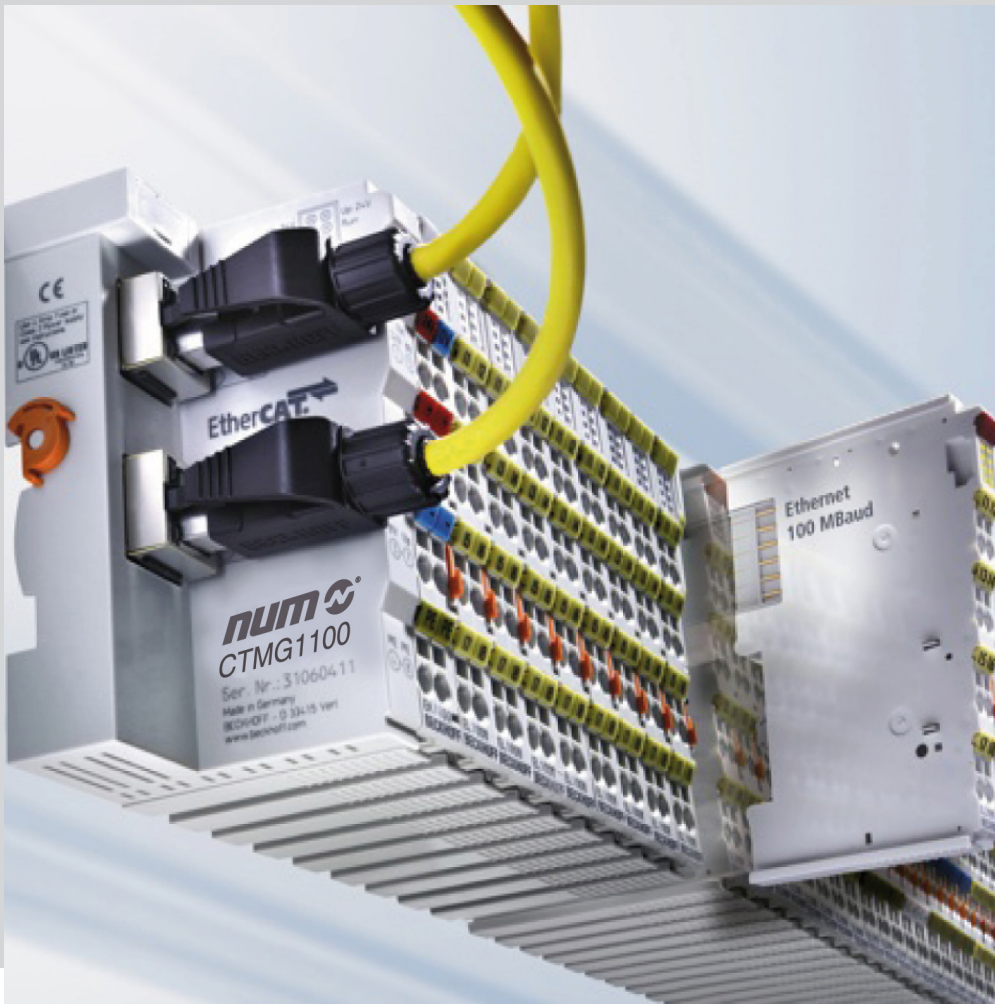
NUM EtherCAT terminals CTMG and CTMT Operating manual

M00032EN-01

Edition 5.2013



www.num.com

CNC HighEnd Applications

Summary

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Summary

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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® is 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

1.1.5 Delivery conditions

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

1.2 Safety instructions

1.2.1 Safety Rules

Consider the following safety instructions and descriptions!
Product specific safety instructions are to be found on the following pages or in the areas mounting, wiring, commissioning etc.

1.2.2 Disclaimer

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.

1.2.3 Personnel Qualification

This description is only intended for the use of trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

1.2.4 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	**Acute risk of injury!** If you **do not** adhere the safety advise adjoining this symbol, there is immediate danger to life and health of individuals!
 WARNING	**Risk of injury!** If you **do not** adhere the safety advise adjoining this symbol, there is danger to life and health of individuals!
 CAUTION	**Hazard to individuals!** If you **do not** adhere the safety advise adjoining this symbol, there is obvious hazard to individuals!
 Warning	**Hazard to the environment or devices** If you **do not** adhere the notice adjoining this symbol, there is obvious hazard to environment and devices.
 Note	**Note or pointer** This symbol indicates information that contributes to better understanding.
	**UL Pointer** This symbol indicates important information about the UL-compliant.

1.3 NUM EtherCAT terminals

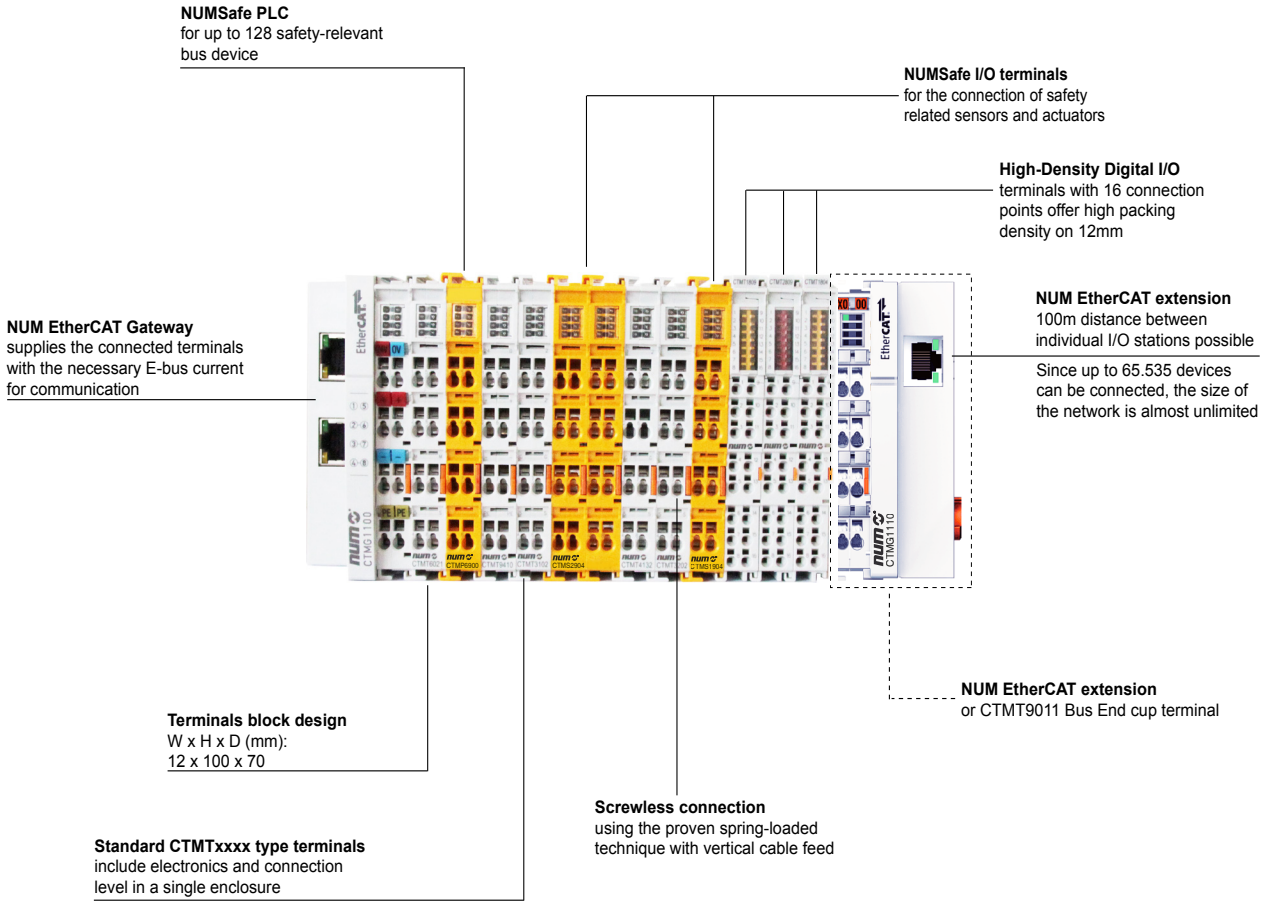
NUM EtherCAT Terminal is a modular system available with different configurable devices:

- Gateways modules CTMG1100
- Extension modules CTMG1110
- Digital and Analogue I/O modules CTMTxxxx
- Safe PLC modules CTMP6900 (1)
- Safe I/O modules modules CTMS1904 and CTMS2904 (1)
- Technological modules CTMTxxxx.

The machine builder can easily create its own configuration made of a mixed combination of different devices. For each line up a gateway is needed which receives the EtherCAT field bus and propagate the message to the different devices by means of the internal E-bus.
Please also refer to chapter 2 for other informations on NUM EtherCAT process and terminals combination.

(1) For more detailed informations on the Safe PLC and Safe I/O modules please refer to the M00033, M00034 and M00035 manuals.

NUM EtherCAT terminals mixed combination



1.3.1 Structure

The robust housing, secure contacts and the solidly built electronics are prominent features of NUM components. An I/O station consists of an EtherCAT Gateway and almost any number of terminals. Since up to 65.535 devices can be connected, the size of the network is almost unlimited.

The electronic terminal blocks are attached to the EtherCAT Gateway. The contacts are made as the terminal clicks into place, without any other manipulation.
This means that each electronic terminal block can be individually exchanged. It can be placed on a standard DIN rail.

A clearly arranged connection panel with LEDs for status display and push-in contact labels ensures clarity in the field. 3-wire conductors with an additional connection for a protective conductor, enable direct connection of sensors and actuators.

1.3.2 Free mix of signals

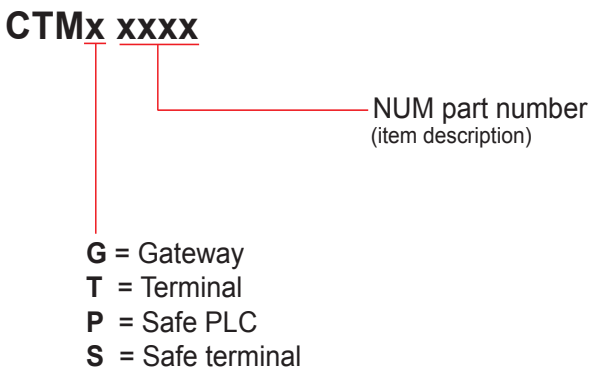
Suitable EtherCAT Terminals are available for all common digital and analog signal types encountered in the world of automation. NUM EtherCAT Terminals enables bit-precise composition of the required I/O channels.

The digital EtherCAT Terminals are designed as 2-, 4-, 8- or 16-channel terminals.

In the 16-channel variant, digital input and output signals are arranged in an ultra-compact way within a standard terminal housing across a width of only 12mm.
The standard analog signals of ± 10 V, 0…10 V, 0…20mA and 4…20mA are all available as 1-, 2-, 4- and 8-channel variants within a standard housing.

1.4 Product identification

NUM EtherCAT terminals identification usually have an 8-digit, which is printed on the device or attached to it on a sticker.



Examples of EtherCAT Gateway terminal CTMG1100:

- **CTM** Structure of production
- **G** Gateway identification
- **1100** Part number.

1.5 Serial number

NUM EtherCAT terminals usually have an 8-digit serial number, which is printed on the device or attached to it on a sticker.

This serial number indicates the construction condition on delivery.

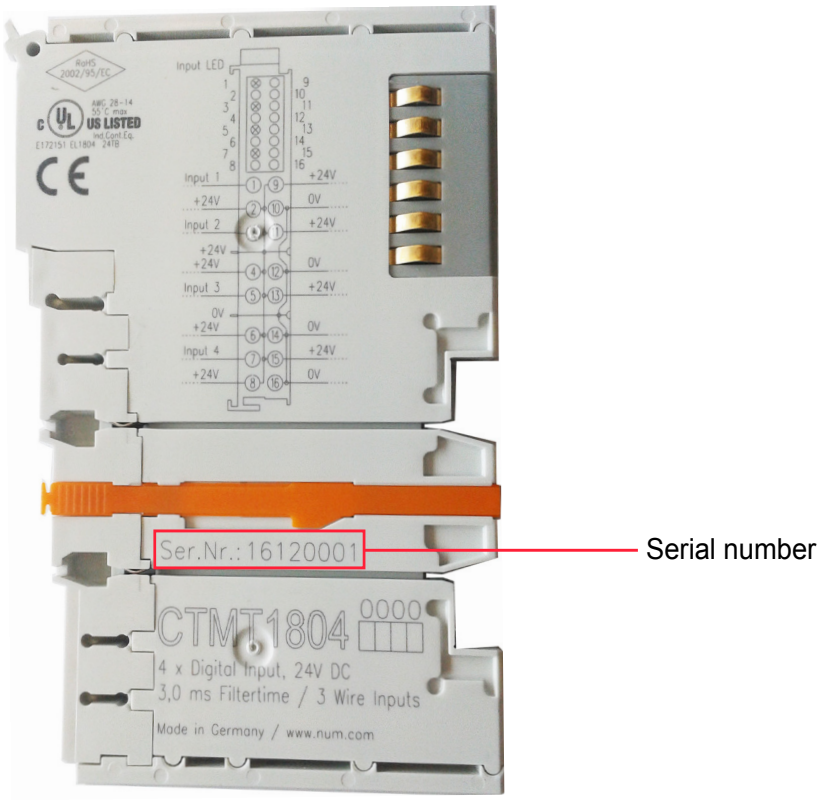
Structure of the serial number

Structure of the serial number: KK YY FF HH

- **KK** - week of production (CW, calendar week)
- **YY** - year of production
- **FF** - firmware version
- **HH** - hardware version

Examples of CTMT1804 serial number data: Ser. Nr.: 16 12 00 01

- **16** - week of production 16
- **12** - year of production 2012
- **00** - firmware version 00
- **01** - hardware version 01.



1.6 Document revisions

Code	Edition	Evolution Index	Meaning of the major documentation evolution points	See chapter
M00032	10.2012	00	First version of the manual.	-
	05.2013	01	- New CTMT2024 4 channel digital output terminal 24VDC, 2A. - New CTMT2602 2-channel relay output terminals 230VAC. - New CTMT2612 2-channel relay output terminals. - New CTMT5101 Incremental encoder interface (RS485). - New CTMT5151 1-Channel incremental encoder interf. (24V).	3, 5, 6

1.7 NUM Agencies

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

1.8 Index

The index at the end of the manual facilitates access to infomation by keywords.

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Summary

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2 EtherCAT Basics communication

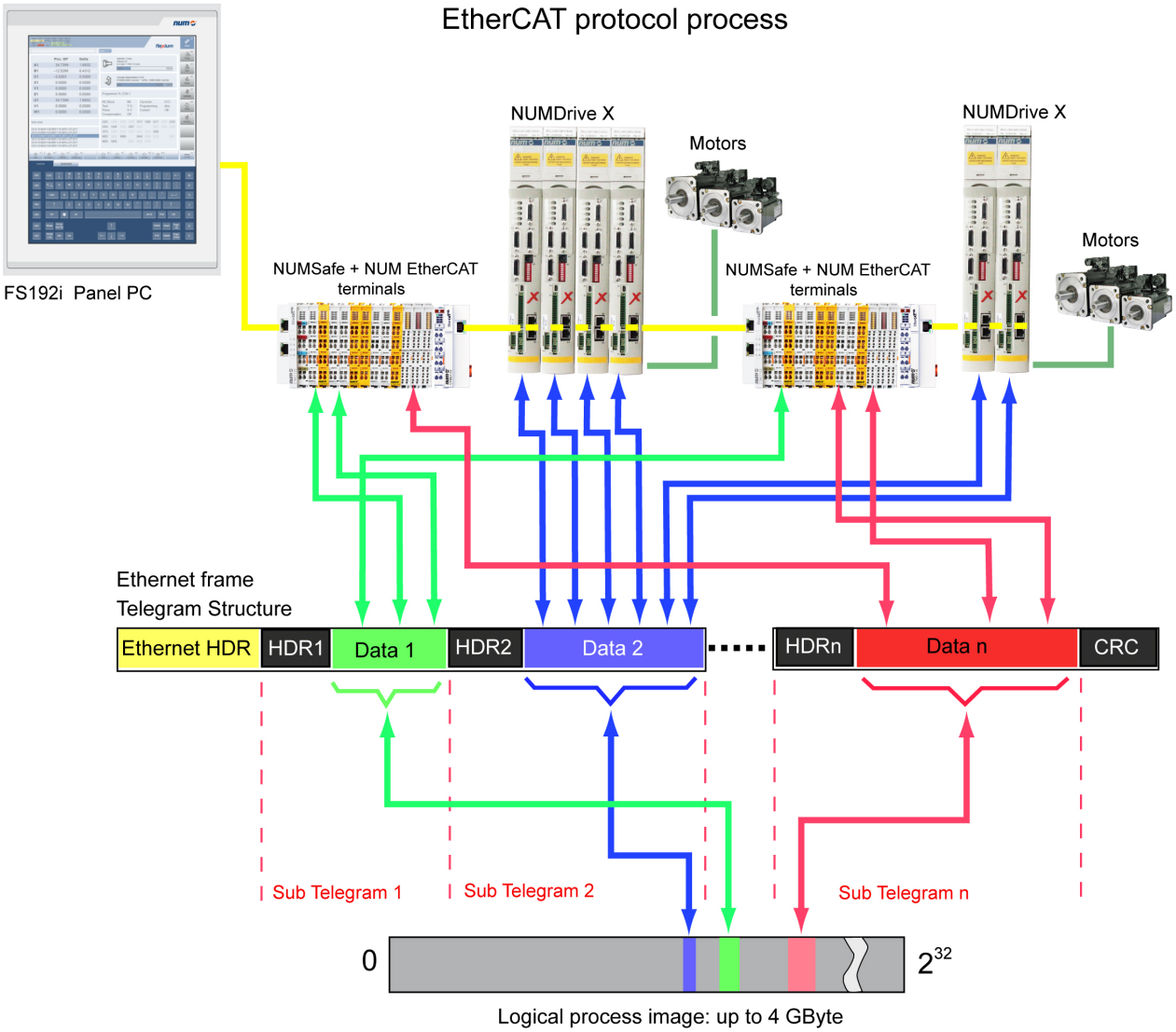
2.1 System Properties

2.1.1 Protocol

The EtherCAT protocol is optimized for process data and is transported directly within the Ethernet frame thanks to a special Ether-type. It may consist of several sub-telegrams, each serving a particular memory area of the logical process images that can be up to 4 gigabytes in size.

The data sequence is independent of the physical order of the Ethernet terminals in the network; addressing can be in any order. Broadcast, Multicast and communication between slaves are possible.

Transfer directly in the Ethernet frame is used in cases where EtherCAT components are operated in the same subnet as the control computer.



Protocol structure
The process image allocation is freely configurable.
Data are copied directly in the I/O terminal to the desired location within the process image: no additional mapping is required. The available logical address space is with very large (4 GB).

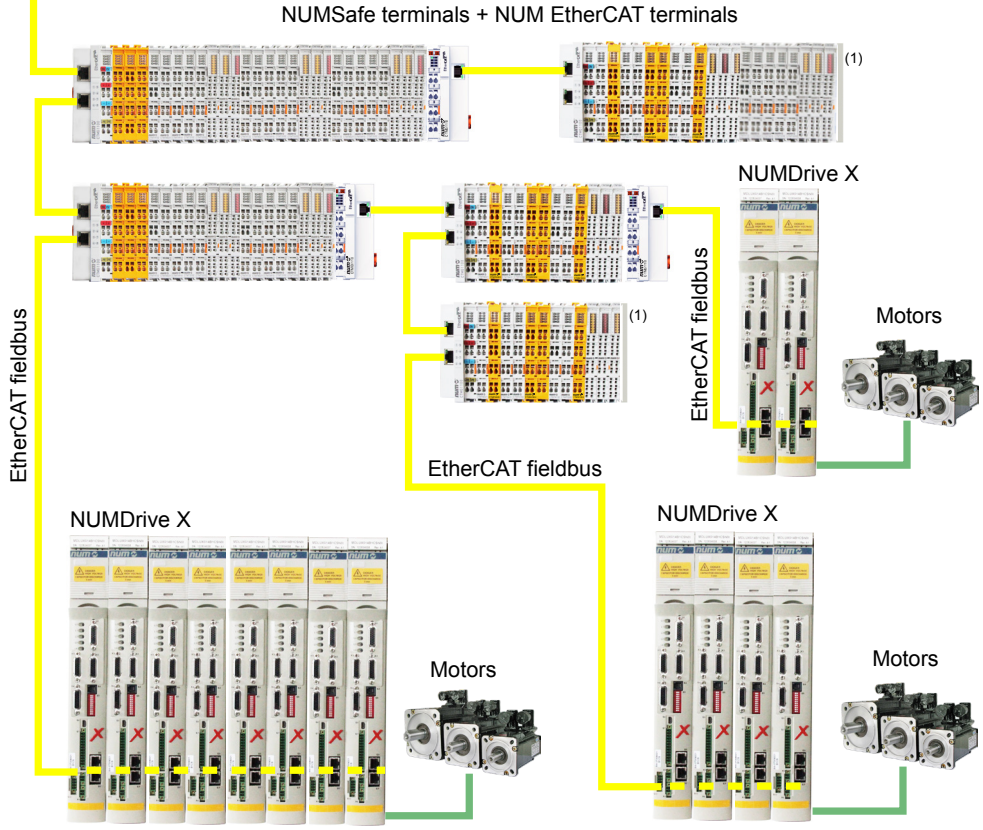
2.1.2 Topology

Line, tree or star: EtherCAT supports almost any topology. The bus or line structure known from the fieldbusses thus also becomes available for Ethernet.

Particularly useful for system wiring is the combination of line and branches or stubs.
The required interfaces exist on the couplers; no additional switches are required. Naturally, the classic switch-based Ethernet star topology can also be used.

FS192i Panel PC

EtherCAT fieldbus combination



(1) CTMT9011 Bus End cup terminal.

Since fast Ethernet physical layer is used, the distance between any two nodes can be up to 100m. Up to 65535 devices can be connected per segment.

Maximum wiring flexibility
With or without switch, line or tree topologies, can be freely selected and combined. The complete bandwidth of the Ethernet network - such as different optical fibers and copper cables - can be used in combination with switches or media converters.

NUM doesn't support an EtherCAT network wired as a ring configuration, because two ports on the master device (FS152/FS192/BoxPC) are not available.

2.1.3 Distributed Clocks

Accurate synchronization is particularly important in cases where spatially distributed processes require simultaneous actions. This may be the case, for example, in applications where several servo axes carry out coordinated movements simultaneously.

The most powerful approach for synchronization is the accurate alignment of distributed clocks, as described in the new IEEE 1588 standard. In contrast to fully synchronous communication, where synchronization quality suffers immediately in the event of a communication fault, distributed aligned clocks have a high degree of tolerance vis-à-vis possible fault-related delays within the communication system.

With EtherCAT, the data exchange is fully based on a pure hardware machine. Since the communication utilizes a logical (and thanks to full-duplex Fast Ethernet also physical) ring structure, the mother clock can determine the run-time offset to the individual daughter clocks simply and accurately - and vice versa. The distributed clocks are adjusted based on this value, which means that a very precise network-wide timebase with a jitter of significantly less then 1 microsecond is available.

However, high-resolution distributed clocks are not only used for synchronization, but can also provide accurate information about the local timing of the data acquisition. For example, controls frequently calculate velocities from sequentially measured positions. Particularly with very short sampling times, even a small temporal jitter in the displacement measurement leads to large step changes in velocity. With EtherCAT new, extended data types are introduced as a logical extension (time stamp and oversampling data type).

The local time is linked to the measured value with a resolution of up to 10ns, which is made possible by the large bandwidth offered by Ethernet. The accuracy of a velocity calculation then no longer depends on the jitter of the communication system. It is orders of magnitude better than that of measuring techniques based on jitter-free communication.

2.1.4 Performance

EtherCAT reaches new dimensions in network performance. Protocol processing is purely hardware-based through an FMMU chip in the terminal and DMA access to the network card of the master.

It is thus independent of protocol stack run-times, CPU performance and software implementation. The update time for 1000 I/Os is only 30µs - including terminal cycle time. Up to 1486 bytes of process data can be exchanged with a single Ethernet frame - this is equivalent to almost 12000 digital inputs and outputs. The transfer of this data quantity only takes 300µs.

The communication with 100 servo axes only takes 100µs. During this time, all axes are provided with set values and control data and report their actual position and status. Distributed clocks enable the axes to be synchronised with a deviation of significantly less than 1 microsecond.

The extremely high performance of the EtherCAT technology enables control concepts that could not be realized with classic fieldbus systems. For example, the Ethernet system can now not only deal with velocity control, but also with the current control of distributed drives. The tremendous bandwidth enables status information to be transferred with each data item.

With EtherCAT, a communication technology is available that matches the superior computing capacity of modern Industrial PCs. The bus system is no longer the bottleneck of the control concept. Distributed I/Os are recorded faster than is possible with most local I/O interfaces. The EtherCAT technology principle is scalable and not bound to the baud rate of 100 MBaud – extension to GBit Ethernet is possible.

2.1.5 Diagnostics

Experience with fieldbus systems shows that availability and commissioning times crucially depend on the diagnostic capability. Only faults that are detected quickly and accurately and which can be precisely located can be corrected quickly. Therefore, special attention was paid to exemplary diagnostic features during the development of EtherCAT.

During commissioning, the actual configuration of the I/O terminals should be checked for consistency with the specified configuration. The topology should also match the saved configuration. Due to the built-in topology recognition down to the individual terminals, this verification can not only take place during system start-up, automatic reading in of the network is also possible (configuration upload).

Bit faults during the transfer are reliably detected through evaluation of the CRC checksum:
The 32 bit CRC polynomial has a minimum hamming distance of 4. Apart from breaking point detection and localization, the protocol, physical transfer behavior and topology of the EtherCAT system enable individual quality monitoring of each individual transmission segment.

The automatic evaluation of the associated error counters enables precise localization of critical network sections. Gradual or changing sources of error such as EMC influences, defective push-in connectors or cable damage are detected and located, even if they do not yet overstrain the self-healing capacity of the network.

2.2 EtherCAT cabling – wire-bound

The cable length between two EtherCAT devices must not exceed 100m.
This results from the FastEthernet technology, which, above all for reasons of signal attenuation over the length of the cable, allows a maximum link length of 5 + 90 + 5m if cables with appropriate properties are used.

2.2.1 Cables and connectors

For connecting EtherCAT devices only Ethernet connections (cables + plugs) that meet the requirements of at least category 5 (CAt5) according to EN 50173 or ISO/IEC 11801 should be used.

EtherCAT uses 4 wires for signal transfer. EtherCAT uses RJ45 plug connectors, for example.

The pin assignment is compatible with the Ethernet standard (ISO/IEC 8802-3).

Pin	Color of conductor	Signal	Description
1	Yellow	TD +	Transmission Data +
2	Orange	TD -	Transmission Data -
3	White	RD +	Receiver Data +
6	Blue	RD -	Receiver Data -

Due to automatic cable detection (auto-crossing) symmetric (1:1) or cross-over cables can be used between EtherCAT devices from NUM.

Note	**Recommended cables** Suitable cables for the connection of EtherCAT devices can be found on the NUM Catalogue!

2.2.2 E-Bus supply

A bus coupler can supply the CTMT terminals added to it with the E-bus system voltage of 5V; a coupler is thereby loadable up to 2A as a rule. Information on how much current each CTMT terminal requires from the E-bus supply is available on chapter 3.

If the added terminals require more current than the coupler can supply, then power feed terminals (e.g. CTMT9410) must be inserted at appropriate places in the terminal strand.

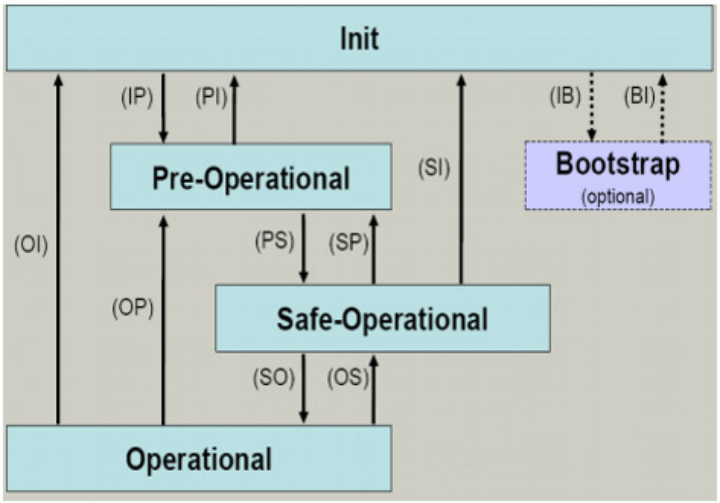
CAUTION	**Caution! Malfunction possible!** The same ground potential must be used for the E-Bus supply of all EtherCAT terminals in a terminal block!.

2.3 EtherCAT State Machine

The state of the EtherCAT slave is controlled via the EtherCAT State Machine (ESM). Depending upon the state, different functions are accessible or executable in the EtherCAT slave.
Specific commands must be sent by the EtherCAT master to the device in each state, particularly during the bootup of the slave.

A distinction is made between the following states:
- Init
- Pre-Operational
- Safe-Operational and
- Operational
- Boot.

The regular state of each EtherCAT slave after bootup is the OP state.



Init
After switch-on the EtherCAT slave in the Init state. No mailbox or process data communication is possible.
The EtherCAT master initializes sync manager channels 0 and 1 for mailbox communication.

Pre-Operational (Pre-Op)
During the transition between Init and Pre-Op the EtherCAT slave checks whether the mailbox was initialized correctly.

In *Pre-Op* state mailbox communication is possible, but not process data communication. The EtherCAT master initializes the sync manager channels for process data (from sync manager channel 2), the FMMU channels and, if the slave supports configurable mapping, PDO mapping or the sync manager PDO assignment. In this state the settings for the process data transfer and perhaps terminal-specific parameters that may differ from the default settings are also transferred.

Safe-Operational (Safe-Op)
During transition between *Pre-Op* and *Safe-Op* the EtherCAT slave checks whether the sync manager channels for process data communication and, if required, the distributed clocks settings are correct.
Before it acknowledges the change of state, the EtherCAT slave copies current input data into the associated DP-RAM areas of the EtherCAT slave controller (ECSC).

In *Safe-Op* state mailbox and process data communication is possible, although the slave keeps its outputs in a safe state, while the input data are updated cyclically.

Operational (Op)

Before the EtherCAT master switches the EtherCAT slave from *Safe-Op* to *Op* it must transfer valid output data.

In the *Op* state the slave copies the output data of the masters to its outputs. Process data and mailbox communication is possible.

Boot

In the *Boot* state the slave firmware can be updated. The Boot state can only be reached via the Init state.

In the *Boot* state mailbox communication via the *file access over EtherCAT (FoE)* protocol is possible, but no other mailbox communication and no process data communication.

2.4 Watchdog settings

2.4.1 Notes for setting the watchdog

CTMT terminals are equipped with a safety feature (watchdog) that switches off the outputs after a specifiable time in the event of an interruption of the process data traffic.
The EtherCAT slave controller (ESC) in the CTMT2xxx terminals features 2 watchdogs:

- SM watchdog (default: 100ms)
- PDI watchdog (default: 100ms).

2.4.2 SM watchdog (SyncManager Watchdog)

The SyncManager watchdog is reset after each successful EtherCAT process data communication with the terminal. If no EtherCAT process data communication takes place with the terminal for longer than the set and activated SM watchdog time, e.g. in the event of a line interruption, the watchdog is triggered and the outputs are set to FALSE.

The OP state of the terminal is unaffected. The watchdog is only reset after a successful EtherCAT process data access. Set the monitoring time as described above.
The SyncManager watchdog monitors correct and timely process data communication with the ESC from the EtherCAT side.

2.4.3 PDI watchdog (Process Data Watchdog)

If no PDI communication with the EtherCAT slave controller (ESC) takes place for longer than the set and activated PDI watchdog time, this watchdog is triggered.
PDI (Process Data Interface) is the internal interface between the ESC and local processors in the EtherCAT slave, for example. The PDI watchdog can be used to monitor this communication for failure.
The PDI watchdog monitors correct and timely process data communication with the ESC from the application side.

2.4.4 Multiplier

Both watchdogs receive their pulses from the local terminal cycle, divided by the watchdog multiplier:

1/25 MHz * (watchdog multiplier + 2) = 100 µs (for default setting of 2498 for the multiplier)

The standard setting of 1000 for the SM watchdog corresponds to a release time of 100ms.

The value in multiplier + 2 corresponds to the number of basic 40ns ticks representing a watchdog tick. The multiplier can be modified in order to adjust the watchdog time over a larger range.

2.4.5 Example “Set SM watchdog”

This checkbox enables manual setting of the watchdog times. If the outputs are set and the EtherCAT communication is interrupted, the SM watchdog is triggered after the set time and the outputs are erased.

This setting can be used for adapting a terminal to a slower EtherCAT master or long cycle times. The default SM watchdog setting is 100 ms. The setting range is 0..65535. Together with a multiplier with a range of 1..65535 this covers a watchdog period between 0..~170 seconds.

Calculation
Multiplier = 2498 → watchdog base time = 1 / 25 MHz * (2498 + 2) = 0.0001 seconds = 100µs
SM watchdog = 10000 → 10000 * 100µs = 1 second watchdog monitoring time

 CAUTION	**CAUTION! Undefined state possible!** The function for switching off of the SM watchdog via SM watchdog = 0 is only implemented in terminals.

 CAUTION	**CAUTION! Damage of devices and undefined state possible!** If the SM watchdog is activated and a value of 0 is entered the watchdog switches off completely. Set outputs are NOT reset if the communication is interrupted.

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Summary

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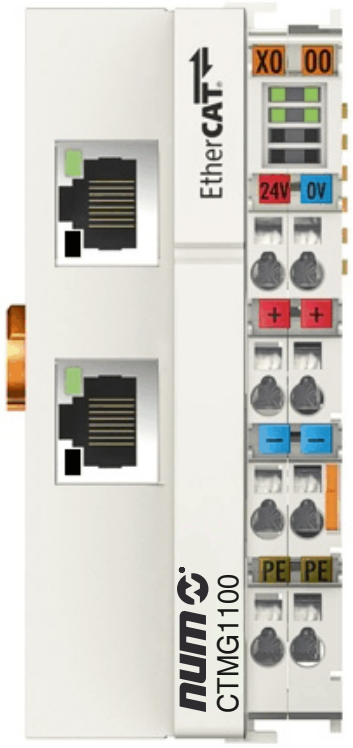
3 System description

3.1 CTMG1100 NUM EtherCAT Gateway



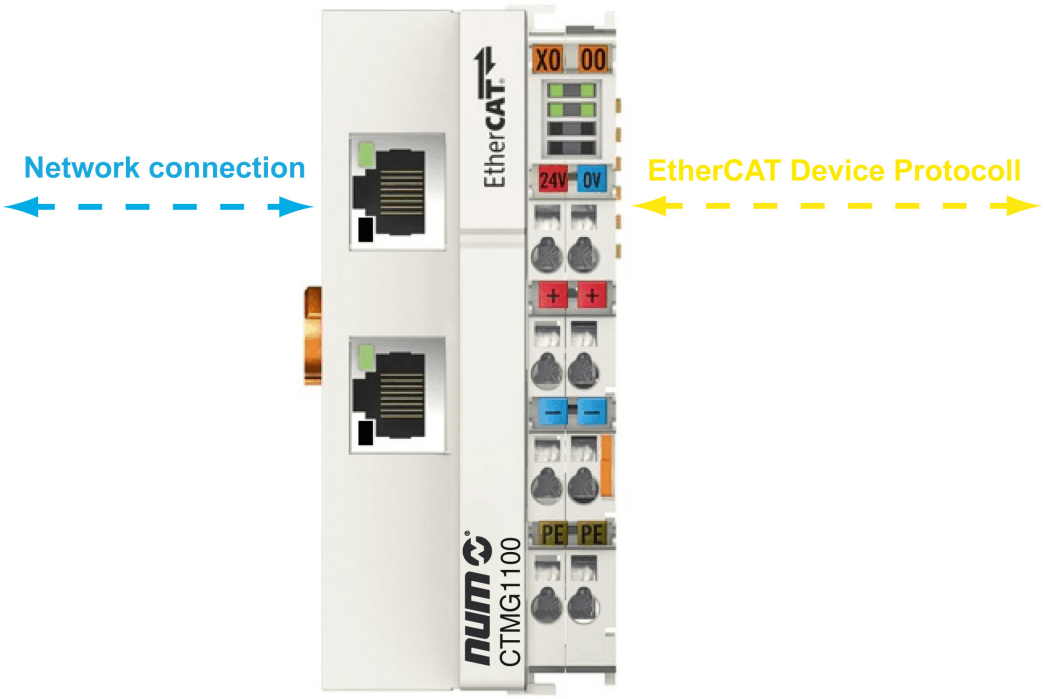
The CTMG1100 Gateway connects EtherCAT with the EtherCAT Terminals (CTMTxxxx).
One station consists of a coupler, any number of EtherCAT Terminals and a bus end terminal, e.g. CTMT9010 or CTMT9011.

The gateway converts the telegrams from Ethernet 100BASE-TX to E-bus signal representation in passing with minimum latency. The gateway is connected to the network via the upper Ethernet interface. The lower RJ-45 socket may be used to connect further EtherCAT devices in the same strand.

The gateway supplies the connected terminals with the necessary E-bus current for communication. The gateway can supply a maximum of 5V/2 A. Power supply terminals (e.g. CTMT9410) must be integrated if more current is required.

In the EtherCAT network, the CTMG1100 Gateway can be installed anywhere in the Ethernet signal transfer section (100BASE-TX). The coupler thereby processes exclusively unaddressed MAC Broadcast telegrams of the type EtherCAT Device Protocol from the EtherCAT master. Since directed addressing via MAC Unicast or IP addressing is not used, neither a switch nor a router can be used.

Overview



An EtherCAT Gateway CTMG1100 is required in order to connect EtherCAT Terminals with E-bus-communication (series CTMTxxxx,) to an EtherCAT network. This gateway relays the communication from the higher-level EtherCAT network to the terminals, or functions as a master itself and generates telegrams.

NUM offers different components for different application scenarios.

A gateway connects the added terminals to the right; it can be connected to the higher level network to the left.

Gateway that support the EtherCAT Device Protocol ‘to the left’ must be connected there to an EtherCAT master.

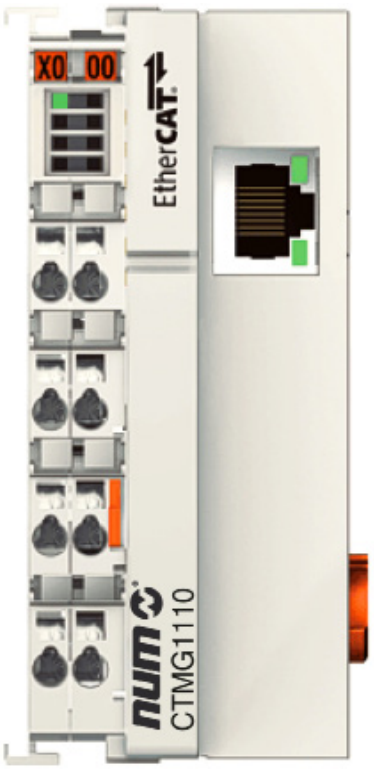
Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMG1100
Task in the EtherCAT-System	Coupling of EtherCAT Terminals (CTMTxxxx) on 100BASE-TX EtherCAT networks
Number of EtherCAT Terminals	Up to 65535 in the complete system
Max. number peripheral signals	Max. 4.2 GB addressable IO points
Data transfer medium	Min. Ethernet CAT-5 cable
Cable length between 2 EtherCAT Gateway	Max. 100m (100BASE-TX)
Protocols / Baud rate	EtherCAT Device protocol / 100 MBaud
HotConnect	No
Delay	Approx. 1µs
Bus connection	2 x RJ45
Power supply	24VDC (-15%/+20%)
Input current	70mA + (E-bus current)/4
E-Bus supply current (5V)	Max. 2000mA
Power contacts	Max. 24VDC, maximal 10A
Dielectric strength	500Vrms (supply voltage/EtherCAT)
Dimensions (W x H x D)	Approx. 44mm x 100mm x 68mm
Weight	Approx. 105g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.2 CTMG1110 NUM EtherCAT extension



Like the E-bus end terminal, the CTMG1110 EtherCAT extension is connected to the end of the EtherCAT Terminal block. The terminal offers the option of connecting an Ethernet cable with RJ 45 connector, thereby extending the EtherCAT strand electrically isolated by up to 100m.

In the CTMG1110 terminal, the E-bus signals are converted on the fly to 100BASE-TX Ethernet signal representation. Power supply to the CTMG1110 electronics is via the E-bus. No parameterisation or configuration tasks are required.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMG1110
Task in the EtherCAT-System	Conversion of the E-bus signals to 100BASE-TX Ethernet for extension of the EtherCAT network
Data transfer medium	Ethernet/EtherCAT CAT 5 cable
Cable length between 2 Bus Couplers	Max. 100m (100BASE-TX)
Delay	Approx. 1µs
Protocols / Baud rate	Any EtherCAT protocol / 100 MBaud
Configuration	No address or configuration setting required
Bus connection	1 x RJ45
Power supply	From E-Bus
Power consumption from E-Bus	Typ. 130mA
Dielectric strength	500 Vrms (supply voltage/EtherCAT)
Dimensions (W x H x D)	Approx. 44mm x 100mm x 68mm
Weight	Approx. 50g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.3 CTMT1004 4 channel digital input terminal 24VDC, 3ms input filter

The CTMT1004, 4 channel digital input terminal acquires the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation unit.

Digital input terminals from the CTMT1004 series have a 3ms input filter and 2 wires connection. The EtherCAT Terminals indicate their state via a LED.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT1004
Number of inputs	4
Connection technology	2-wires
Nominal voltage of inputs	24VDC (-15% / +20%)
Signal voltage “0”	-3V ... 5V (EN 61131-2, Typ 1)
Signal voltage “1”	15V ... 30V (EN 61131-2, Typ 1)
Input filter	3ms
Input current	Typ. 3mA (EN 61131-2, Typ 1)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Typ. 90mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	4 input bits
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 50g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.4 CTMT1008 8 channel digital input terminal 24VDC, 3ms input filter

The CTMT1008, 8 channel digital input terminal acquires the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation unit.

Digital input terminals from the CTMT100x series have a 3ms input filter and 1 wires connection. The EtherCAT Terminals indicate their state via a LED.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT1008
Number of inputs	8
Nominal voltage of inputs	24VDC (-15% / +20%)
Connection technology	1-wire
Signal voltage “0”	-3V ... 5V (EN 61131-2, Typ 1)
Signal voltage “1”	15V ... 30V (EN 61131-2, Typ 1)
Input filter	3ms
Input current	Typ. 3mA (EN 61131-2, Typ 1)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Typ. 90mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	4 input bits
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 50g
Operating temperature	0°C ... + 55°C (aligned in horizontal installation position)
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.5 CTMT1804 4 digital inputs 24VDC, 3ms input filter

HD EtherCAT input terminals, 4 digital input channels, 24VDC, 3 wires connection

The CTMT1804 digital input terminals acquire the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation device.
The EtherCAT Terminals each contain four channels, consisting of a signal input, 24VDC and 0V. The signal states are displayed by LEDs. The power contacts are looped through.

For the CTMT1804 EtherCAT terminals, the reference ground for all inputs is the 0V power contact. The versions have input filters with different speeds (CTMT1804: 3ms). The wires can be connected without tools in the case of solid wires using a direct plug-in technique.
The HD EtherCAT Terminals (High Density) with increased packing density feature 16 connection points in the housing of a 12 mm terminal block.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT1804
Number of inputs	4
Nominal voltage of inputs	24VDC (-15% / +20%)
Connection technology	3-wires
Signal voltage “0”	-3V ... 5V (EN 61131-2, Typ 1)
Signal voltage “1”	15V ... 30V (EN 61131-2, Typ 1)
Input filter	3ms
Input current	Typ. 3mA (EN 61131-2, Typ 1)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Typ. 100mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	4 input bits
Configuration	No address setting, configuration via Flexium Tools
Conductor types	Solid wire, stranded wire and ferrule
Conductor connection	Solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver
Rated cross-section	Solid wire: 0.08…1.5mm²; stranded wire: 0.25…1.5mm²; ferrule: 0.14…0.75mm²
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 60g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.6 CTMT1809 16 digital inputs 24VDC, 3ms input filter

HD EtherCAT input terminals, 16 digital input channels, 24VDC

The CTMT1809 digital input terminals acquire the binary control signals from the process level and transmit them, in an electrically isolated form, to the higher-level automation device. The EtherCAT Terminals each contain 16 channels, whose signal states are displayed by LEDs.

The terminals are particularly suitable for space-saving use in control cabinets. By using the single-conductor connection technique, a multi-channel sensor can be connected in the smallest space with a minimum amount of wiring. The power contacts are looped through.

For the CTMT1809 EtherCAT Terminals, the reference ground for all inputs is the 0V power contact. and has 3ms input filters. The conductors can be connected without tools in the case of solid wires using a direct plug-in technique.
The HD EtherCAT Terminals (High Density) with increased packing density feature 16 connection points in the housing of a 12 mm terminal block.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT1809
Number of inputs	16
Nominal voltage of inputs	24VDC (-15% / +20%)
Connection technology	1-wire
Signal voltage “0”	-3V ... 5V (EN 61131-2, Typ 1)
Signal voltage “1”	15V ... 30V (EN 61131-2, Typ 1)
Input filter	3ms
Input current	Typ. 3mA (EN 61131-2, Typ 1)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Typ. 100mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	16 input bits
Configuration	No address setting, configuration via Flexium Tools
Conductor types	Solid wire, stranded wire and ferrule
Conductor connection	Solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver
Rated cross-section	Solid wire: 0.08…1.5mm²; stranded wire: 0.25…1.5mm²; ferrule: 0.14…0.75mm²
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 60g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.7 CTMT2004 4 channel digital output terminal 24VDC, 0.5A

The CTMT2004 channel digital output terminal connects the binary control signals from the automation unit on to the actuators at the process level with electrical isolation.

The EtherCAT terminals indicate their state via a LED.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT2004
Number of outputs	4
Connection technology	2-wires
Load type	Ohmic, inductive, lamp load
Nominal output voltage	24VDC (-15% / +20%)
Switching times	T_{on}: 60µs typ.; T_{off}: 300µs typ.
Output current max. (p. channel)	Max. 0.5 A (short-circuit-proof)
Switch-off energy (ind.)	Max. 150mJ/channel
Current consumption from load voltage	Typ. 15mA
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Typ. 100mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	4 output bits
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 50g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.8 CTMT2008 8 channel digital output terminal 24VDC, 0.5A

The CTMT2008 8 channel digital output terminal connects the binary control signals from the automation unit on to the actuators at the process level with electrical isolation.

The EtherCAT Terminals indicate their state via a LED.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT2008
Number of outputs	8
Connection technology	1-wire
Load type	Ohmic, inductive, lamp load
Nominal output voltage	24VDC (-15% / +20%)
Switching times	T_{ON}: 60µs typ.; T_{OFF}: 300µs typ.
Output current max. (p. channel)	Max. 0.5 A (short-circuit-proof)
Switch-off energy (ind.)	Max. 150 mJ/channel
Current consumption from load voltage	Typ. 15 mA
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Typ. 110mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	8 output bits
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 50g
Operating temperature	0°C ... + 55°C (aligned horizontal installation position) 0 °C ... + 45 °C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.9 CTMT2024 4 channel digital output terminal 24VDC, 2A

The CTMT2024 digital output terminals connect the binary control signals from the automation unit on to the actuators at the process level with electrical isolation. The terminals offer short circuit protection and indicate their signal state via LEDs.

The CTMT2024 enables direct connection of four 2-wire actuators. It features four earth connecting points.

Technical data	CTMT2024
Number of outputs	4
Reverse voltage protection	Yes
Load type	Ohmic, inductive, lamp load
Nominal output voltage	24VDC (-15% / +20%)
Switching times	Ton: 40µs typ.; Toff: 200µs typ.
Output current max. (p. channel)	max. 2A (short-circuit-proof)
Switch-off energy (ind.)	< 1.7 J/channel
Current consumption from load voltage	typ. 13mA + load
Supply voltage for internal E-bus circuit	via E-bus
Current consump. via E-bus	typ. 110mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	4 output bits
Configuration	No address setting, configuration via NUMSafe System Manager
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

3.10 CTMT2602 2-channel relay output terminals 230VAC

The CTMT2602 output terminals have two relays each of which has a single contact (2 x normally open, with power contacts). The relay contact of the CTMT2602 is connected to the power contacts, which are suitable for use at up to 230VAC, and can be generally used for switching devices requiring mains power.

The EtherCAT Terminals indicate their signal state by means of light emitting diodes. The power contacts are not looped through.

Technical data	CTMT2602
Number of outputs	2 x make contacts for power contact
Rated load voltage	230VAC / 30VDC
Resistive switch current	5A AC / DC
Inductive switch current	2A AC / DC
Minimum permitted load	10mA at 5VDC
Lamp test, electronic ballasts	4 x 58W
Operating cycles mech. (min.)	2×10^7
Operating cycles electr. (min.)	1×10^5 (5A / 30VDC)
Power supply	via the E-Bus
Current consump. via E-bus	Typ. 170mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	2 output bits
Configuration	No address or configuration settings
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 50g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

3.11 CTMT2612 2-channel relay output terminals

The CTMT2612 output terminals have two relays each of which has a single contact (2 x change over). The relay contact is connected to the power contacts, which are suitable for use at up to 230VAC, and can be generally used for switching devices requiring mains power.

The EtherCAT Terminals indicate their signal state by means of light emitting diodes. The EL2612 has potential-free contacts. The power contacts are not looped through.

Technical data	CTMT2612
Number of outputs	2 x change-over
Rated load voltage	125VAC / 30VDC
Inductive switch current	-
Minimum permitted load	10µA at 10mVDC
Lamp test, electronic ballasts	-
Operating cycles mech. (min.)	1 x 10^8
Operating cycles electr. (min.)	2 x 10^5 (1A /30VDC)
Power supply	via the E-Bus
Current consump. via E-bus	Typ. 150mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	2 output bits
Configuration	No address or configuration settings
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 50g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

3.12 CTMT2809 16 digital output channels terminal HD EtherCAT 24VDC

The CTMT2809 digital output terminal connects the binary control signals from the automation device on to the actuators at the process level with electrical isolation. The CTMT2809 is protected against polarity reversal and process load currents with outputs protected against overload and short-circuit.
The EtherCAT Terminal contains 16 channels, whose signal states are displayed by LEDs.

The terminal is particularly suitable for space-saving use in control cabinets. The connection technology is particularly suitable for single-ended inputs. All components have to use the same reference point as the CTMT2809. The power contacts are looped through.

The outputs are fed via the 24V power contact. The conductors can be connected without tools in the case of solid wires using a direct plug-in technique.
The HD EtherCAT Terminals (High Density) with increased packing density feature 16 connection points in the housing of a 12mm terminal block.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT2809
Number of outputs	16
Connection technology	1-wire
Rated load voltage	24VDC (-15% / +20%)
Load type	Ohmic, inductive, lamp load
Max. output current	0.5A (short-circuit-proof) per channel
Breaking energy	< 150 mJ/channel
Switching times	Typ. T_{ON}: 60 µs, typ. T_{OFF}: 300µs
Supply voltage for internal E-bus circuit	Via power contacts
Current consumption via E-bus	Typ. 140mA
Curr. consumption power contacts	Typ. 30 mA + load
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	16 input bits
Configuration	No address setting, configuration via Flexium Tools
Conductor types	Solid wire, stranded wire and ferrule
Conductor connection	Solid wire conductors: direct plug-in technique; stranded wire conductors and ferrules: spring actuation by screwdriver
Rated cross-section	Solid wire: 0.08…1.5mm²; stranded wire: 0.25…1.5mm²; ferrule: 0.14…0.75mm²
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 65g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.13 CTMT3102 2 channel analog input terminals -10…+10V, diff. input, 16 bits

The CTMT3102 analog input terminals measure input voltages from -10 to +10 V.

The significantly faster conversion time and support for distributed clocks enable use in time-critical applications and set them apart from the CTMT30xx series.

The differential inputs of the CTMT3102 has the same reference ground, which is not connected to the power contacts.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT3102
Number of analog inputs	2 (differential)
Signal voltage	10V ... +10V
Distributed Clocks	Yes
Distributed Clocks precision	<< 1µs
Internal resistance	> 200kΩ
Limit frequency input filter	5kHz
Common-mode voltage U_{CM}	35V max.
Conversion time (default setting): 50 Hz filter)	Approx. 60µs (Fast mode: approx. 40µs)
Resolution	16 bit (incl. sign)
Measuring error (full measuring range)	< ± 0.3 % (total meas. range)
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Typ. 180mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bit width in the process image (default setting)	Inputs: 2 x 16 bit; Status: 2 x 8 bit
Configuration	Via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 60g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.14 CTMT3122 2 channel analog input terminal 4…20mA, differential input, 16 bits

The CTMT3122 analog input terminals measure input currents from 4 to 20mA.
The significantly faster conversion time and support for distributed clocks enable use in time-critical applications.

Overcurrent and undercurrent are displayed not only in the process image, but also by an error LED for each channel.

The differential inputs of the CTMT3122 have the same reference ground, which is not connected to the power contacts.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT3122
Number of analog inputs	2 (differential)
Signal current	4…20mA
Distributed Clocks	Yes
Distributed Clocks precision	<< 1µs
Internal resistance	85Ω typ. + diode voltage
Limit frequency input filter	5kHz
Common-mode voltage U_{CM}	35V max.
Conversion time (default setting): 50 Hz filter)	Approx. 50µs (Fast mode: approx. 35µs)
Resolution	16 bit (incl. sign)
Measuring error (full measuring range)	< ± 0.3 % (total meas. range)
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Typ. 180mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bit width in the process image (default setting)	Inputs: 2 x 16 bit; Status: 2 x 8 bit
Configuration	Via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

Configuration of 0/4..20mA differential inputs

Technical background

The internal input electronics of these terminals have the following characteristic (see Fig. 1):

- Differential current measurement, i.e. concrete potential reference is primarily not required. The system limit applies is the individual terminal CTMT31xx.
- Current measurement via a 33Ω shunt per channel, resulting in a maximum voltage drop of 660 mV via the shunt.
- Internal resistor configuration with GND point (A) central to the shunt. The configuration of the resistors is symmetric, such that the potential of (A) is central relative to the voltage drop via the shunt.
- All channels within the terminal have this GNDint potential in common.
- For 1/2-channel terminals the common GNDint potential (A):
  - is connected to a terminal point and not with GNDPC (power contact).
  - for 4-channel terminals it is connected with GNDPC.

- The centre point of the voltage drop over the 33Ω shunt is referred to common mode point (CMP). According to the technical product data, the maximum permitted UCM voltage (common mode) refers to the potential between the CMP of a channel and the internal GND or the potential between the CMP of 2 channels within a terminal.
  It must not exceed the specified limit (typically ±10 or ±35V).

Accordingly, for multi-channel measurements U_{CM} specifications must be followed.

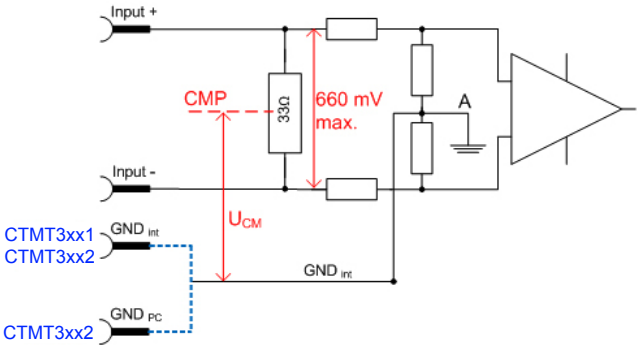


Fig.1: Internal connection diagram for CTMT31xx 0/4..20mA inputs

The block diagram of a 2-channel terminal shows the connected GND points within the terminal (Fig. 2):

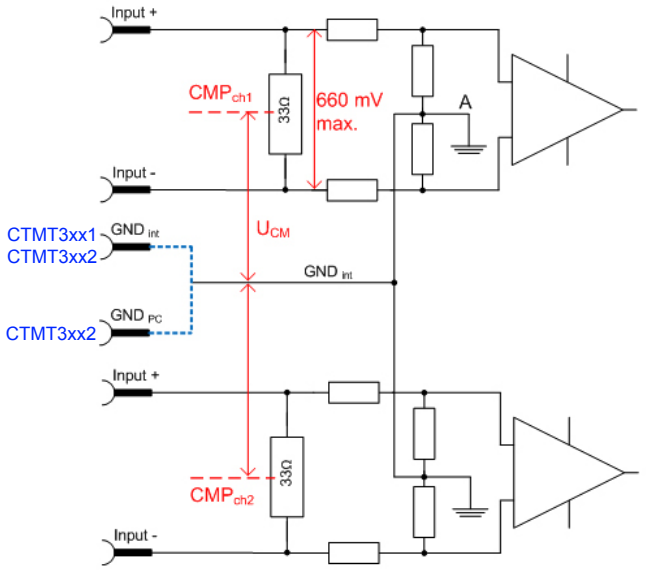


Fig.2: Internal connection diagram for a CTMT3xx2 terminal

For all channels within the terminal U_{CM}, max must not be exceeded.

Note	**U_{CM} for 0/4..20mA inputs** If U_{CM} of an analog input channel is exceeded, internal equalizing currents result in erroneous measurements. For 1/2-channel terminals the internal GND is therefore fed out to a terminal point, so that the U_{CM} specification can be met through application-specific configuration of this GND point, even in cases of atypical sensor configuration.

Example 1
The CTMT3xxx is connected to 2 sensors, which are supplied with 5 and 24V.
Both current measurements are executed as low-side measurements.

This connection type is permitted, because at Imax CMPch1 and CMPch2 are approx. 330mV above 0V, which means that UCM is is always < 0.5V. The requirement of UCM < 10V (applicable to CTMT30xx) is therefore adhered to.

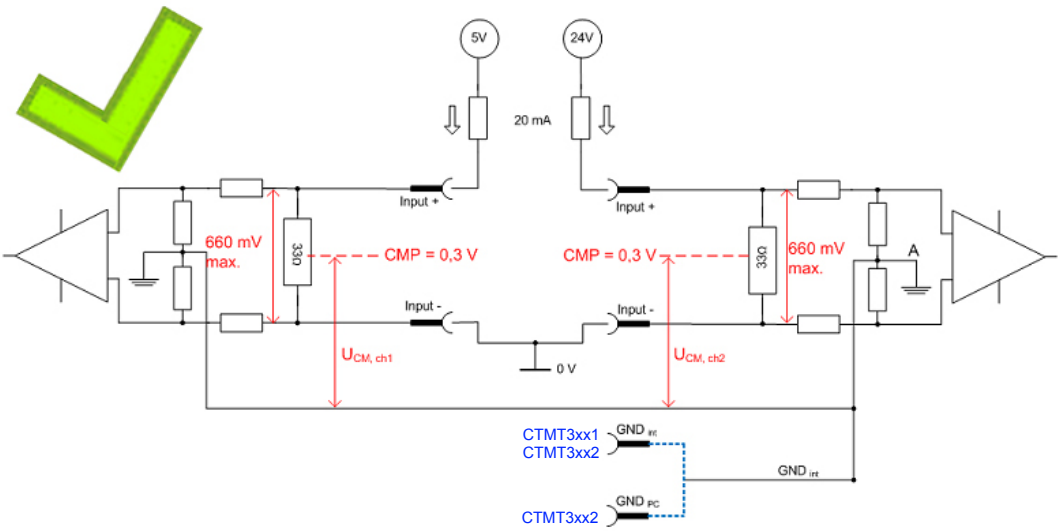


Fig.3: Example 1, low-side measurement

If the CTMT31x2 terminals have no external GNDint connection, the GNDint potential can adjust itself as required (referred to as “floating”).

Please note that for this mode reduced measuring accuracy is to be expected.

Example 2

The same CTMT3xx2 is now again connected with the two 20mA sensors, although this time with one low-side measurement at 5 V and one high-side measurement at 12V.

This results in significant potential differences UCM > 10V (applicable to CTMT30xx) between the two channels, which is not permitted.

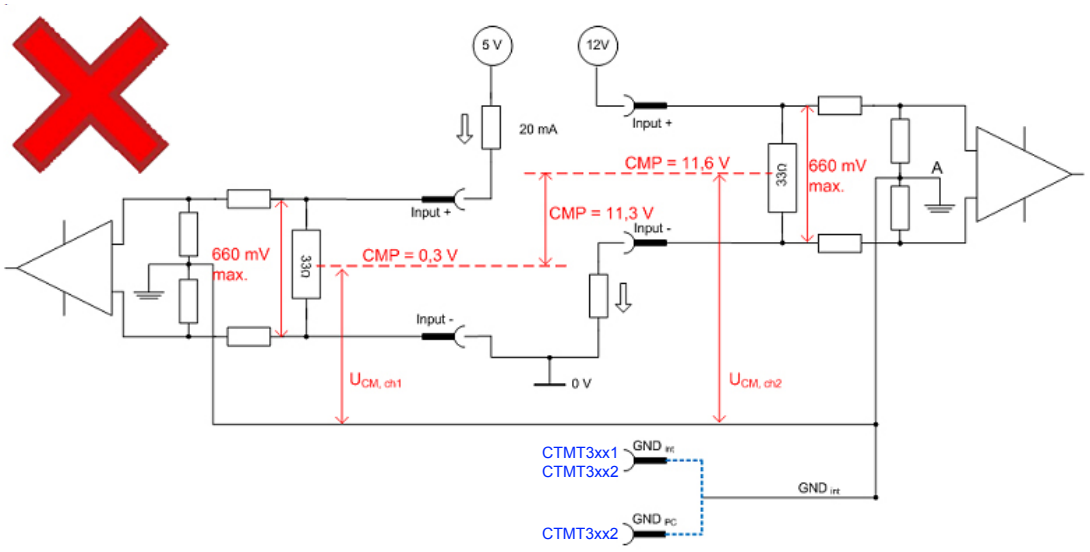


Fig.4: Example 2, high-side / low-side measurement

To rectify this, GNDint can in this case be connected externally with an auxiliary potential of 6V relative to “0 V”. The resulting A/GNDint will be in the middle, i.e. approx. 0.3V or 11.6V.

Summary
This results in certain concrete specifications for external connection with 0/4..20 mA sensors:

- We recommended connecting GND_{int} with a low-impedance potential, because this significantly improves the measuring accuracy of the CTMT31xx.
  Please note the instructions relating to the U_{CM} potential reference.

- The U_{CM} potential reference must be adhered to between CMP ↔ GND_{int} and $CMP_{ch(x)}$ ↔ $CMP_{ch(y)}$.
  If this cannot be guaranteed, the single-channel version should be used.

- Terminal configuration:
  - CTMT3xx1/CTMT3xx2: GNDint is connected to terminal point for external connection. GND_{int} should be connected externally such that condition 2 is met.

  If the sensor cable is shielded, the shield should not be connected with the GND_{int} terminal point but with a dedicated low-impedance shield point.

- If terminal points of several CTMT31xx terminals are connected with each other, ensure that condition 2 is met.

 **Note**	**Connection of GND_{int}** In the CTMT31xx terminals the internal GND, GND_{int} connection is fed out to terminal contacts. To achieve a precise measurement result GND_{int} should be connected to a suitable external low-impedance potential, taking account the specifications for U_{CM}.

3.15 CTMT3162 2 channel analog input terminal 0…10V, single-ended, 16 bits

The CTMT3162 analog input terminals measure input voltages from 0 to 10V with 16-bit resolution.

The significantly faster conversion time and support for distributed clocks enable use in time-critical applications. Overrange and limit evaluation is displayed via the process data.

The inputs of the CTMT3162 have a common reference potential, which is connected to the 0V power contact.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT3162
Number of analog inputs	2 (single-ended)
Signal voltage	0 ...10V
Distributed Clocks	Yes
Distributed Clocks precision	<< 1µs
Internal resistance	> 200kΩ
Limit frequency input filter	5kHz
Dielectric strength	30V max.
Conversion time (default setting): 50 Hz filter)	Approx. 50µs
Resolution	16 bit (incl. sign)
Measuring error (full measuring range)	< ± 0.3 % (total meas. range)
Supply voltage for internal E-bus circuit	Via E-bus
Current consumption. via E-bus	Typ. 180mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bit width in the process image (default setting)	Inputs: 2 x 16 bit; Status: 2 x 8 bit
Configuration	Via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 60g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.16 CTMT3202 2 channel input terminals Pt100 (RTD)

The CTMT3202 analog input terminals allow resistance sensors to be connected directly and can operate 2- and 3 wire sensors. Several characteristic sensor curves (PT100, PT1000, NI120, NI1000, KTY types and others) are supported.

The terminals from the CTMT3202 can measure the temperature at the measuring point or directly output the resistance values of the sensors. For temperature measurements the temperature value is calculated via the characteristic curves stored in the terminal. A microprocessor handles linearization across the whole temperature range, which is freely selectable.

The EtherCAT Terminal's standard settings are: resolution 0.1 °C in the temperature range of Pt100 sensors in 3-wire connection. The EtherCAT Terminals indicate their signal state by means of light emitting diodes. Sensor malfunctions such as broken wires are indicated by error LEDs.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT3202
Number of inputs	2
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000, KT/KTY Resistance measurement 10Ω…1 kΩ or 10Ω 4kΩ (e.g. potentiometer)
Connection method	2- or 3-wire (default: 3-wire)
Temperature range	Depends on range: -200…+850°C (PT sensors); -60…+250°C (Ni sensors)
Resolution	0.1°C per digit
Conversion time	Approx. 800ms .. 2ms (configurable), depending on configuration and filter setting, approx. 85ms default setting
Measuring current	Typ. 0.5mA
Measuring error	< ±0.5°C for Pt sensors
Bit width in the process image	Max. 8 byte input
Supply voltage for internal E-bus circuit	Via the E-Bus
Current consumption E-bus	Typ. 190mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 60g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

General

The CTMT3202 analog input terminals enable resistance sensors to be connected directly.
A micro-controller within the terminal is used for converting and linearizing the resistance to a temperature value.

The temperatures are displayed as follows:
- Measurement range 0 to 1047Ω: 1/64Ω
- Measurement range 0 to 4095Ω: 1/16Ω
  (It is not recommended to use the terminal in the range from 0 to 10Ω)
- All other measuring ranges: 1/10 °C (1 digit = 0.1 °C)

Besides that, a wire breakage is reported to the controller and indicated by the ERROR LED. Pt100, NI100, Pt200, Pt500, NI120, NI1000 and Pt1000 elements are implemented over their full measuring ranges as resistance sensors.
The terminal can be fully configured over the fieldbus. A self-defined scaling of the output can, for instance, be performed, or the temperature conversion can be switched off.

In the delivery state, the measured value is displayed in increments of 1/10° C in two's complement format (integer). The complete measuring range is output for each resistance sensor.
Other types of representation are selectable via index 8000:02 (e.g. display of the sign of the number or high resolution with 1/100 Ohm).

Measurement principle of a resistance sensor

The evaluation of the resistance sensor (RTD element) usually takes place by measuring the voltage drop across a sensor through which a constant measurement current is flowing.

The voltage change ΔU measured in the CTMT3202 is approximately proportional to the resistance change ΔR.

A constant current must flow through the resistor in order for the resistance to be measured.
The change in relation to the initial value is determined internally in the CTMT3202 by means of a Wheatstone bridge (fig. 1).

In order to avoid errors due to self-heating, the measurement current must be kept as small as possible. A current of 1mA, for example, causes a voltage drop of 0.1V in a Pt100 at 0 °C.

In industrial plants, large distances are bridged between sensor and CTMT3202 using long feed cables. In order to avoid the influence of the resistance of the cables, platinum resistance sensors are also manufactured with three-wire or four-wire connections.
This makes separate feeding of the measurement current possible, i.e. the feed cable error can be compensated. Installation with three or four wires is strongly advised for outdoor areas.

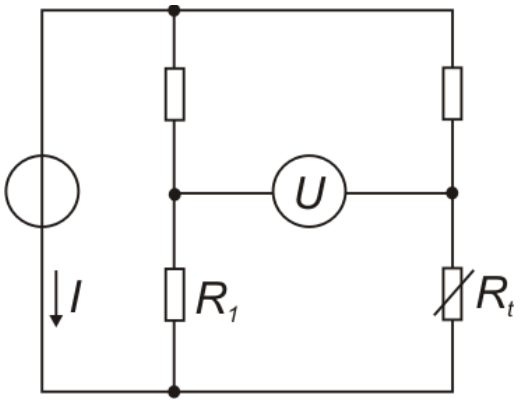


Fig. 1: Wheatstone bridge

For a Wheatstone bridge which is balanced as far as possible, the following applies:
ΔU ~ ΔR = Rt — R1

The voltage change is proportional to the resistance change and hence also to the temperature change.

 Note	**Connection of input channels** Due to this measurement principle (resistive temperature sensor) you must not connect one sensor in parallel with 2 or more input channels!

Overview of suitable resistance sensors

The following resistance sensors are suitable for temperature measurement with the CTMT320x and can be selected via the object 8000:19:

Type	Implemented temperature range
Pt100	200°C to 850°C (for High Precision Terminals)
NI100	60°C to 250
Pt1000	200°C to 850°C
Pt500	200°C to 850°C
Pt200	-200°C to 1.370°C
NI1000	-60°C to 250°C
NI1000 - 100°C: 1500 Ohm	-30 to 160°C
NI120	60°C to 320°C
KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 KTY81-121, KTY81-122 KTY81-151, KTY81-152 KTY81/82-210,220,250 KTY81-221, KTY81-222 KTY81-251, KTY81-252	50...150°C
KTY83-110,120,150 KTY83-121, KTY83-122 KTY83-151, KTY83-152	-50...175°C
KTY84-130,150 KTY84-151	-40...300°C
KTY21/23-6 KTY1x-5 KTY1x-7 KTY21/23-5, KTY21/23-7	-50...150°C

3.17 CTMT4102 2 channel analog output terminal 0V to +10V, 16 bits

The CTMT4102 analog output terminal generates signals in the range between 0V and +10V.

The voltage is supplied to the process level with a resolution of 16 bits, and is electrically isolated. The output channels of an EtherCAT terminal have a common ground potential.

The Run LEDs indicate the data exchange with the EtherCAT Gateway.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT4102
Number of outputs	2
Signal voltage	0V to +10V (short-circuit-proof)
Connection technology	2-wires, single-ended
Accuracy	± 0.1 % of full-scale value
Resolution	16 bit
Conversion time	Approx. 40µs (Fast mode approx. 25µs)
Load	> 5kΩ
Power supply for outputs	Via E-Bus
Current consumption of outputs (via E-bus)	Max. 15mA per output (specified at max. load)
Supply voltage for internal E-bus circuit	Via E-Bus
Current consumption via E-bus	Typ. 210mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	Outputs: 2 x 16 bit data
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.18 CTMT4122 2 channel analog output terminal 4 to 20 mA, 16 bits

The CTMT4122 analog output terminal generates signals in the range between 4 mA to 20 mA.

The power is supplied electrically isolated to the process level with a resolution of 16 bits.
The output channels of an EtherCAT Terminal have a common ground potential.

The two Run LEDs indicate the data exchange with the EtherCAT Gateway.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT4122
Number of outputs	2
Signal current per channel	4 to 20mA (short-circuit-proof)
Connection technology	3-wires, single-ended
Accuracy	± 0.2 % of full-scale value
Resolution	16 bit
Conversion time	Approx. 40µs (Fast mode approx. 25µs)
Load	> 500Ω
Power supply for outputs	Via power contacts
Current consumption from load voltage (power contacts)	Typ. 15mA + output current
Supply voltage for internal E-bus circuit	Via E-Bus
Current consumption via E-bus	Typ. 190mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	Outputs: 2 x 16 bit data
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.19 CTMT4132 2 channel analog output terminal -10V to +10V, 16 bits

The CTMT4132 analog output terminal generates signals in the range between -10V and +10V.
The voltage is supplied to the process level with a resolution of 16 bits, and is electrically isolated.

The output channels of an EtherCAT terminal have a common ground potential.
The Run LEDs indicate the data exchange with the EtherCAT Gateway.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

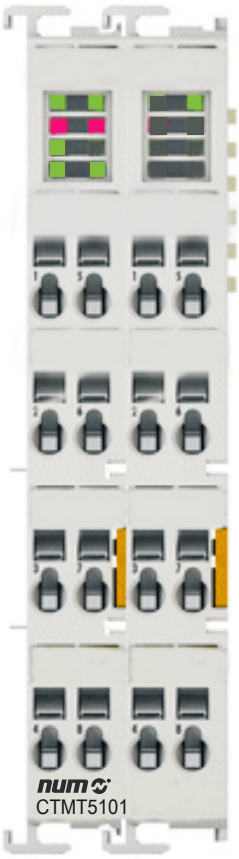
Technical data

Technical data	CTMT4132
Number of outputs	2
Signal current per channel	-10V to +10V (short-circuit-proof)
Connection technology	2-wires, single-ended
Accuracy	± 0.1 % of full-scale value
Resolution	16 bit
Conversion time	Approx. 40µs (Fast mode approx. 25µs)
Load	> 5kΩ
Current consumption of outputs (via E-bus)	Max. 15 mA per output (specified at max. load)
Supply voltage for internal E-bus circuit	Via E-Bus
Current consumption via E-bus	Typ. 210mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	Outputs: 2 x 16 bit data
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.20 CTMT5101 Incremental encoder interface (RS485)

The CTMT5101 EtherCAT Terminal is an interface for the direct connection of incremental encoders with differential inputs (RS485). A 16-bit counter (in normal operating mode) or a switchable 16/32-bit counter (in enhanced operating mode) with a quadrature decoder and a 16-bit latch (in normal operating mode) or 32-bit latch (in enhanced operating mode) for the zero pulse can be read, set or enabled. Incremental encoders with alarm outputs can be connected at the interface's negative switching status input.

Periodic time and frequency measurement is possible. The gate input allows the counter to be halted, alternatively with high or low level. The latch input is also configurable and evaluates the higher or lower level. The CTMT5101 supports the functionality of a bidirectional counter (channel A), channel B forces the direction of counting.
For the Terminal connections and Diagnostics LEDs please refer to the chapter 4 and chapter 6.



Technical data	CTMT5101
Sensor connection	A, /A, B, /B, C, /C (RS485 differential inputs)
Additional inputs	Gate, Latch (24VDC, both max. allowable 1 MHz), Status input (max. 5VDC, floating, negative switching)
Sensor operating voltage	5VDC/max. 0.5A
Sensor output current	0.5A
Counter	16 bit, 16 / 32 bit switchable
Zero pulse latch	16 bit, 16 / 32 bit switchable
Limit frequency	1MHz signal equals 4 million increments with 4-fold evaluation
Quadrature decoder	4-fold evaluation
Distributed clocks	Yes
Broken wire detection to sensor	Yes
Commands	Read, Set, Enable
Supply voltage for internal E bus circuit	via E bus
Current consump. via E-bus	typ. 130mA
Current consumption of power contacts	0.1A (without sensor load current)
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	Up to 6 bytes outputs, 22 bytes inputs, depends on parameterization
Configuration	Via Flexium Tools
Weight	approx. 100g
Bits width in process image	Outputs: 2 x 16 bit data
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 27mm x 100mm x 70mm (width aligned: 24mm)
Weight	Approx. 100g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class / Installation position	IP 20 / variable
Approvals	CE, Ex, UL

3.21 CTMT5151 1-Channel incremental encoder interface (24V)

The CTMT5151 EtherCAT Terminal is an interface with 24V inputs for the direct connection of incremental encoders. A 32 bit counter with a quadrature decoder and a 32 bit latch for the zero pulse can be read, set or enabled.

The CTMT5151 supports distributed clocks, i.e. the input data can be monitored synchronously with other data that are also linked to distributed clock terminals. The accuracy across the system is < 100ns. With a moving axis, the micro-increment functionality offers 256 times higher axis position resolution than physically provided by the encoder.

The CTMT5151 can also be used as a single-channel 32/16 bit counter on channel A, in which case the signal level on channel B defines the count direction. With the CTMT5151, two 32 bit counters with quadrature decoder can be read and set. The CTMT5151 terminals support the high precision Distributed Clocks functionality.

For the Terminal connections and Diagnostics LEDs please refer to the chapter 4 and chapter 6.

Technical data	CTMT5151
Encoder connection	A, B, C, Gate/Latch input, 24V
Sensor inputs	1
Signal voltage “0” (inputs A, B, C, Gate/Latch)	0 .. 5V (EN 61131-2, Type 1)
Signal voltage “1” (inputs A, B, C, Gate/Latch)	15 .. 30V (EN 61131-2, Type 1)
Encoder operating voltage	24V
Counter	1 x 32/16 bit binary, switchable
Limit frequency	100kHz
Quadrature decoder	4-fold evaluation
Commands	Read, Set, Latching
Supply voltage for internal E-bus circuit	via the E-Bus
Distributed Clocks	Yes
Supply voltage	24VDC (-15 %/+20 %)
Current consumption E-bus	typ. 130mA
Current consumption power contacts	0.1A (without encoder lead current)
Electrical isolation	500Veff (E bus/field potential)
Configuration	No address setting, config. via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

3.22 CTMT6001 Serial Interface Terminal 1 channel (RS232C)

The CTMT6001 serial interface enable the connection of devices with RS232 interface.

The CTMT6001 operates in conformity with the CCITT V.28/DIN 66 259-1 standards.
The device connected to the CTMT6001 EtherCAT Terminal communicates with the automation device via the gateway.

The active communication channel operates independently of the higher-level bus system in full duplex mode or selectable half duplex mode (CTMT6021) at up to 115.2 kbaud.

The RS232 interface guarantees high immunity to interference through electrically isolated signals,

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT6001
Data transfer channels	TxD and RxD, full duplex
Data transfer rate	2400..115200 baud Default: 9600 baud, 8 data bits, no parity, 1 stop bit From firmware 07: also 12000 baud and 14400 baud
Data buffer	864 byte receive buffer, 128 byte transmit buffer
Bit transfer	-
Level interface	RS232
Bit distortion	< 3%
Cable length	Max. 15m
Line impedance	-
Providing external supply	-
Diagnosis	Status LEDs
Power supply	Via the E-Bus
Current consumption via E-bus	Typ. 120mA
Electrical isolation	500Veff (E-bus/RS232)
Bits width in process image	1 x 8 bit Control/Status, Inputs/Outputs: 3 x 8 bit user data or 1 x 8 bit Control/Status, Inputs/Outputs: 5 x 8 bit user data or 1 x 16 bit Control/Status, Inputs/Outputs: 22 x 8 bit user data (configurable)
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

Technology

The CTMT600x and CTMT602x serial interface terminals enable the connection of devices with an RS232 (or RS485 / RS 422) interface.

In the case of the CTMT600x, the data is exchanged with the controller in full duplex mode; in the case of the CTMT602x, half duplex mode is additionally possible. The receive buffer has 864 bytes, the send buffer 128 bytes.

Data transfer between the terminal and the controller takes place via a handshake. The factory setting of the terminals is 9600 baud, 8 data bits, 1 stop bit, no parity: in the case of the CTMT600x, RTS/CTS control is active; the CTMT602x operates in full duplex mode with deactivated point to point connection.

Level interfaces

The CTMT6001 terminal operate at an RS232 level with reference to GND, the CTMT6021 with a differential RS485/422 level.

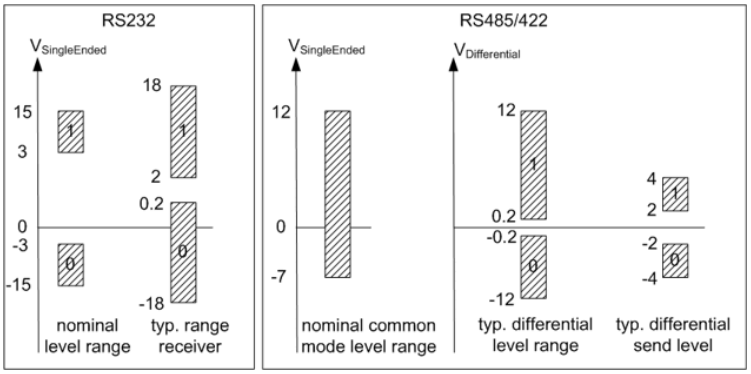


Fig. 1: Level interfaces RS232, RS485/422

Termination

The serial RS422 and RS485 communication technologies operate with voltage levels on a 2-wire line. Reflections at high-resistance line ends can lead to signal distortion. For this reason termination resistors are required at the receiver.

For RS422/485 these are 120 Ω resistors, which together with the line resistance result in a voltage drop over the transmission link.

Note	**Permitted cable length** The line resistance together with the termination resistor results in an overall voltage drop over the transmission link. The system design should ensure that the voltage does not drop below 200mV at the receiver (see Fig. 1), which is the minimum voltage required.

In RS422 mode each line must be terminated with 120Ω at the receiver.

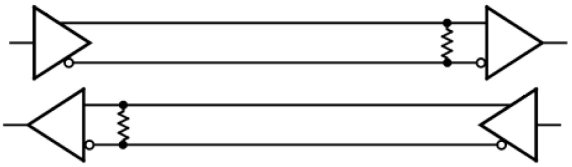


Fig. 2: RS422 termination

In RS485 mode with several devices, termination resistors are only used at the two end devices.

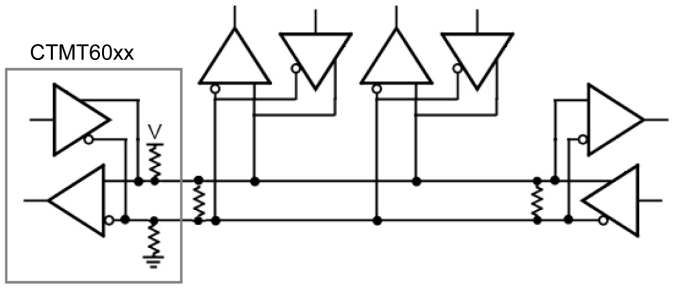


Fig. 3: RS422 termination

Note	**Termination with CTMT602x** The CTMT602x devices do not have integrated termination resistors, in order to enable operation in bus mode. Any termination that may be required must be connected outside the terminal. The CTMT602x devices feature integrated bias-failsafe resistors, which bring the bus lines to defined levels, even if the line is disconnected.

3.23 CTMT6021 Serial Interface Terminal 1 channel (RS422/RS485)

The CTMT6021 serial interfaces enable the connection of devices with RS422/RS485 interface.
See previous pages for the CTMT6021 technology, level interfaces and terminations.

The device connected to the CTMT6021 EtherCAT Terminal communicates with the automation device via the gateway.
The active communication channel operates independently of the higher-level bus system in full duplex mode or selectable half duplex mode at up to 115.2 kbaud.

The interface guarantees high immunity to interference through electrically isolated signals, which is additionally guaranteed through differential signal transmission.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT6021
Data transfer channels	TxD and RxD, full/half duplex
Data transfer rate	2400..115200 baud Default: 9600 Baud, 8 data bits, no parity, 1 stop bit
Data buffer	864 byte receive buffer, 128 byte transmit buffer
Bit transfer	With differential signal
Level interface	RS422/RS485
Bit distortion	-
Cable length	Max. 1000m (Twisted Pair)
Line impedance	120Ω
Providing external supply	-
Diagnosis	Status LEDs
Power supply	Via the E-Bus
Current consumption via E-bus	Typ. 220mA
Electrical isolation	500 Vrms (E-bus/RS422, E-Bus/RS485)
Bits width in process image	1 x 8 bit Control/Status, Inputs/Outputs: 3 x 8 bit user data or 1 x 8 bit Control/Status, Inputs/Outputs: 5 x 8 bit user data or 1 x 16 bit Control/Status, Inputs/Outputs: 22 x 8 bit user data (configurable)
Configuration	No address setting, configuration via Flexium Tools
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 55g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

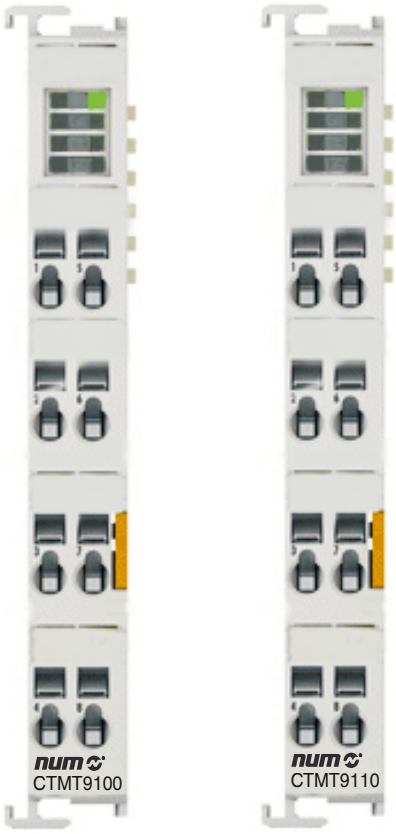
3.24 CTMT9011 Bus End cup terminal protection

Each EtherCAT terminal block must be terminated at the right hand end with a CTMT9011 bus end cap due to mechanical and electrical protection.

Technical data

Technical data	CTMT9011
Electrical isolation	Yes
Bits width in process image	0
Configuration	No address or configuration settings
PE contact	No
Electrical connection to mounting rail	No
Dimensions (W x H x D)	Approx. 7mm x 100mm x 34mm (width aligned: 5mm)
Weight	Approx. 8g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	Aligned to the last terminal in the terminal block
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE

3.25 CTMT9100, CTMT9110 Power supply terminal 24VDC



The CTMT9100 / CTMT9110 feed terminal can be positioned at any location between the input and output terminals for establishing a further potential group or for supplying the terminals following on the right in applications with high current load.

The E-Bus is looped through.

The CTMT9110 has a diagnostic function which is displayed on the process image.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT9100	CTMT9110
Nominal voltage	24VDC	
Power contact current load	Max. 10A	
Electrical isolation	Yes	
Current consumption from E-Bus	-	Typ. 90mA
Bit width in the process image	-	1 bit (diagnosis)
Configuration	No address or configuration settings	
Power LED	Yes	Yes
Diagnosis	No	Yes, in process image
Electrical connection to mounting rail	No	
PE contact	Yes	
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)	
Weight	Approx. 50g	
Operating temperature	0°C ... + 55°C	
Storage temperature	-25°C ... + 85°C	
Relative humidity	95%, no condensation	
Mounting	On 35mm mounting rail (conforms to EN 50022)	
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29	
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4	
Protection class	IP 20	
Installation position	Variable	
Approvals	CE, Ex, UL	

3.26 CTMT9410 Power supply terminals for E-bus

The CTMT9410 power supply terminal is used to refresh the E-bus.
Data is exchanged between the coupler and the EtherCAT Terminal over the E-bus.

Each terminal draws a certain amount of current from the E-bus (see “current consumption E-bus” in the technical data). This current is fed into the E-bus by the relevant gateway’s power supply unit.

In configurations with a large number of terminals it is possible to use the CTMT9410 in order to supply an extra 2A to the E-bus.

The CTMT9410 has a diagnostic function which is displayed by LED and on the process image.

Connections and Diagnostics LEDs

Note	**Terminal connections:** please refer to the chapter 4. **Diagnostics LEDs:** please refer to the chapter 6.

Technical data

Technical data	CTMT9410
Input voltage	24VDC
Output current for E-bus supply	2A
Power contact voltage	24VDC
Power contact current load	Max. 10A
Current consumption from E-Bus	Typ. 90mA
Electrical isolation	Yes
Diagnosis	Yes, via LED and in the process image
Electrical connection to mounting rail	No
PE contact	Yes
Bits width in process image	2 bits (diagnosis)
Configuration	No address or configuration settings
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned: 12mm)
Weight	Approx. 65g
Operating temperature	0°C ... + 55°C
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 50022)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, Ex, UL

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Summary

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4 Installation and connections

4.1 Installation on mounting rails

 WARNING	**Risk of electric shock and damage of device!** Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the EtherCAT terminals!

4.1.1 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!

4.1.2 Control cabinet

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

4.2 Installation position and minimum distances

Optimum installation position (standard)
The optimum installation position requires the mounting rail to be installed horizontally and the connection surfaces of the terminals to face forward (see Fig. 1).

The terminals are ventilated from below, which enables optimum cooling of the electronics through convection. “From below” is relative to the acceleration of gravity.

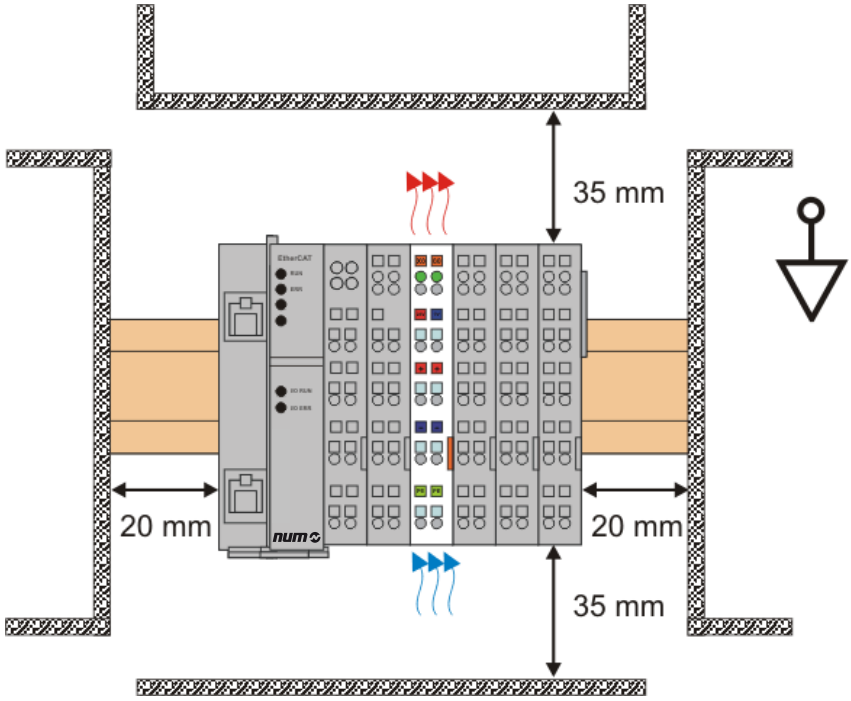


Fig.1

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.

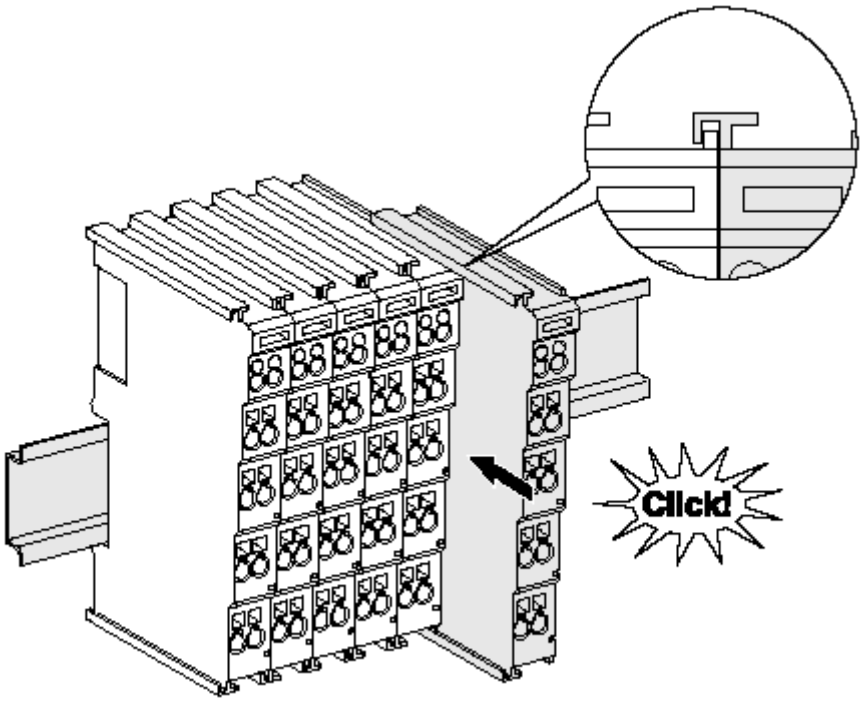
Note	**Constraints regarding installation position and operating temperature range** Please refer to the technical data for a terminal to ascertain whether any restrictions regarding the installation position and/or the operating temperature range have been specified. When installing high power dissipation terminals ensure that an adequate spacing is maintained between other components above and below the terminal in order to guarantee adequate ventilation!.

4.3 Installation on mounting rails

WARNING	**Risk of electric shock and damage of device!** Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the EtherCAT terminals!

Assembly

The terminals are attached to commercially available 35mm mounting rails (according to EN 50022) by applying slight pressure:

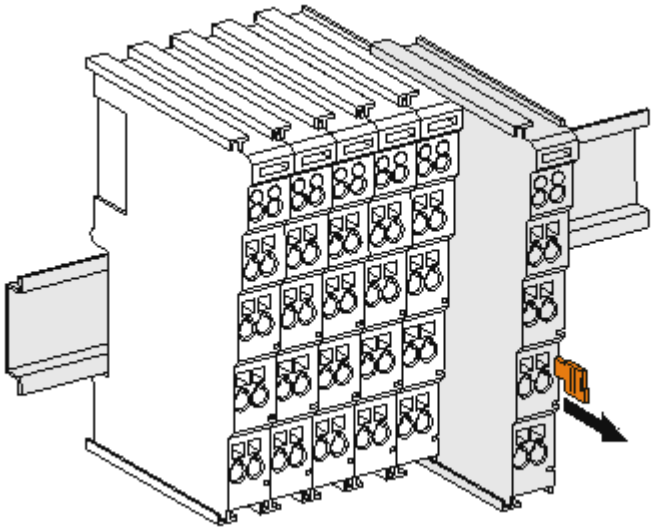


1. First attach the EtherCAT Gateway to the mounting rail.

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.

Note	**Fixing of mounting rails** The locking mechanism of the terminals and couplers extends to the profile of the mounting rail. At the installation, the locking mechanism of the components must not come into conflict with the fixing bolts of the mounting rail. To mount the mounting rails with a height of 7.5 mm under the terminals and couplers, you should use flat mounting connections (e.g. countersunk screws or blind rivets).

Disassembly



Each terminal is secured by a lock on the mounting rail, which must be released for disassembly:

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.

4.4 Operation in potentially explosive atmospheres (ATEX)

4.4.1 Special conditions

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**

4.5 Electrical installation

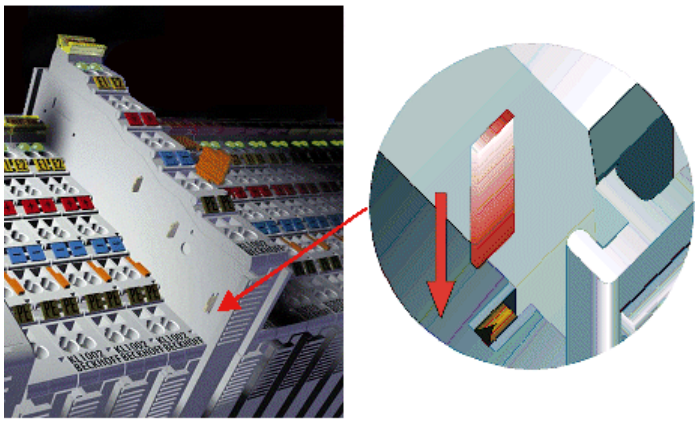
4.5.1 Connections within a EtherCAT terminal block

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.

- 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 (up to 24 V) or for higher voltages via power feed terminals.

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.

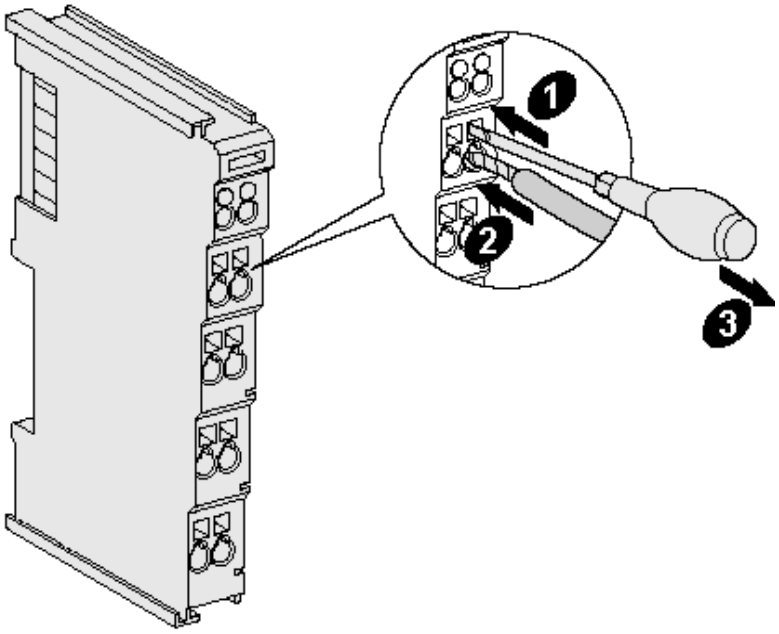


CAUTION	**Possible damage of the device** Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during 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!

4.6 Terminal connections

4.6.1 General terminal connections



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.

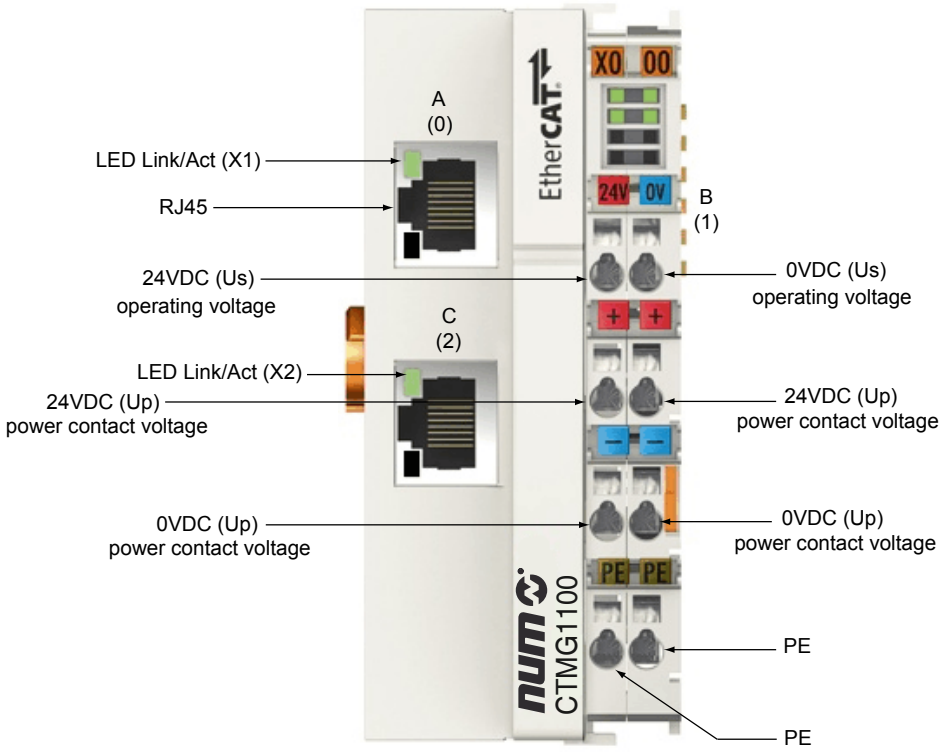
3. The terminal closes automatically when the pressure is released, holding the wire safely and permanently.

Wire cross section	0.08 ... 2.5mm²
Strip length	8 ...9mm

Shielding

Note	**Shielding** Analog sensors and actors should always be connected with shielded, twisted paired wires. .

4.6.2 CTMG1100 NUM EtherCAT Gateway connections



Port allocation

According to the EtherCAT specification, an ESC (EtherCAT Slave Controller, hardware processing unit of the EtherCAT protocol) can have 1 to 4 ports, which it controls itself.
Via an open port it can handle outgoing and incoming Ethernet traffic.
The data flow direction in a fully wired CTMG1100 is shown as an example in fig. 1:

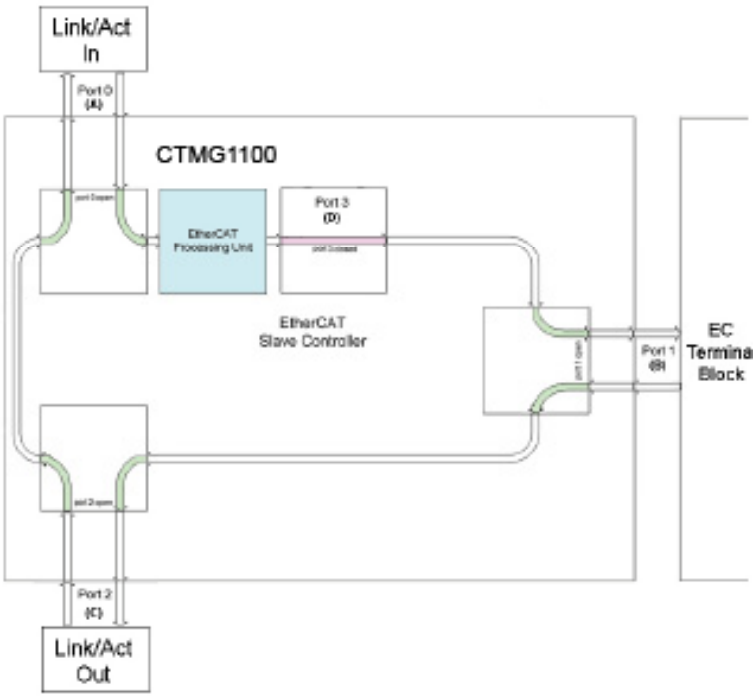


Fig. 1 Internal and external port assignment - CTMG1100 bus coupler

Frame processing sequence

The EtherCAT frame arriving at the EtherCAT signal input is passed on by Port 0 (A) to the EtherCAT processing unit.

- The EtherCAT frame arrives at Port 1 (B) and the data frame departs via Port 1 (B) to the following slave in the EtherCAT terminal network (if a slave is connected there and reports ‘Link’).
- After the arrival of the data frame at Port 1 (B) from the terminal network, this is passed on to Port 2 (C) and leaves the coupler at the following EtherCAT output (if a slave is connected there and reports ‘Link’).
- The data frame arrives at Port 2 (C). This is now passed on to Port 0 (A) and leaves the CTMG1100 via the EtherCAT input.

 Note	**Processing of the data** The data in the EtherCAT datagrams are processed only between Ports 0 (A) and 3 (D) in the EtherCAT processing unit. The non-implemented (internal) Port 3 (D) is considered to be closed and passes on the datagram to Port 1 (B).

4.6.2.1 Power Supply, Potential Groups with CTMG1100

EtherCAT Gateway power supply
The EtherCAT Gateway require a 24VDC supply for their operation. The connection is made by means of the upper spring-loaded terminals labelled 24V and 0V. The supply voltage feeds the Bus Coupler electronics and is also used for the direct voltage generation for the E-Bus.

The voltage for the E-Bus is generated by a DC/DC converter without galvanic isolation.
The units supply the E-bus with max. 2mA E-bus current. Power feed terminals are to be inserted if the added terminals require more current.

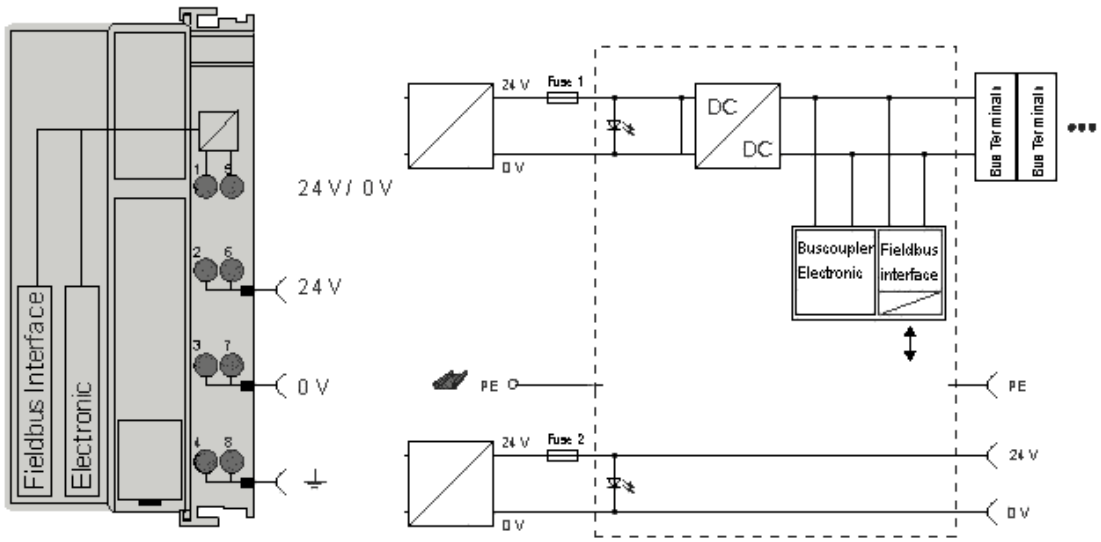
Input for Power Contacts
The bottom six connections with spring-loaded terminals can be used to feed the supply for the peripherals. The spring-loaded terminals are joined in pairs to a power contact. The feed for the power contacts has no connection to the voltage supply for the EtherCAT Gateway.

The design of the feed permits voltages of up to 24V. The assignment in pairs and the electrical connection between feed terminal contacts allows the connection wires to be looped through to various terminal points.
The current load via the power contacts may not permanently exceed 10A; the supply line must therefore be protected by a 10A fuse (slow-blow).

Electrical isolation
The EtherCAT Gateway operate by means of three independent potential groups.

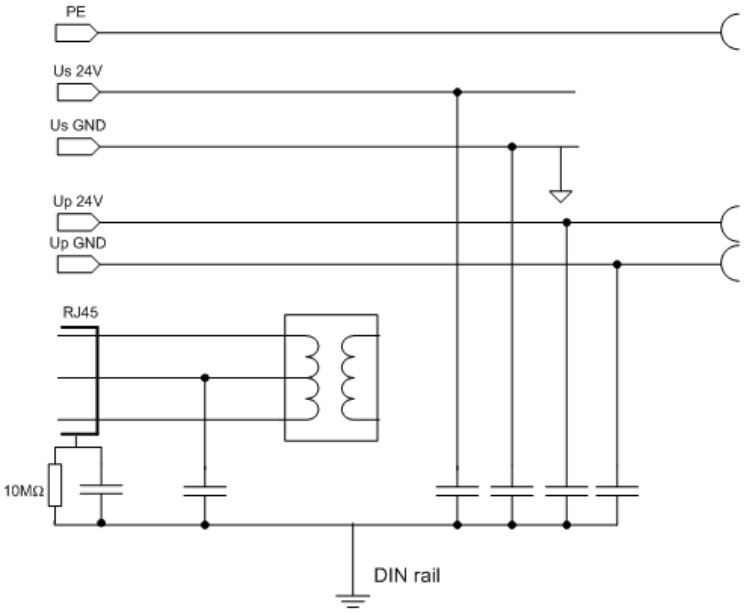
The supply voltage feeds the E-Bus electronics in the EtherCAT Gateway and the E-Bus itself, which are electrically isolated. The supply voltage is also used to generate the operating voltage for the fieldbus.

Remark: All the Bus Terminals are electrically isolated from the E-Bus. The E-Bus is thus electrically isolated from everything else.



Potential diagram CTMGxxxx

Ground concept



Fusing

Coupler supply, fuse 1:

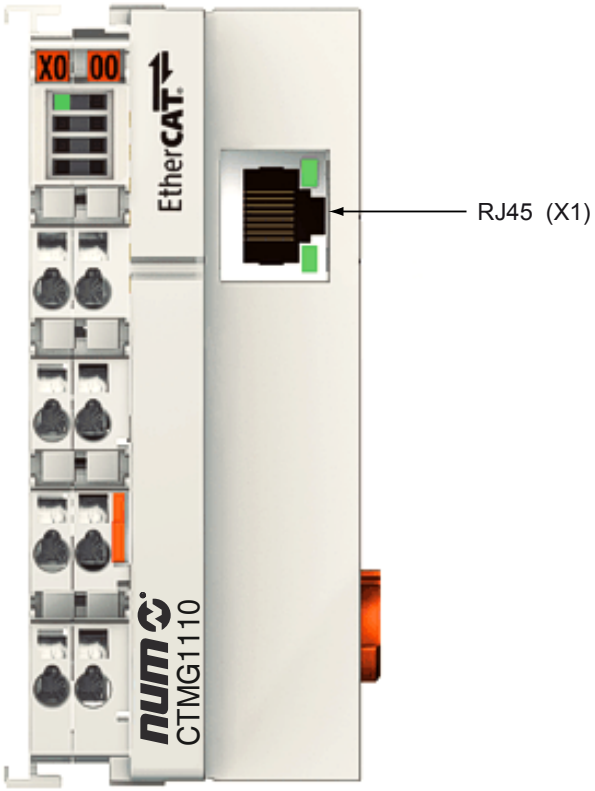
- Depending on the required current consumption and hence the configured terminals typical max. 1A.

Power contacts, fuse 2:

- Permitted max. 10A (slow-blow)

Coupler electronics and power contacts can be supplied together from the same source; the fusing must then be dimensioned accordingly to max. 10A.

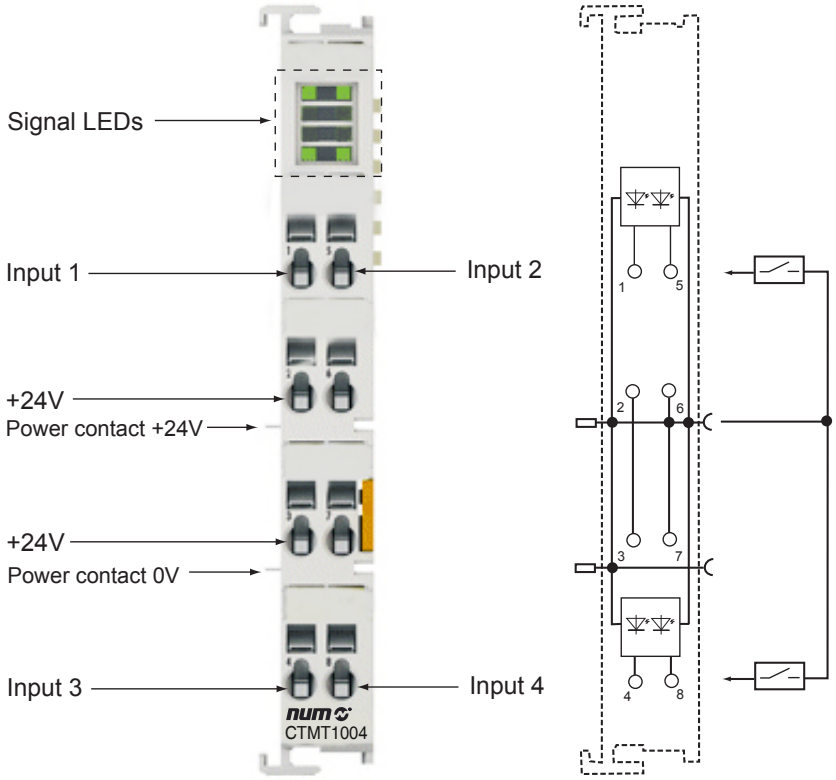
4.6.3 CTMG1110 NUM EtherCAT extension connections



Connections

Terminal	No	Description
X1	1	RJ45 connection for EtherCAT networks (100BASE-TX Ethernet signal representation)

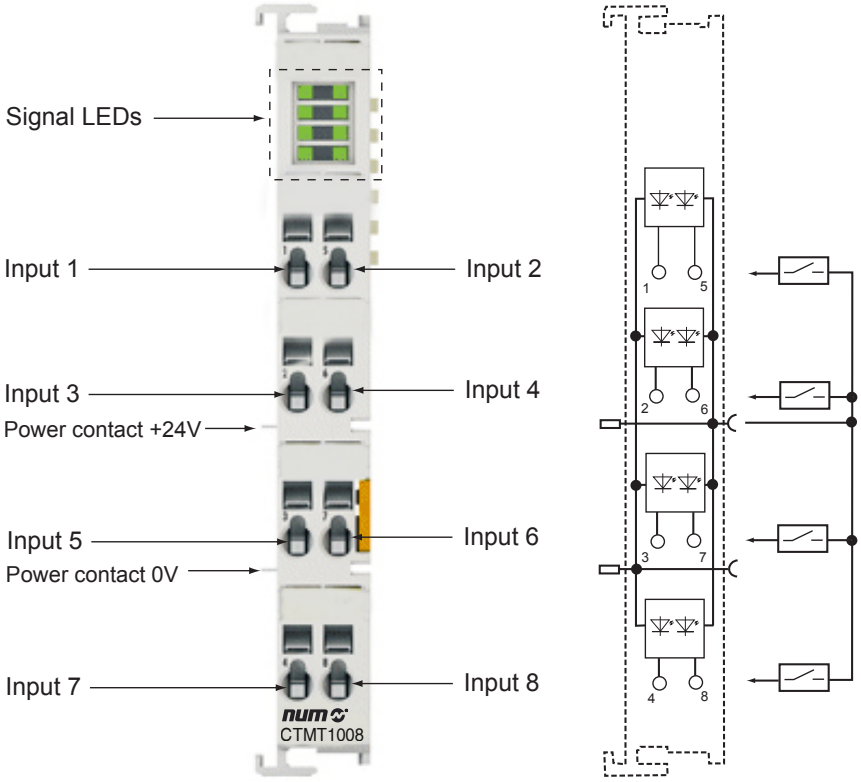
4.6.4 CTMT1004 terminal connections



Connections

Terminal	No	Description
Input 1	1	Input 1
+24V	2	Sensor supply voltage for input 1 (connected internally with terminal 3, 6, 7 and positive power contact)
+24V	3	Sensor supply voltage for input 3 (connected internally with terminal 2, 6, 7 and positive power contact)
Input 3	4	Input 3
Input 2	5	Input 2
+24V	6	Sensor supply voltage for input 2 (connected internally with terminal 2, 3, 7 and positive power contact)
+24V	7	Sensor supply voltage for input 4 (connected internally with terminal 2, 3, 6 and positive power contact)
Input 4	8	Input 4

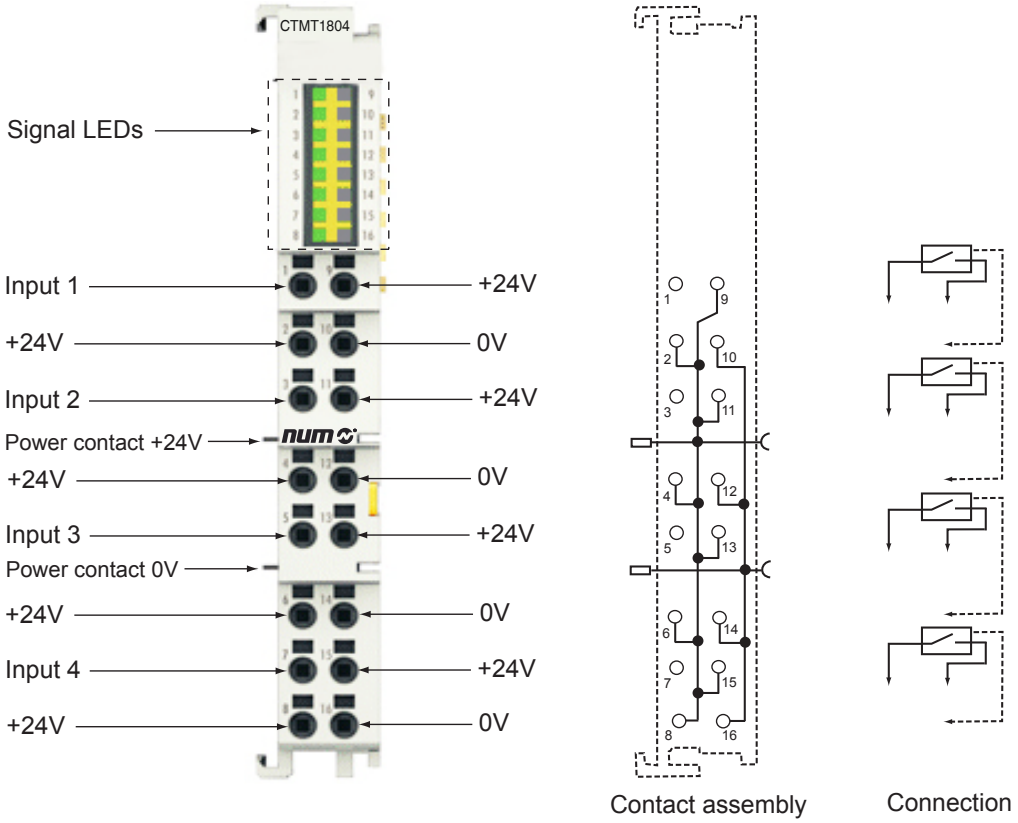
4.6.5 CTMT1008 terminal connections



Connections

Terminal	No	Description
Input 1	1	Input 1
Input 3	2	Input 3
Input 5	3	Input 5
Input 7	4	Input 7
Input 2	5	Input 2
Input 4	6	Input 4
Input 6	7	Input 6
Input 8	8	Input 8

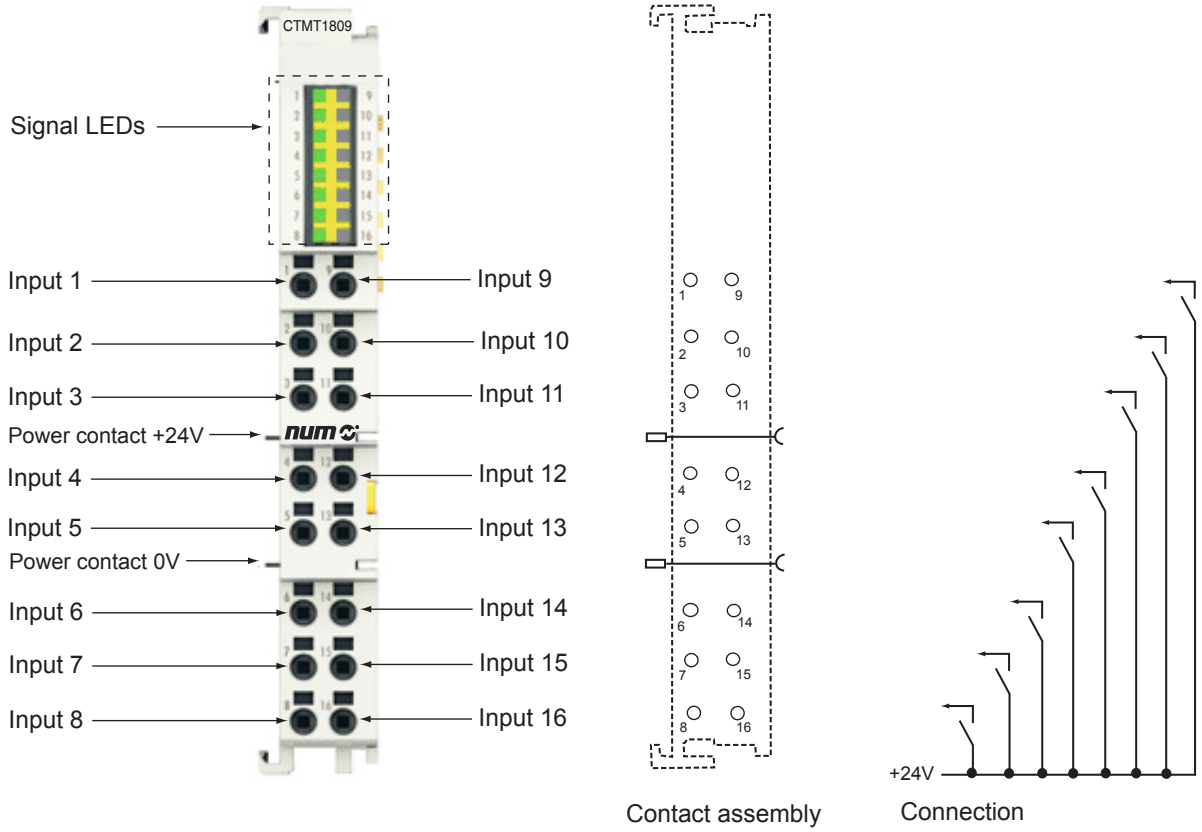
4.6.6 CTMT1804 terminal connections



Connections

Terminal	No	Description
Input 1	1	Input 1
+24V	2	24V (connected internally with terminal 4, 6, 8, 9, 11, 13, 15 and positive power contact)
Input 2	3	Input 3
+24V	4	+24V (connected internally with terminal 2, 6, 8, 9, 11, 13, 15 and positive power contact)
Input 3	5	Input 5
+24V	6	+24V (connected internally with terminal 2, 4, 8, 9, 11, 13, 15 and positive power contact)
Input 4	7	Input 7
+24V	8	+24 V (connected internally with terminal 2, 4, 6, 9, 11, 13, 15 and positive power contact)
+24V	9	+24 V (connected internally with terminal 2, 4, 6, 8, 11, 13, 15 and positive power contact)
0V	10	0V (connected internally with terminal 12, 14, 16 and negative power contact)
+24V	11	+24V (connected internally with terminal 2, 4, 6, 8, 9, 13, 15 and positive power contact)
0V	12	0V (connected internally with terminal 10, 14, 16 and negative power contact)
+24V	13	+24 V (connected internally with terminal 2, 4, 6, 8, 9, 11, 15 and positive power contact)
0V	14	0V (connected internally with terminal 10, 12, 16 and negative power contact)
+24V	15	+24V (connected internally with terminal 2, 4, 6, 8, 9, 11, 13 and positive power contact)
0V	16	0V (connected internally with terminal 10, 12, 14 and negative power contact)

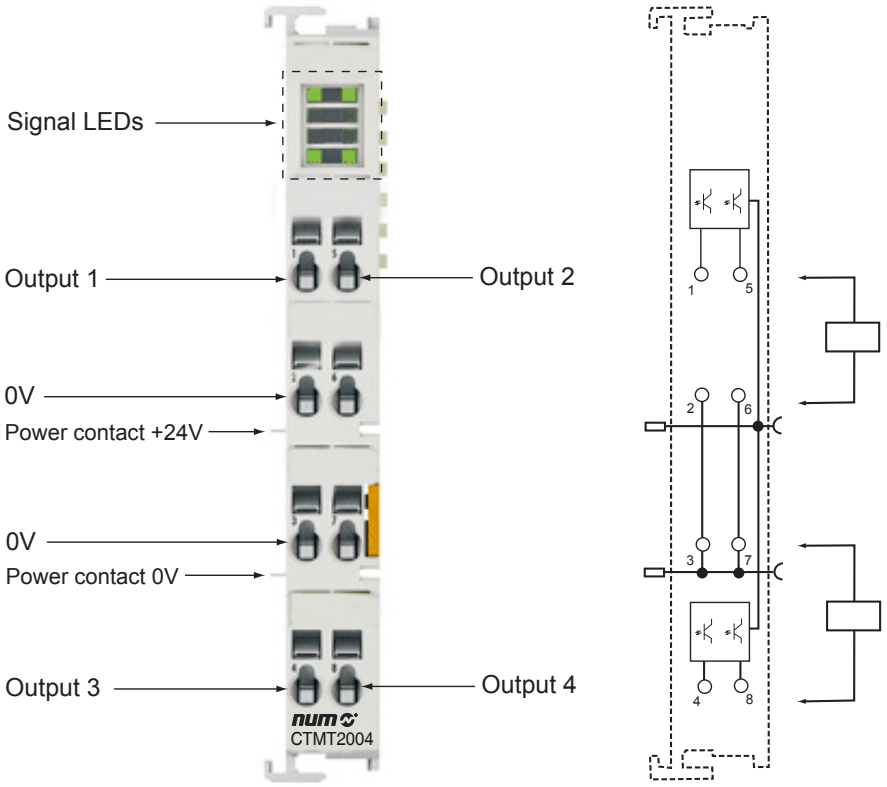
4.6.7 CTMT1809 terminal connections



Connections

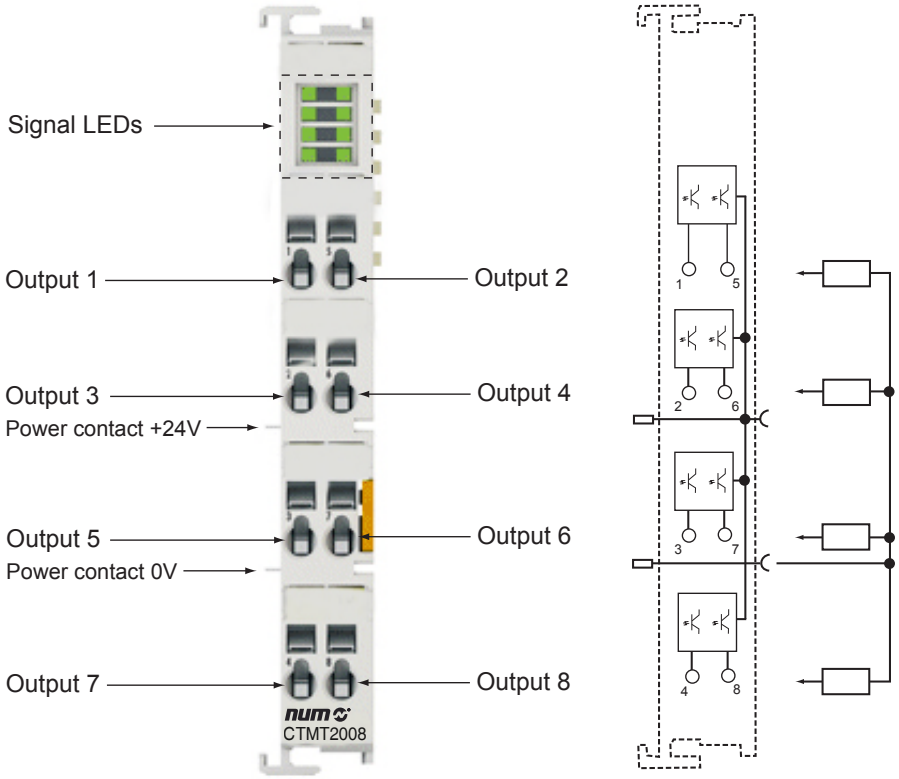
Terminal	No	Description
Input 1	1	Input 1
Input 2	2	Input 2
Input 3	3	Input 3
Input 4	4	Input 4
Input 5	5	Input 5
Input 6	6	Input 6
Input 7	7	Input 7
Input 8	8	Input 8
Input 9	9	Input 9
Input 10	10	Input 10
Input 11	11	Input 11
Input 12	12	Input 12
Input 13	13	Input 13
Input 14	14	Input 14
Input 15	15	Input 15
Input 16	16	Input 16

4.6.8 CTMT2004 terminal connections



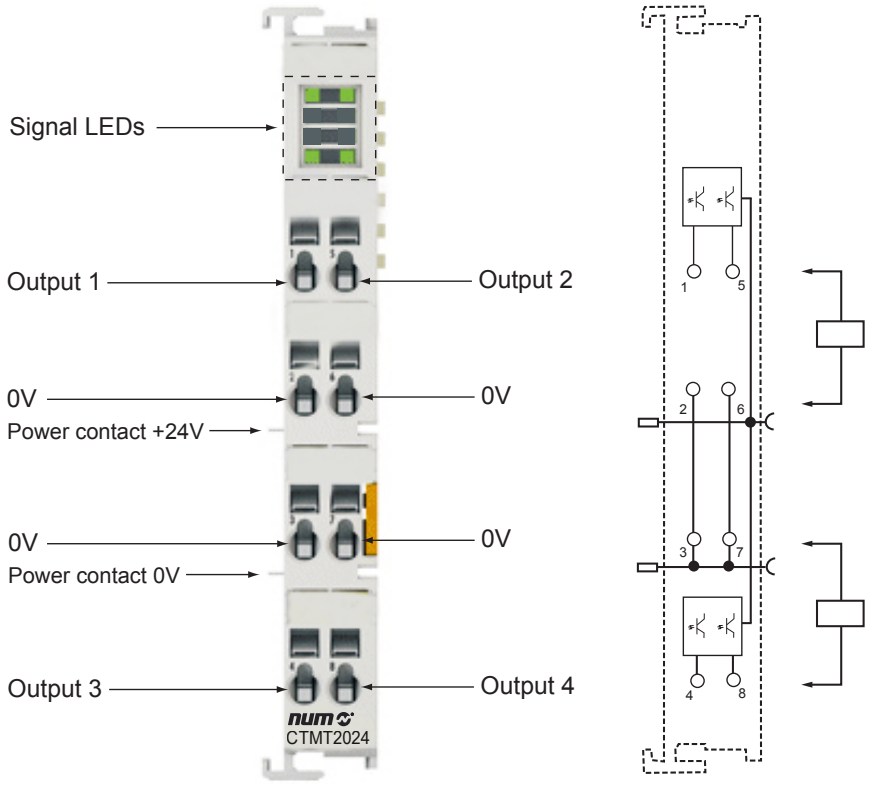
Terminal	No	Description
Output 1	1	Ouput 1
0V	2	Ground for output 1 (connected internally with terminal 3, 6, 7 and negative power contact)
0V	3	Ground for output 3 (connected internally with terminal 2, 6, 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
0V	6	Ground for output 2 (connected internally with terminal 2, 3, 7 and negative power contact)
0V	7	Ground for output 4 (connected internally with terminal 2, 3, 6 and negative power contact)
Output 4	8	Output 4

4.6.9 CTMT2008 terminal connections



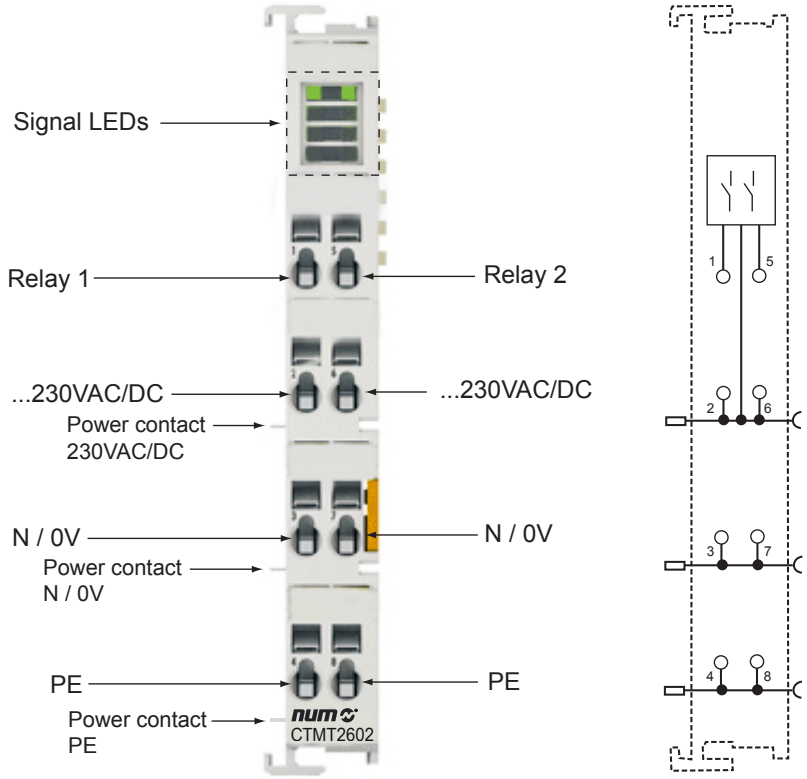
Terminal	No	Description
Output 1	1	Ouput 1
Output 3	2	Ouput 3
Output 5	3	Ouput 5
Output 7	4	Output 7
Output 2	5	Output 2
Output 4	6	Ouput 4
Output 6	7	Ouput 6
Output 8	8	Output 8

4.6.10 CTMT2024 terminal connections



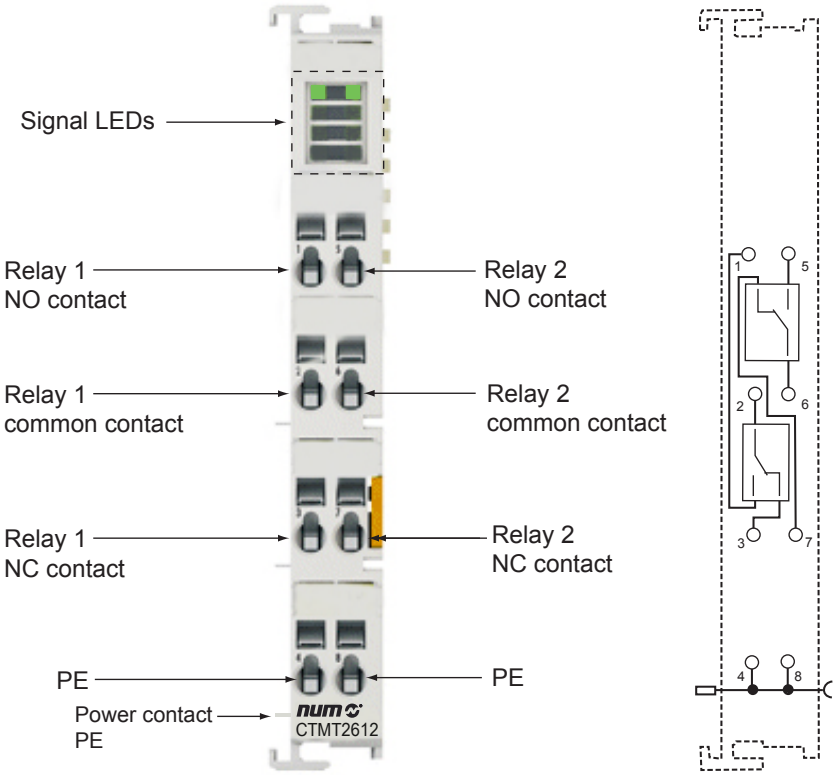
Terminal	No	Description
Output 1	1	Ouput 1
0V	2	Ground for output 1 (connected internally with terminal 3, 6, 7 and negative power contact)
0V	3	Ground for output 3 (connected internally with terminal 2, 6, 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
0V	6	Ground for output 2 (connected internally with terminal 2, 3, 7 and negative power contact)
0V	7	Ground for output 4 (connected internally with terminal 2, 3, 6 and negative power contact)
Output 4	8	Output 4

4.6.11 CTMT2602 terminal connections



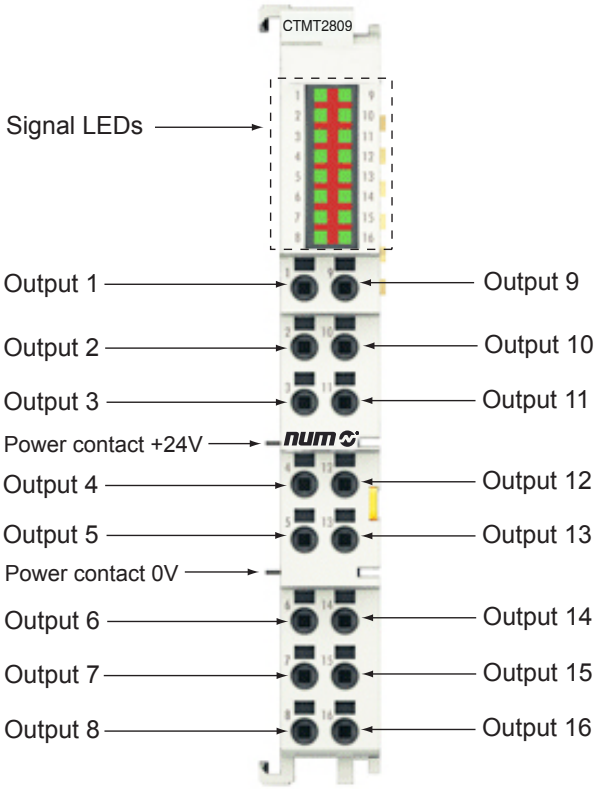
Terminal	No	Description
Relay 1	1	Ouput 1
...230 VAC/DC	2	≤ 230 VAC resp. ≤ 30VDC (internally connected with terminal 6 und L power contact)
N / 0V	3	Neutral line / 0V (internally connected with terminal 7 and N power contact)
PE	4	PE (internally connected with terminal 8)
Relay 2	5	Output 2
...230 VAC/DC	6	≤ 230 VAC resp. ≤ 30VDC (internally connected with terminal 2 und L power contact)
N / 0V	7	Neutral line / 0V (internally connected with terminal 3 and N power contact)
PE	8	PE (internally connected with terminal 4)

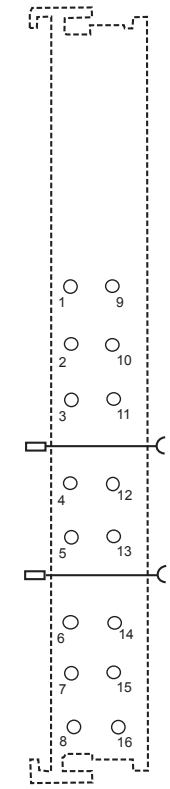
4.6.12 CTMT2612 terminal connections



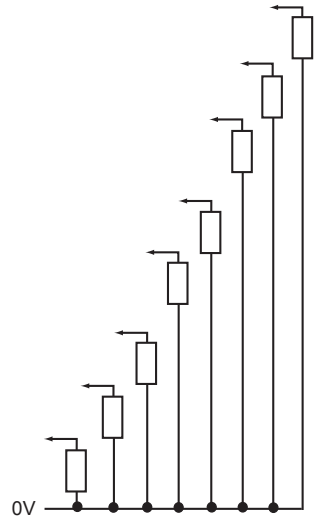
Terminal	No	Description
Relay 1	1	Relay 1, NO contact
Relay 1	2	Relay 1, Common contact
Relay 1	3	Relay 1, NC contact
PE	4	PE (internally connected with terminal 8)
Relay 2,	5	Relay 2, NO contact
Relay 2,	6	Relay 2, Common contact
Relay 2	7	Relay 2, NC contact
PE	8	PE (internally connected with terminal 4)

4.6.13 CTMT2809 terminal connections





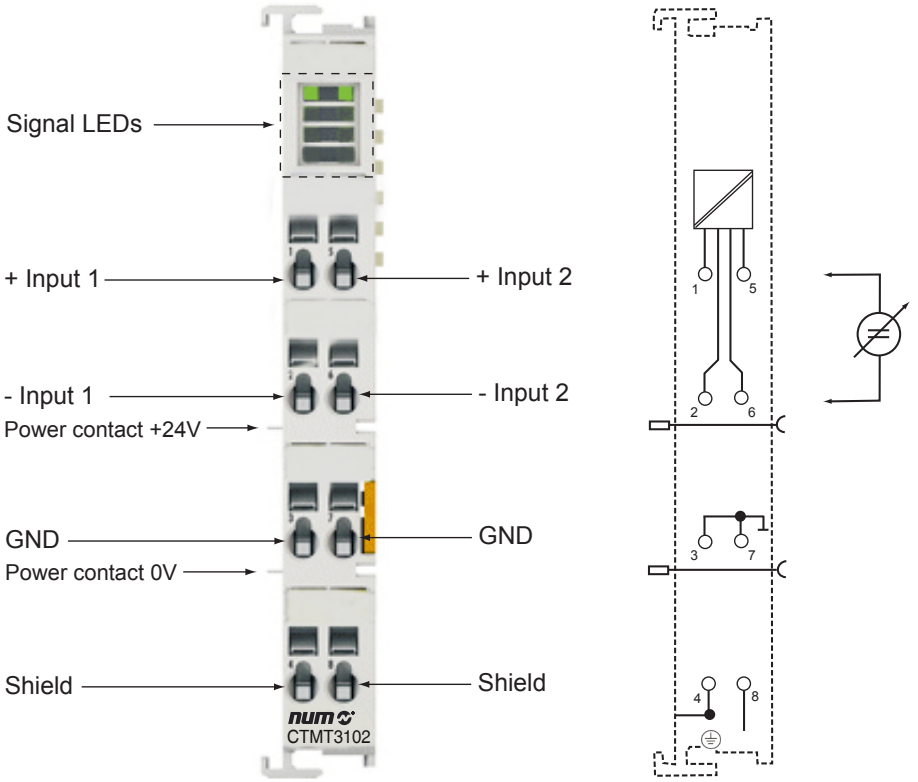
Contact assembly



Connection

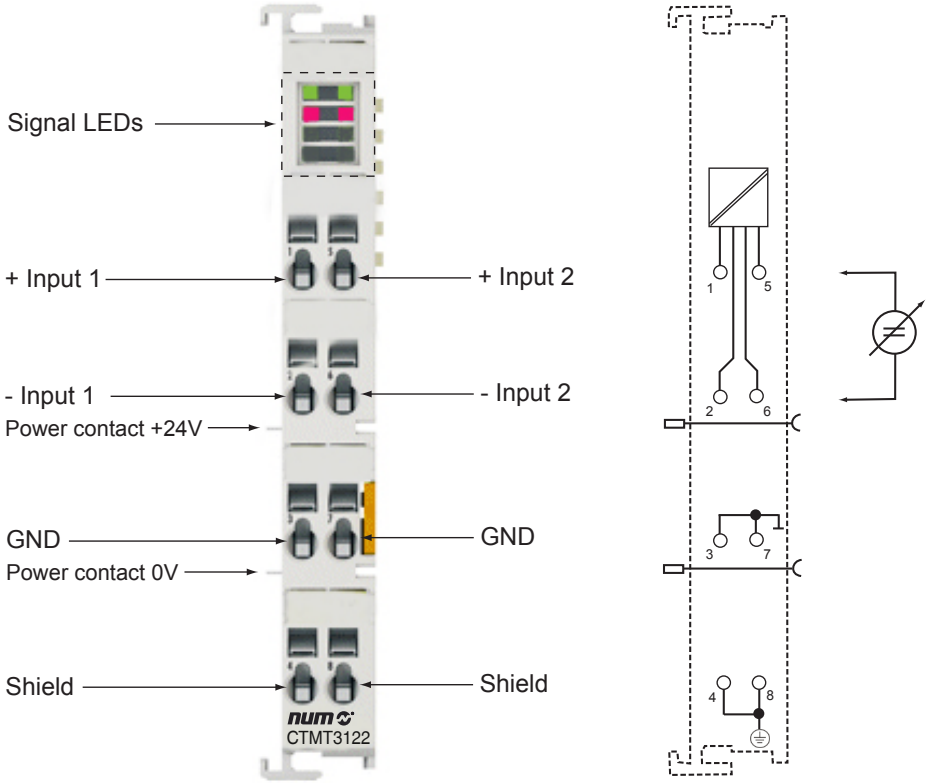
Terminal	No	Description
Output 1	1	Ouput 1
Output 2	2	Ouput 2
Output 3	3	Ouput 3
Output 4	4	Output 4
Output 5	5	Output 5
Output 6	6	Ouput 6
Output 7	7	Ouput 7
Output 8	8	Output 8
Output 9	9	Ouput 9
Output 10	10	Ouput 10
Output 11	11	Ouput 11
Output 12	12	Output 12
Output 13	13	Output 13
Output 14	14	Ouput 14
Output 15	15	Ouput 15
Output 16	16	Output 16

4.6.14 CTMT3102 terminal connections



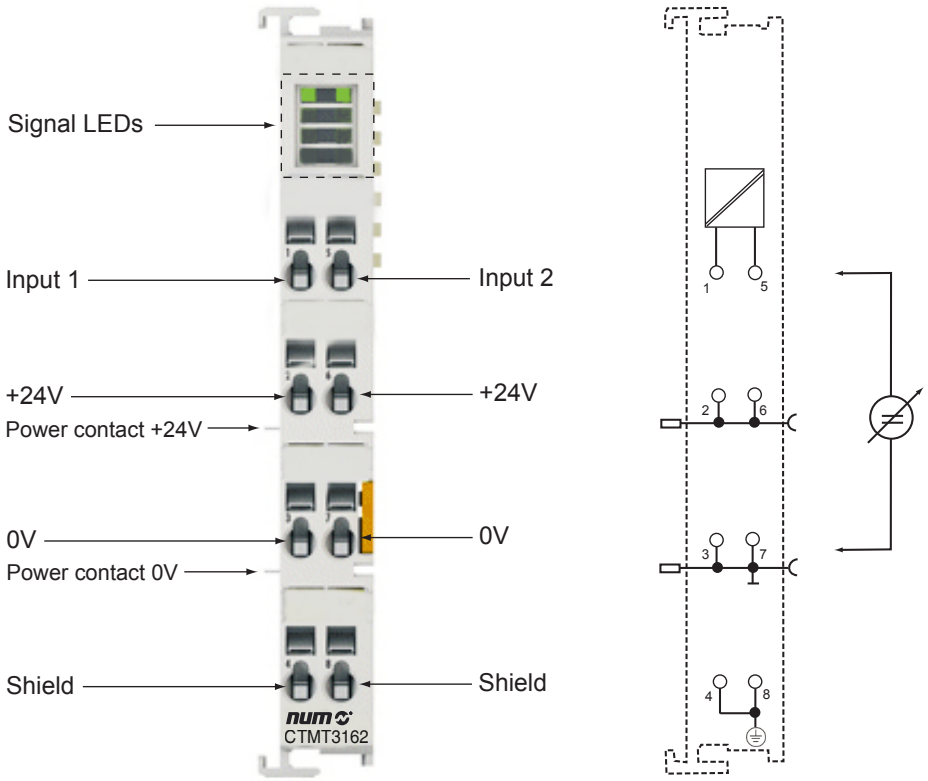
Terminal	No	Description
+ Input 1	1	+ Input channel 1
- Input 1	2	- Input channel 1
GND	3	Signal ground (internally connected with terminal point 7)
Shield	4	Shield (internally connected with terminal point 8)
+ Input 2	5	+ Input channel 2
- Input 2	6	- Input channel 2
GND	7	Signal ground (internally connected with terminal point 3)
Shield	8	Shield (internally connected with terminal point 4)

4.6.15 CTMT3122 terminal connections



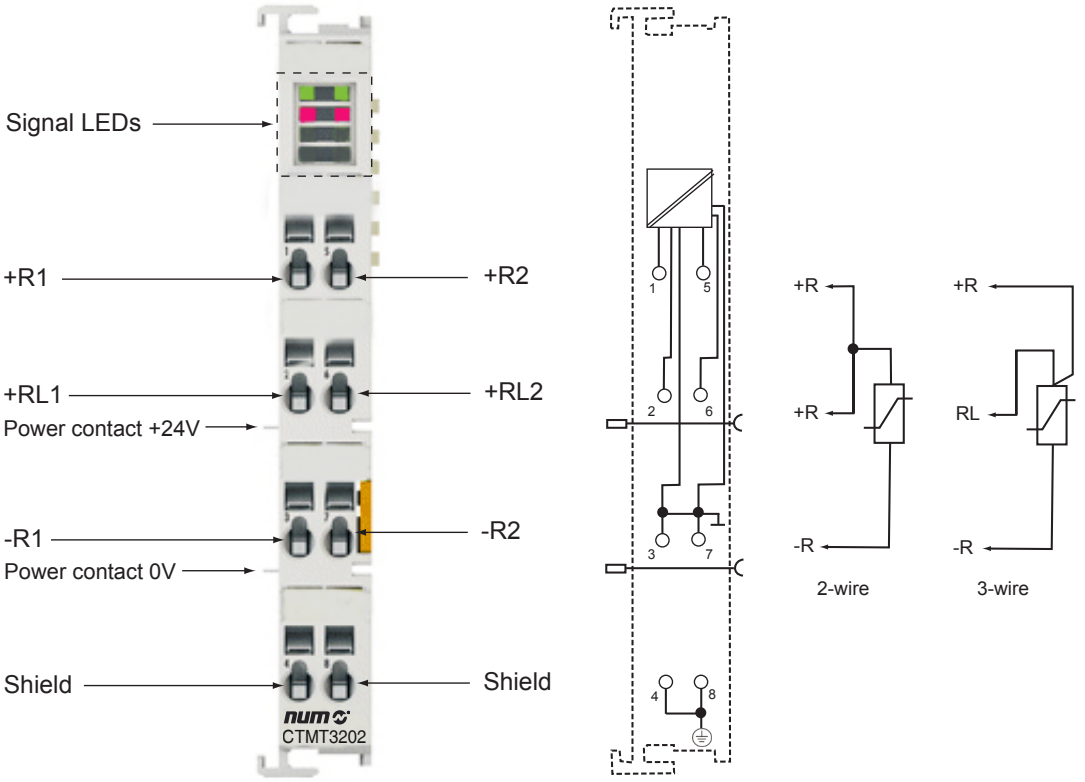
Terminal	No	Description
+ Input 1	1	+ Input channel 1
- Input 1	2	- Input channel 1
GND	3	Signal ground (internally connected with terminal point 7)
Shield	4	Shield (internally connected with terminal point 8)
+ Input 2	5	+ Input channel 2
- Input 2	6	- Input channel 2
GND	7	Signal ground (internally connected with terminal point 3)
Shield	8	Shield (internally connected with terminal point 4)

4.6.16 CTMT3162 terminal connections



Terminal	No	Description
Input 1	1	Input channel 1
+24V	2	+24V (internally connected with terminal point 6 and negative power contact)
0V	3	0V (internally connected with terminal point 7 and negative power contact)
Shield	4	Shield (internally connected with terminal point 8)
Input 2	5	Input channel 2
+24V	6	+24V (internally connected with terminal point 2 and negative power contact)
0V	7	0V (internally connected with terminal point 3 and negative power contact)
Shield	8	Shield (internally connected with terminal point 4)

4.6.17 CTMT3202 terminal connections



Terminal	No	Description
+R1	1	Input +R1
+RL1	2	Input +RL1
-R1	3	Input -R1
Shield	4	Shield (internally connected with terminal point 8)
+R2	5	Input +R2
+RL2	6	Input +RL2
-R2	7	Input -R2
Shield	8	Shield (connected internally with terminal 4)

4.6.17.1 Connection of analog signal cables Pt100 (RTD) with CTMT3202

The RTD input terminals of the CTMT3202 series measure the analog resistance of the sensor. The voltage drop at the sensor (including the line resistances, depending on the connection technology) is equivalent to the sensor resistance and therefore a measure for the sensor temperature, if the characteristic sensor curve is known.

The following procedure serves for connecting analog signal cables in order to ensure error-free measurement of the analog signals.

Procedures

- Sensor cable to be used:
  - Tightly twisted
  - Shielded copper braid
  - Use low-impedance cable, particularly for 2-wire connection.

- Keep the sensor and sensor cables free from external potential.
  On no account should the GND connections (3/7 for CTMT3202) be connected with other potentials.

- The resistor for the RTD sensor (e.g. 100 or 1000Ω nominal) should be chosen based on the ratio between sensor resistance and line resistance, taking account of the connection type (2/3/4-wire).

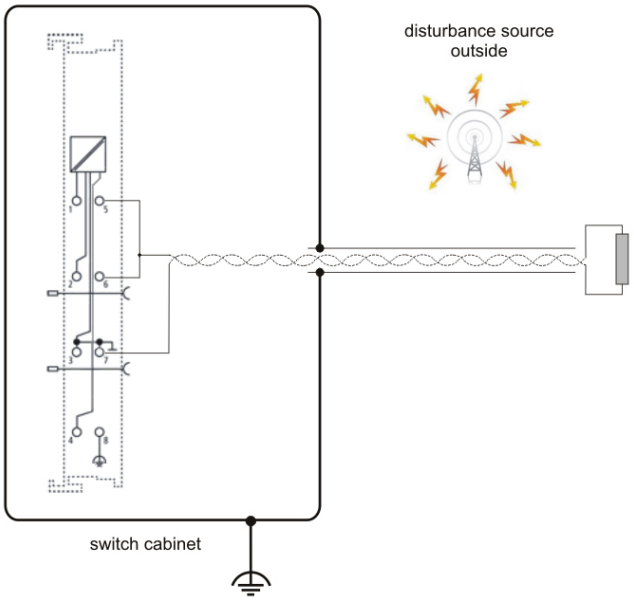
Shielding measures

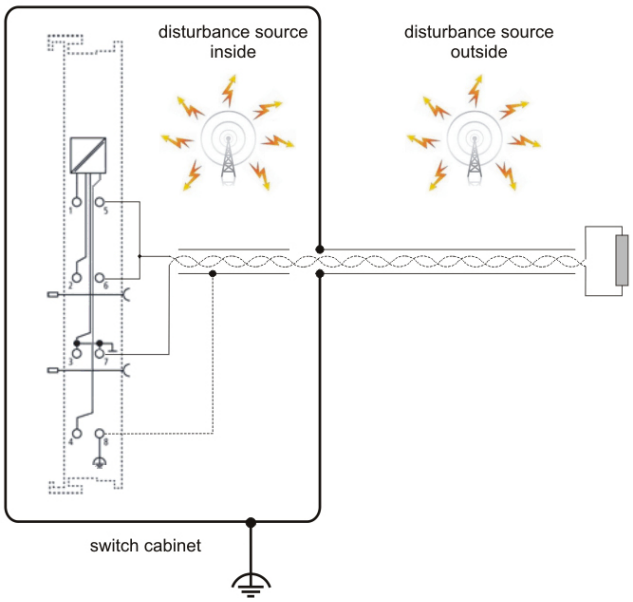
Note	**Shielding measures** Due to the complexity in the “EMC” area, there is no generally applicable guideline, but only technical measures in accordance with the state of the art, which can sometimes contradict each other. These must be checked for feasibility and effectiveness, taking into account the plant specifications, and applied by the plant installer following assessment. The following notes on shielding are to be understood as technical suggestions that have proven themselves from time to time in practical use. It must be checked in each case which measures can be applied, depending on the installation and plant. The effectiveness of each measure must be checked individually. The formal transferability of measures to other types of plant is in general not possible. Priority is to be given to typical national or general normative specifications.

A shielding approach is described below that in many cases improves the measurement quality. The suggested measures must be checked for feasibility and effectiveness in the actual plant.

- Apply the shield with a low resistance and enveloping the cable by 360°.
- At the entry point into the control cabinet, the shield should be earthed conductively.
- The shield should be earthed again at the terminal:
  - At the terminal connection point, if present.
  - If no terminal connection point is available, earth the shield as close to the terminal as possible.
  - To avoid ground loops the shield can be undone after entry into the control cabinet. A capacitive connection to the terminal shield contact is possible.
- Avoid unshielded cable lengths of > 50cm.

Example for CTMT3202 shield connection with shield contact, in the presence of potential disturbance sources inside or inside and outside the control cabinet





Connection techniques

The electrical connection of a resistance sensor to the CTMT3202 can take place using the two-wire, three-wire omethods. In the three and four-wire methods, the error caused by the sensor connecting wires' own resistance should be eliminated.
To this end, in the three-wire method one end is fitted with two connecting wires, in the four-wire method both ends are fitted with two connecting wires.

Two-wire technique

If the two-wire technique is used to connect the EL320x, the terminal is connected via a two-core cable, whose own resistance RL is connected in series with the resistance sensor Rt (fig. 2).

The addition of these resistances causes a systematically increased temperature display, making compensation necessary. Compensation is performed by the compensation resistor RA, which is represented internally in the terminal by the object 80x0:1B and which can be adjusted with a resolution of 1/32 Ohm.

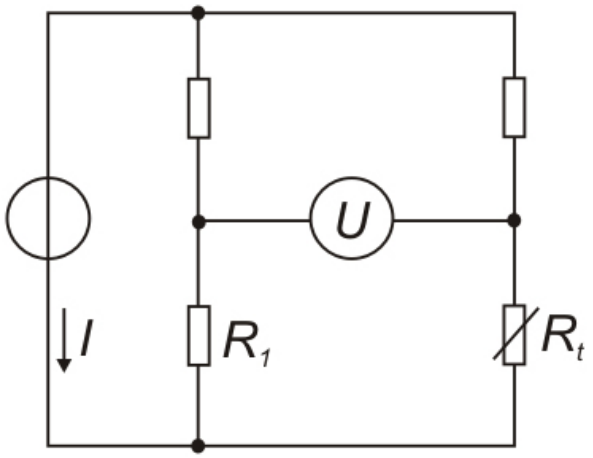


Fig. 1: Wheatstone bridge

Example:
The cross-sectional area of the 50m long copper wire connecting cable is 0.5 mm^2. The specific resistance of copper is 0.0175 O mm^2 m^{-1}.

Determination of the total resistance of the feed cable:
R_{Ltotal} = 0.0175Ω mm^2 m^{-1} * (2 * 50m / 0.5 mm^2) = 3.5Ω

For a resistance change of the Pt100 of ˜0.39 O/K, the resulting temperature deviation is:
3.5Ω / (0.39 Ω/°C) = 8.97 °C

Note	**Two-wire connection** If the CTMT3202 is operated with a two-wire connection, the inputs +R and +RL must be bridged by the user.

Compensation

In order to compensate this error, the CTMT3202's internal circuit generally assumes a cable resistance of 10Ω, which is set via the object 8000:1B.

For the compensation, the resistance value R_{Ltotal} (3.5Ω in the example) is entered in the index 8000:1B. At a resolution of 1/32Ω, this results in a value to be entered of:

3.5Ω / (1/32) Ω = 112dec

Further calculations for the compensation take place internally in the terminal.

T**hree-wire technique**

The three-wire connection technique has the advantage that the influence of the cable resistances is minimized and compensation of the measurement circuit is not necessary. An additional cable is fed to the resistance sensor, as a result of which two measurement circuits are formed, one of which is used as a reference circuit (fig. 3).

Both the value and the temperature dependence of the cable resistance can be compensated, if one assumes as a prerequisite that the properties of the 3 wires in the feed cable are identical and that they are exposed to the same temperatures.

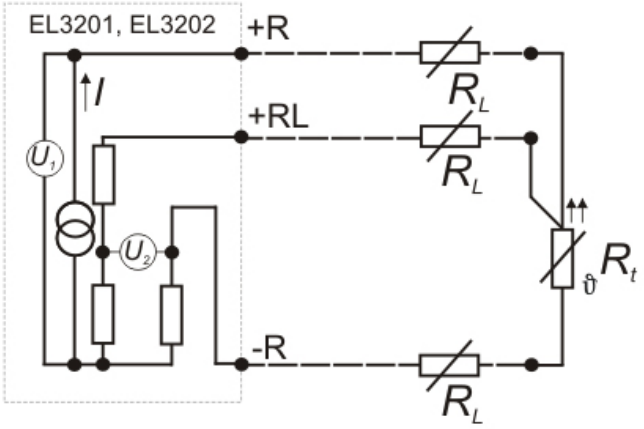
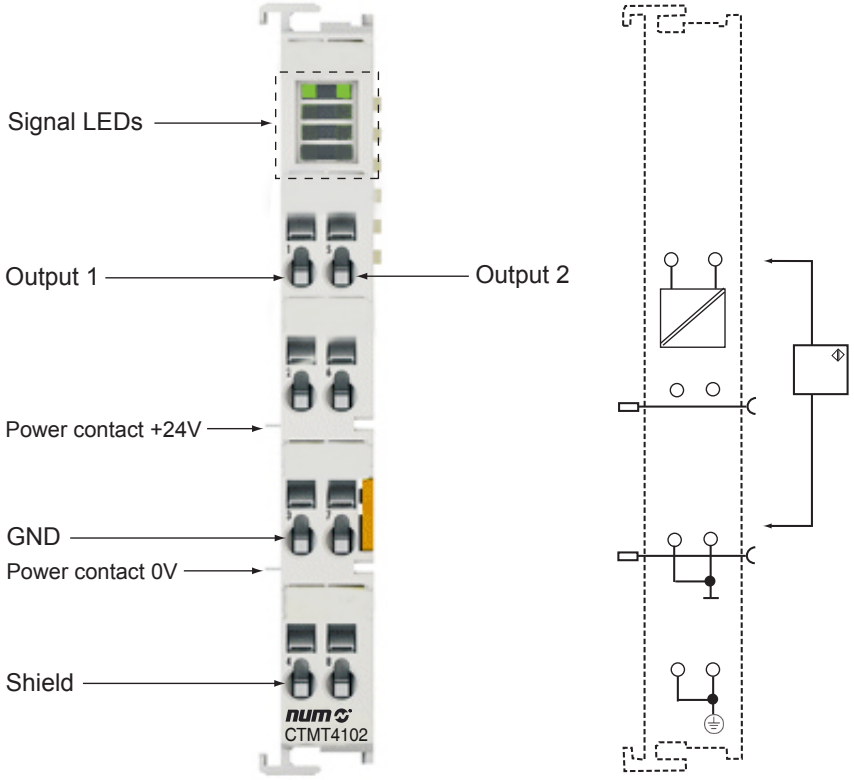


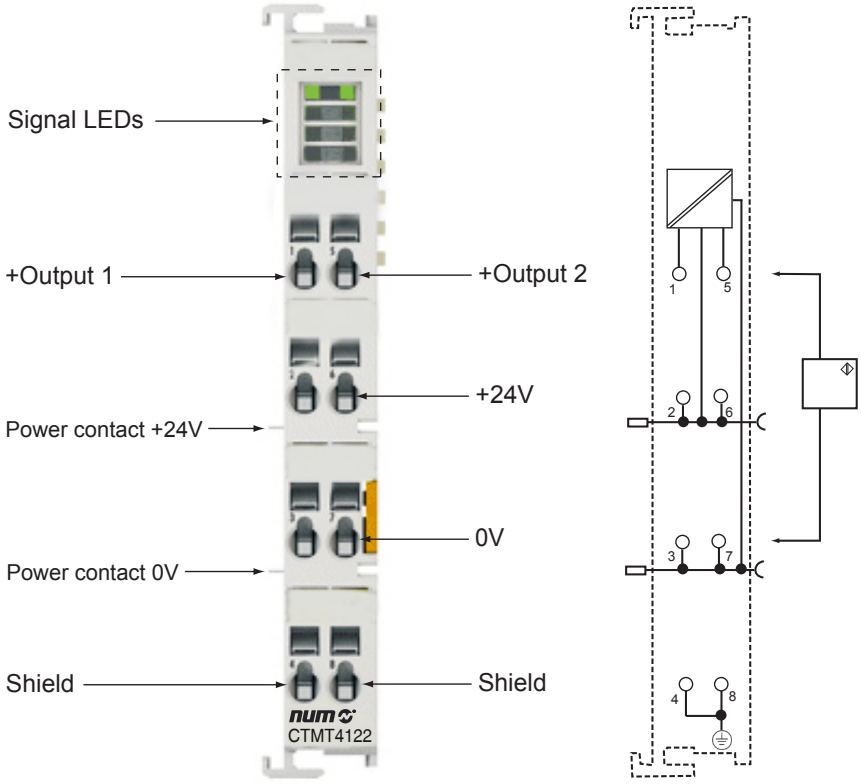
Fig. 3: Three-wire connection technique

4.6.18 CTMT4102 terminal connections



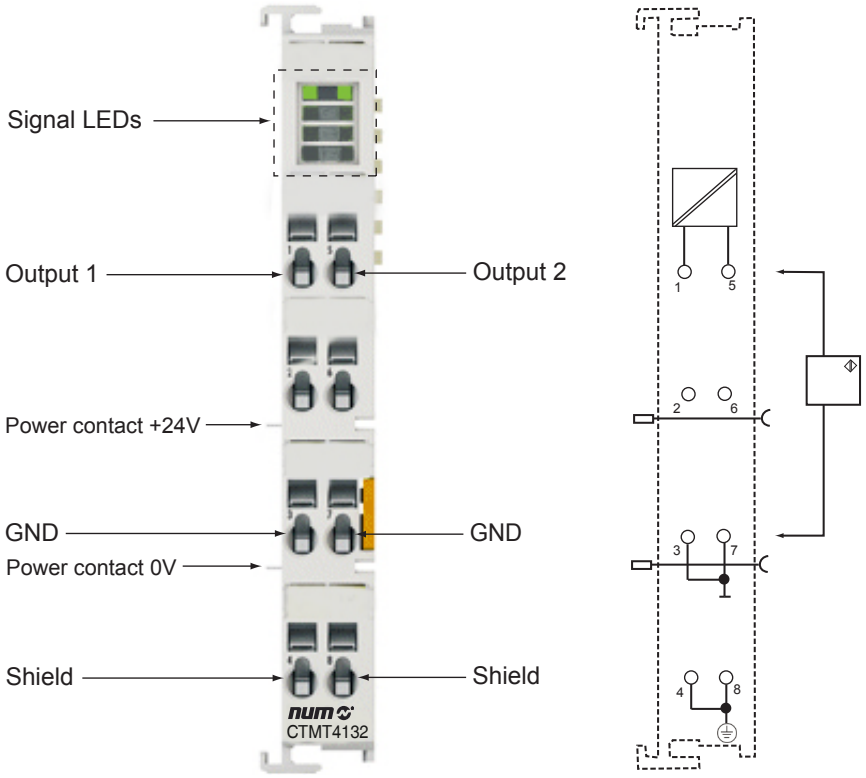
Terminal	No	Description
Output 1	1	Output 1
+24V	2	Not connected
GND	3	Internal ground (internally connected with terminal point 7)
Shield	4	PE contact (internally connected with terminal point 8)
Output 2	5	Output 2
+24V	6	Not connected
GND	7	Internal ground (internally connected with terminal point 3)
Shield	8	PE contact (internally connected with terminal point 4)

4.6.19 CTMT4122 terminal connections



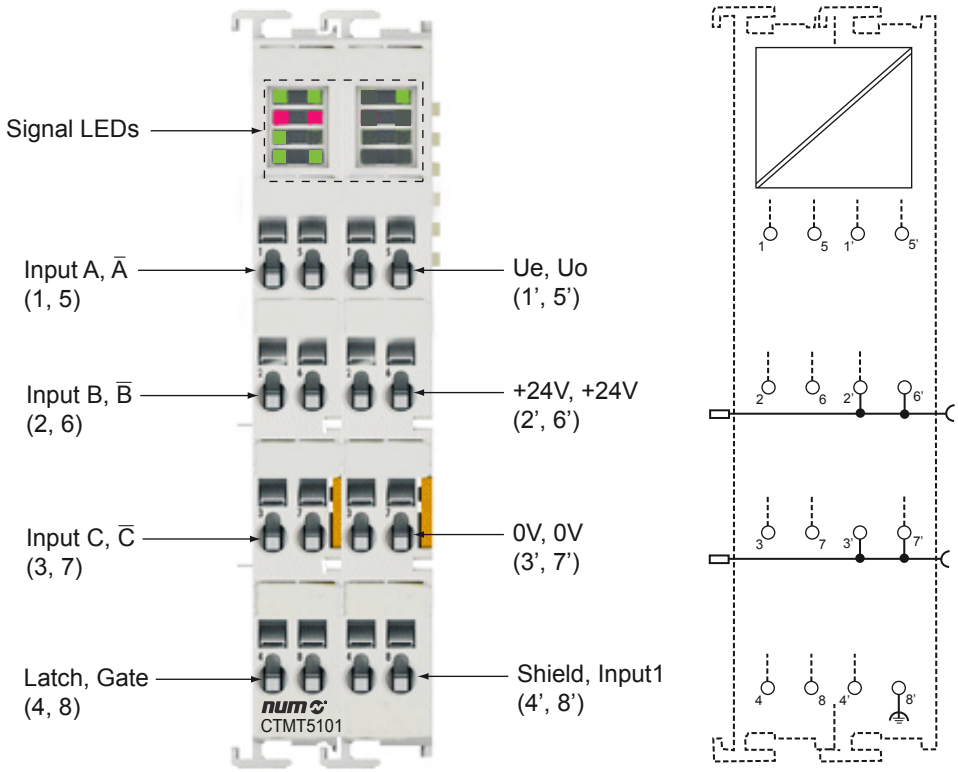
Terminal	No	Description
Output 1	1	Output 1
+24V	2	+24V (internally connected with terminal point 6 and positive power contact)
GND	3	Internal ground (internally connected with terminal point 7)
Shield	4	PE contact (internally connected with terminal point 8)
Output 2	5	Output 2
+24V	6	+24V (internally connected with terminal point 2 and positive power contact)
GND	7	Internal ground (internally connected with terminal point 3)
Shield	8	PE contact (internally connected with terminal point 4)

4.6.20 CTMT4132 terminal connections



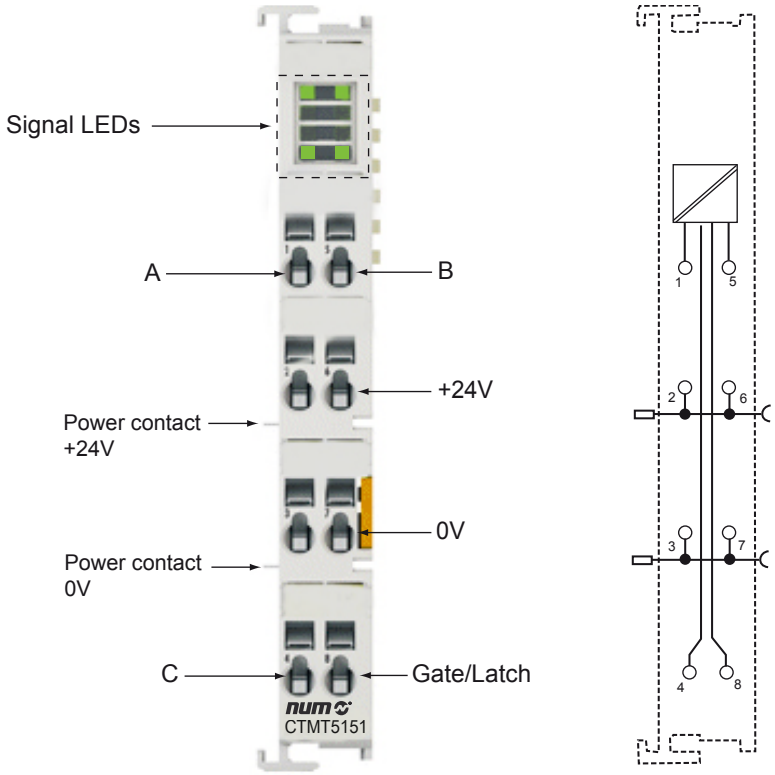
Terminal	No	Description
Output 1	1	Output 1
+24V	2	Not connected
GND	3	Internal ground (internally connected with terminal point 7)
Shield	4	PE contact (internally connected with terminal point 8)
Output 2	5	Output 2
+24V	6	Not connected
GND	7	Internal ground (internally connected with terminal point 3)
Shield	8	PE contact (internally connected with terminal point 4)

4.6.21 CTMT5101 terminal connections



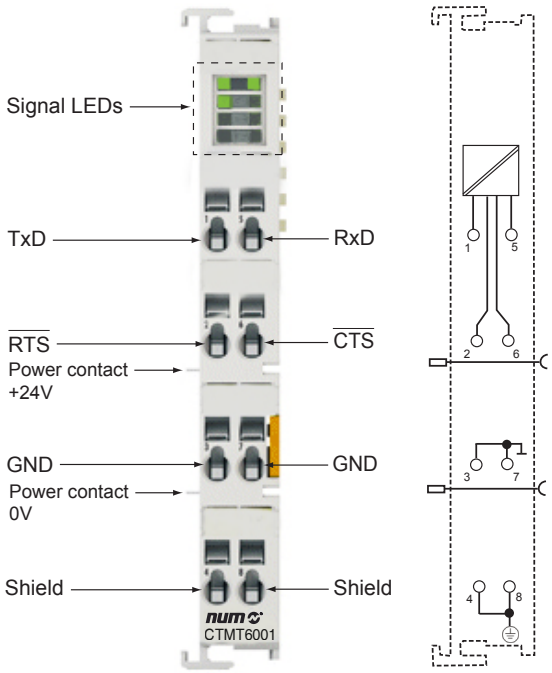
Terminal	No	Description
A	1	Encoder input A
B	2	Encoder input B
C	3	Encoder input C
Latch 24V	4	Latch input
Ā	5	Encoder input Ā
B̄	6	Encoder input B̄
C̄	7	Encoder input C̄
Gate 24V	8	Gate input
Ue = +5V	1'	+5V Encoder supply
+24V	2'	+24V (connected internally with terminal 6' and positive power contact)
0V	3'	0V (connected internally with terminal 7' and negative power contact)
Input 1	4'	Status input 1 Alarm input of the rotary transducer. Internally connected to 5V via pull-up resistor. Negative switching, if connected with GND, error bit is set with LED display. If externally feeded (not recommended), the maximum allowable voltage to GND is 5V.
Uo = 0V	5'	0V Encoder supply
+24V	6'	+24V (connected internally with terminal 2' and positive power contact)
0V	7'	0V (connected internally with terminal 3' and negative power contact)
Shield	8'	Shield

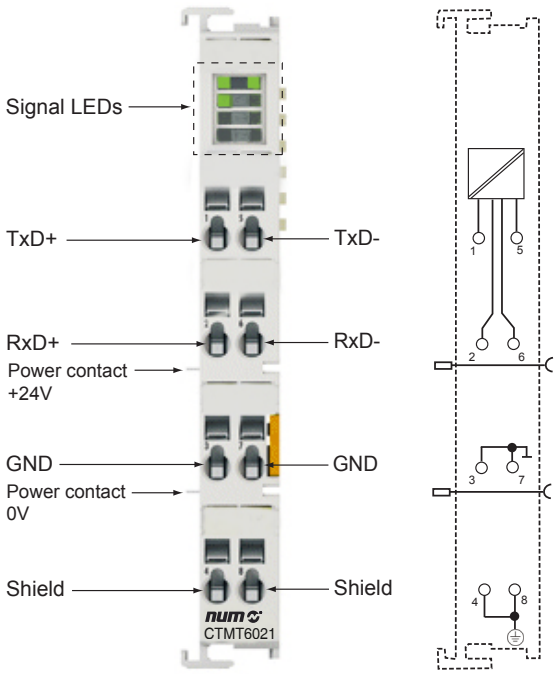
4.6.22 CTMT5151 terminal connections



Terminal	No	Description
A	1	Encoder input A
+24V	2	+24V (connected internally with terminal 6 and positive power contact)
0V	3	0V (connected internally with terminal 7 and negative power contact)
C	4	Encoder input C
B	5	Encoder input B
+24V	6	+24V (connected internally with terminal 2 and positive power contact)
0V	7	0V (connected internally with terminal 3 and negative power contact)
Gate/Latch 24V	8	Gate/Latch input

4.6.23 CTMT6001, CTMT6021 terminal connections





Connections with CTMT6001

Terminal	Name	Description
1	TxD	Signal line (Transmit Data)
5	RxD	Signal line (Receive Data)
2	RTS	Control line (Request To Send)
6	CTS	Control line (Clear To Send)
3	GND	Ground (connected internally with terminal 7)
7	GND	Ground (connected internally with terminal 3)
4	Shield	Shield (connected internally with terminal 8)
8	Shield	Shield (connected internally with terminal 4)

Connections with CTMT6021

Terminal	Name	Description
1	TxD+	Signal line + (Transmit Data)
5	RxD-	Signal line - (Transmit Data)
2	RxD+	Signal line + (Receive Data)
6	RxD-	Signal line - (Receive Data)
3	GND	Ground (connected internally with terminal 7)
7	GND	Ground (connected internally with terminal 3)
4	Shield	Shield (connected internally with terminal 8)
8	Shield	Shield (connected internally with terminal 4)

Connection for RS422 transfer
In the RS422 mode, data is transferred in full duplex mode. Only peer-to-peer connections can be established.

Connection for RS485 transfer
In the RS485 mode, the data is exchanged by means of half duplex transfer. A bus structure can be created in this mode of operation.

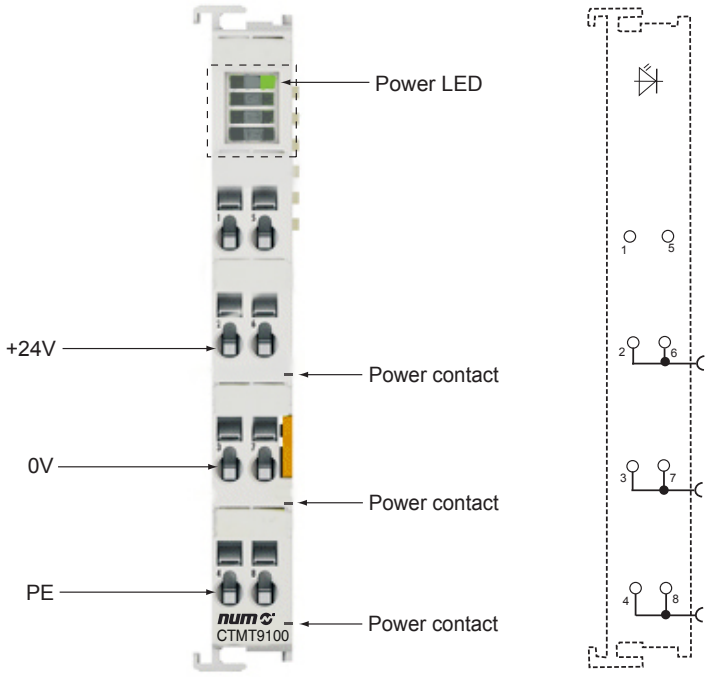
The transmit and receive lines are connected to one another in RS485 operating mode.
As a result, the terminal receives not only the data from other devices, but also its own transmitted data.

In operating mode RS485, the reception of new data is only possible if transmission is complete.

Enable half duplex	Enable point to point connection (RS422	Modus
0	**0**	RS485: The terminal receives its own data and the data from other devices
0	**1**	RS422: Normal operating mode; the terminal operates in full duplex mode.
1	**0**	RS485: The terminal only receives data from other devices.
1	**1**	RS422: The receiver is only enabled after the last data has been transmitted.

4.6.24 CTMT9100, CTMT9110 Potential supply terminal connections

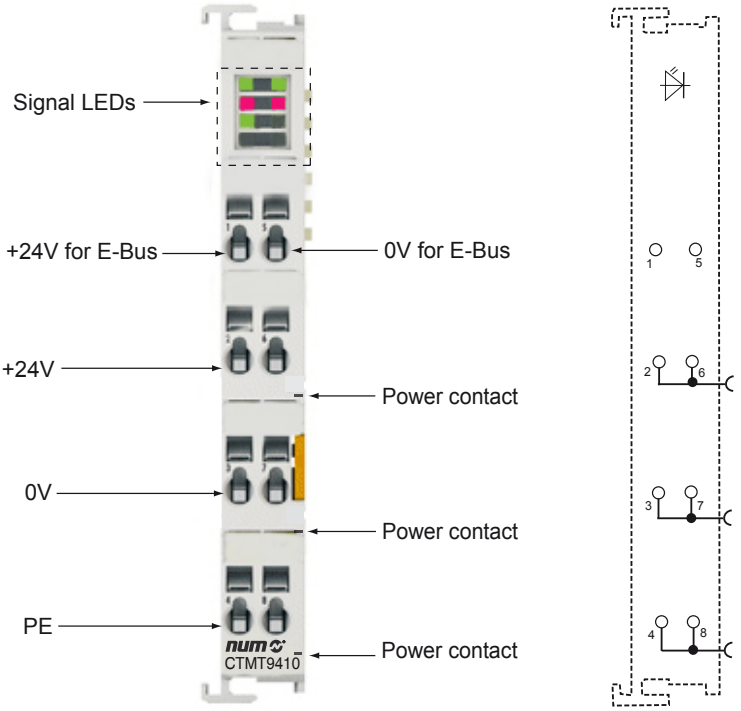
CTMT9100 / CTMT9110 connections



Terminal	No	Description
-	1	Not used
+24V	2	Supply input +24V
0V	3	0V for supply input
PE	4	PE (connected internally with terminal 8 and PE power contact)
-	5	Not used
+24V	6	Supply input +24V
0V	7	0V for supply input
PE	8	PE (connected internally with terminal 4 and PE power contact)

CAUTION	**Hazard to individuals and devices!** When designing a Bus Terminal block with different potentials on the power contacts (e.g. 24 VDC). Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

4.6.25 CTMT9410 Power supply terminals for E-bus terminal connections



Terminal	No	Description
+24 V for E-Bus	1	Supply input +24V for the E-Bus
+24V	2	Supply input +24V (connected internally with terminal 6 and positive power contact)
0V	3	0V for supply input (connected internally with terminal 7 and negative power contact)
PE	4	PE (connected internally with terminal 8)
0V for E-Bus	5	0V for supply input E-Bus
+24V	6	Supply input +24V (connected internally with terminal 2 and positive power contact)
0V	7	0V for supply input (connected internally with terminal 3 and negative power contact)
PE	8	PE (connected internally with terminal 4)

4.7 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.

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Summary

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5 Terminal configuration with Flexium Tools

5.1 Entering the terminals configuration


Note

Important note!

Terminals configuration with Flexium Tools

Please refer to the Flexium Commissioning manual M00010 for entering the NUM EtherCAT terminals CTMG and CTMT configuration with Flexium Tools.

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Summary

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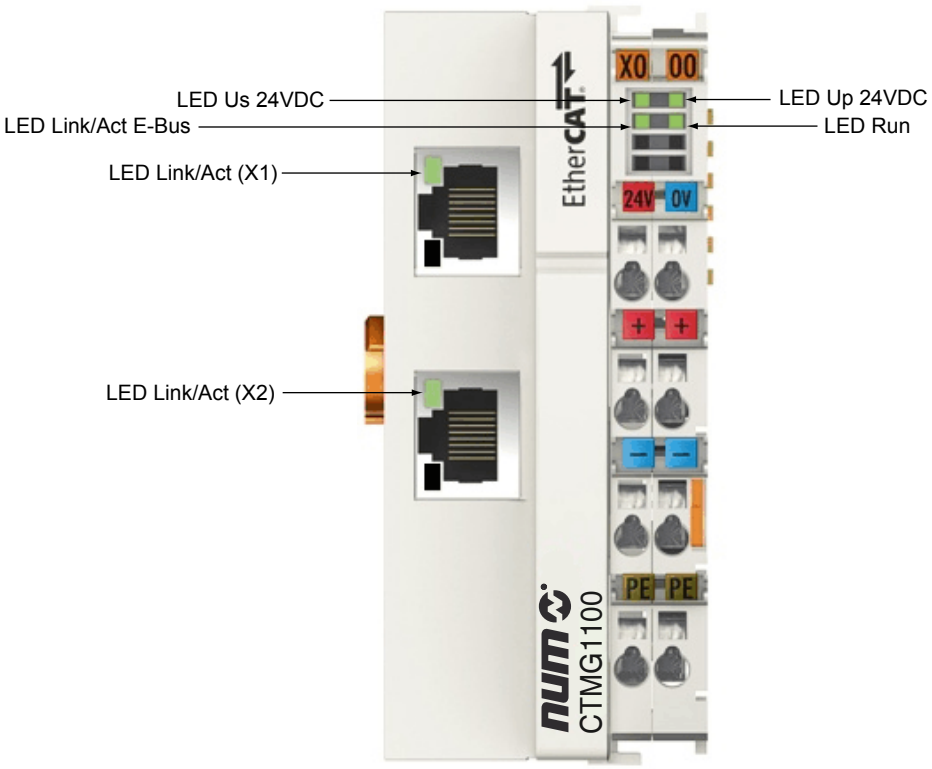
6 Diagnostic

6.1 CTMG1100 Diagnostic LEDs



LEDs for power supply diagnosis

LED	Color	Display	Status	Meaning
Us	Green	OFF	-	No operating voltage connected
		ON	-	24VDC operating voltage connected
Up	Green	OFF	-	No 24VDC power connected to the power contacts
		ON	-	24VDC power connected to the power contacts

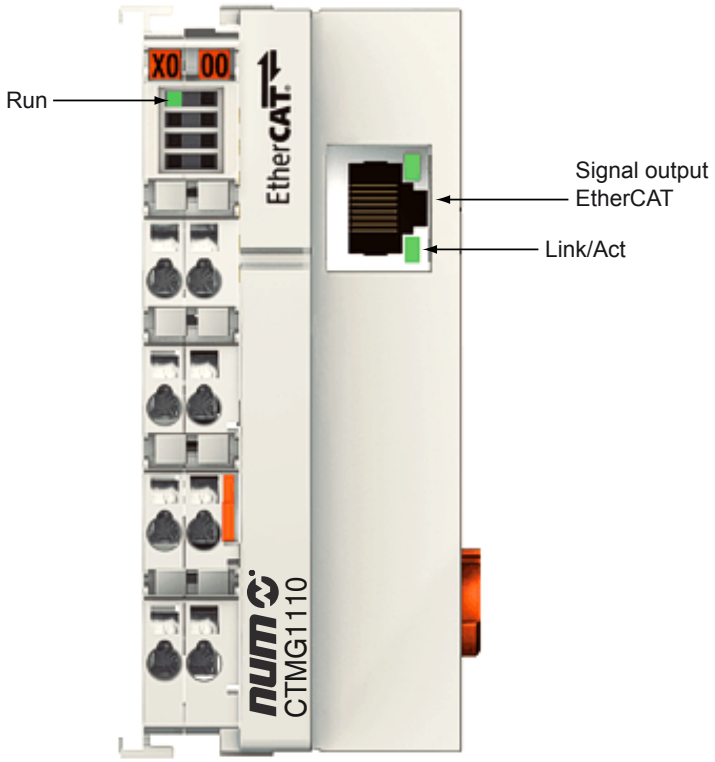
LEDs for EtherCAT State Machine/PLC diagnosis

LED	Color	Display	Status	Meaning
Run	Green	OFF	Init	State of the EtherCAT State Machine: *INIT = Initialization*
		Blinking	Pre-Operational	State of the EtherCAT State Machine: *PREOP = Pre-Operational*
		Single flash	Safe-Operational	State of the EtherCAT State Machine: *SAFEOP = Safe-Operational*
		ON	Operational	State of the EtherCAT State Machine: *OP = Operational*
		Flashes	Bootstrap	State of the EtherCAT State Machine: *BOOT = Bootstrap* (Update of the coupler firmware)

LEDs for fieldbus diagnosis

LED	Color	Display	Status	Meaning
LINK / ACT (X1 IN)	Green	OFF	-	No connection with the previous EtherCAT client
		ON	Linked	Previous EtherCAT-client connected
		Blinking	Active	Communication with the previous EtherCAT client
LINK / ACT (X2 OUT)	Green	OFF	-	No connection with the next EtherCAT client
		ON	Linked	Next EtherCAT client connected
		Blinking	Active	Communication with the next EtherCAT client
LINK / ACT E-Bus	Green	OFF	-	No connection/communication with internal E-Bus
		ON	Linked	Connection with internal E-Bus
		Blinking	Active	Connection/communication with internal E-Bus

6.2 CTMG1110 Diagnostic LEDs



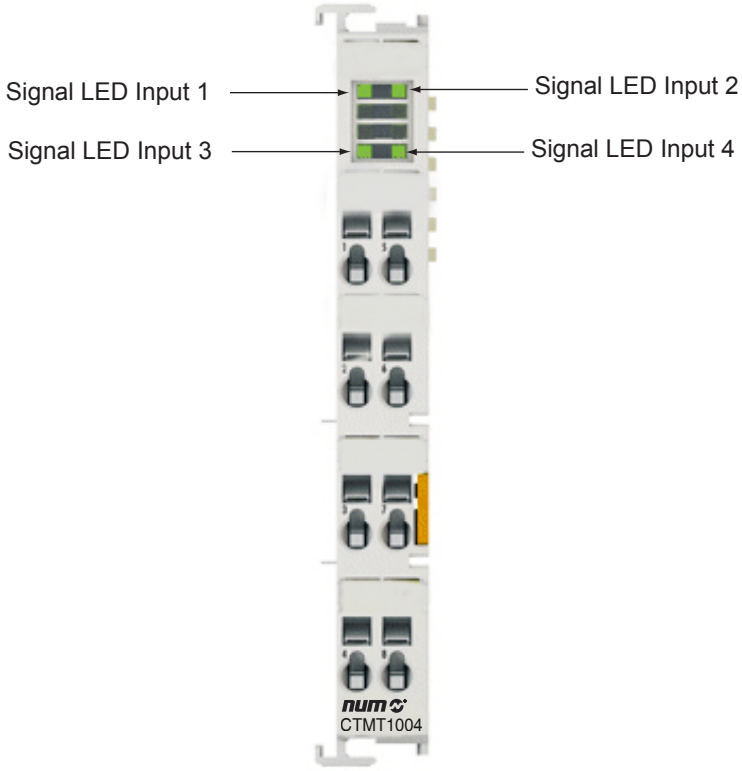
LEDs for fieldbus diagnosis

LED	Color	Display	Status	Meaning
LINK / ACT	Green	OFF	-	No connection with EtherCAT client
		ON	Linked	EtherCAT-client connected
		Blinking	Active	Communication with EtherCAT client

LED for EtherCAT State Machine diagnosis

LED	Color	Meaning	
RUN	Green	This LED indicates the terminal's operating state	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal.
		Even flashing	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Slow flashing	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.
		Fast flashing	State of the EtherCAT State Machine: **BOOTSTRAP** = Function for firmware updates of the terminal.

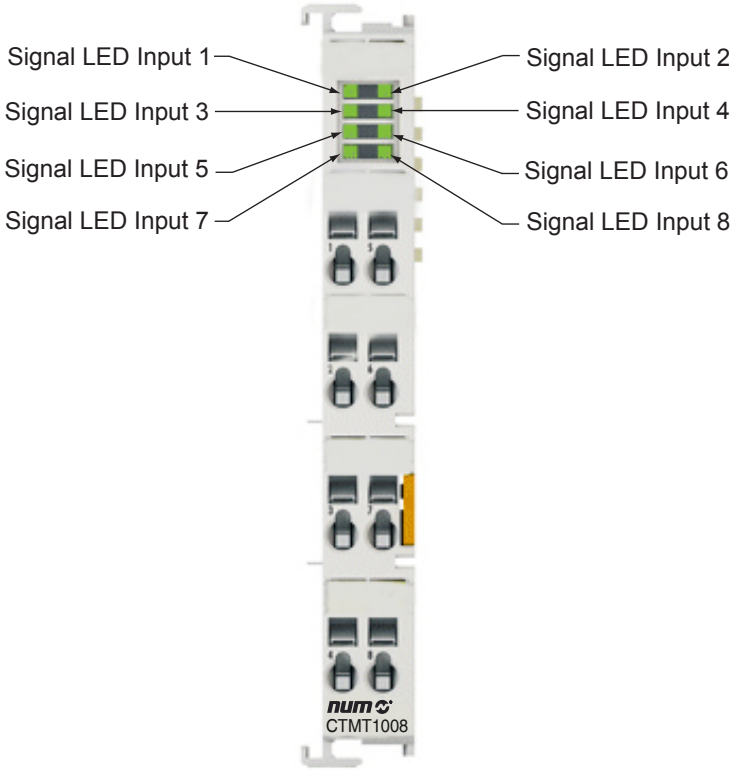
6.3 CTMT1004 Diagnostic LEDs



LEDs

LED	Color	Meaning	
INPUT 1	Green	ON	Signal voltage “0” (-3 V ... 5 V)
INPUT 2			
INPUT 3		OFF	Signal voltage “1” (15 V ... 30 V)
INPUT 4			

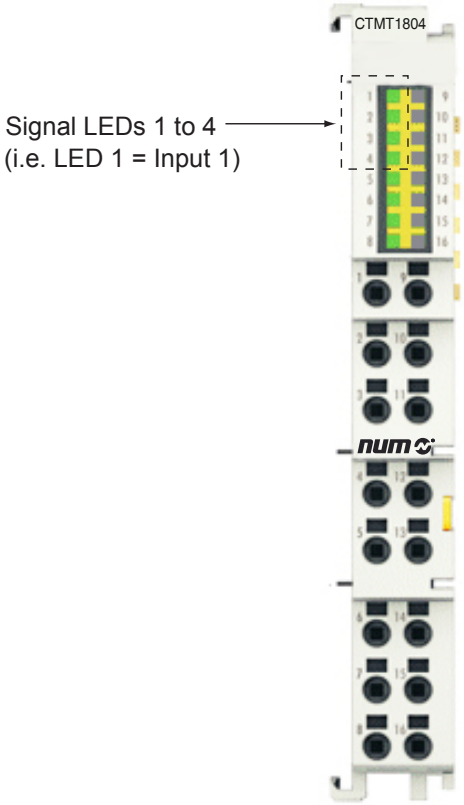
6.4 CTMT1008 Diagnostic LEDs



LEDs

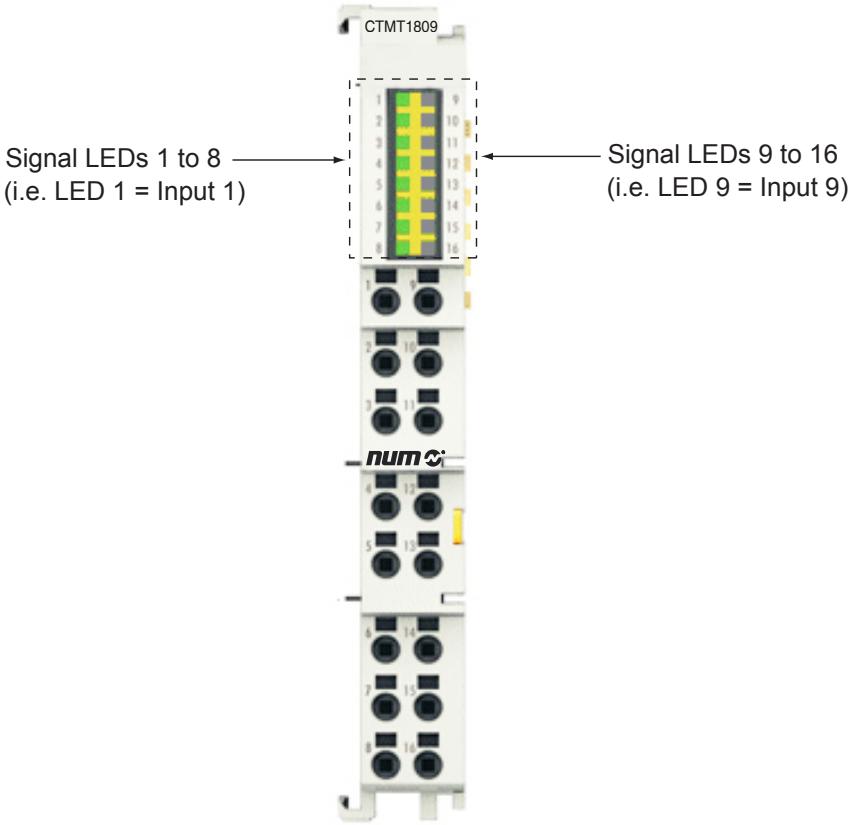
LED	Color	Meaning	
INPUT 1	Green	OFF	Signal voltage “0” (-3 V ... 5 V)
INPUT 2			
INPUT 3			
INPUT 4			
INPUT 5		ON	Signal voltage “1” (15 V ... 30 V)
INPUT 6			
INPUT 7			
INPUT 8			

6.5 CTMT1804 Diagnostic LEDs



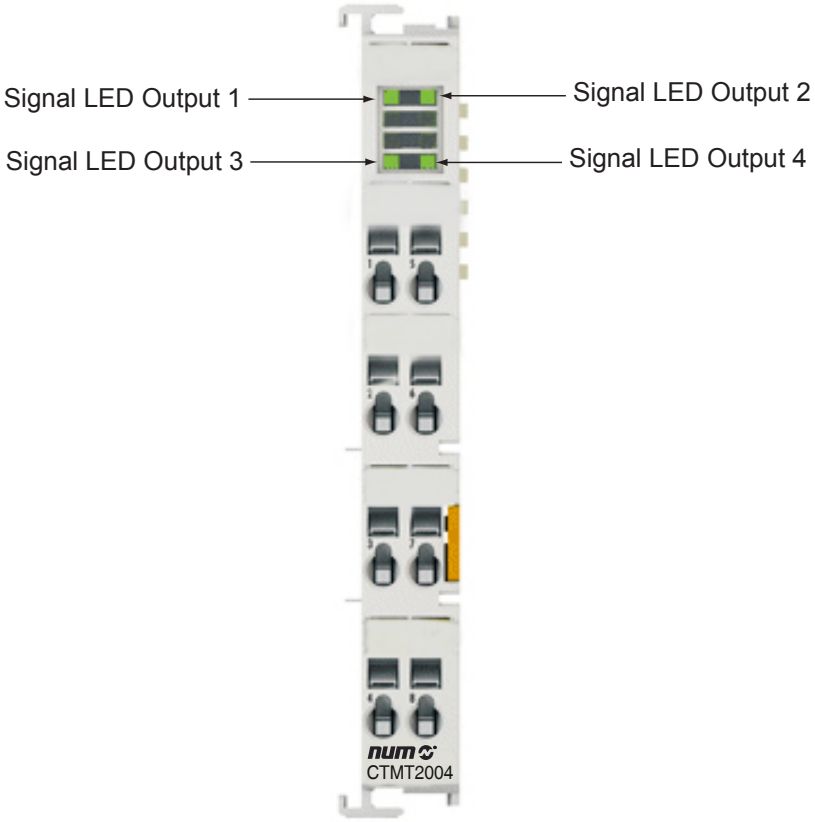
LED	Color	Meaning	
INPUT 1 - 4	Green	OFF	Signal voltage "0" (-3V ... 5V)
		ON	Signal voltage “1” (15V ... 30V)

6.6 CTMT1809 Diagnostic LEDs



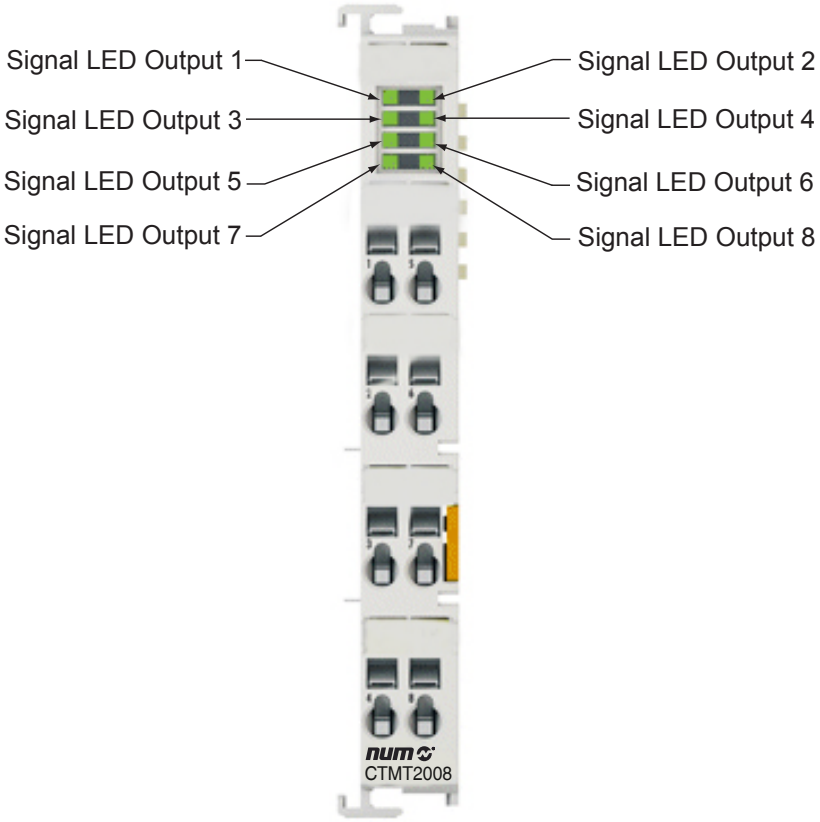
LED	Color	Meaning	
INPUT 1 - 16	Green	OFF	Signal voltage "0" (-3V ... 5V)
		ON	Signal voltage “1” (15V ... 30V)

6.7 CTMT2004 Diagnostic LEDs



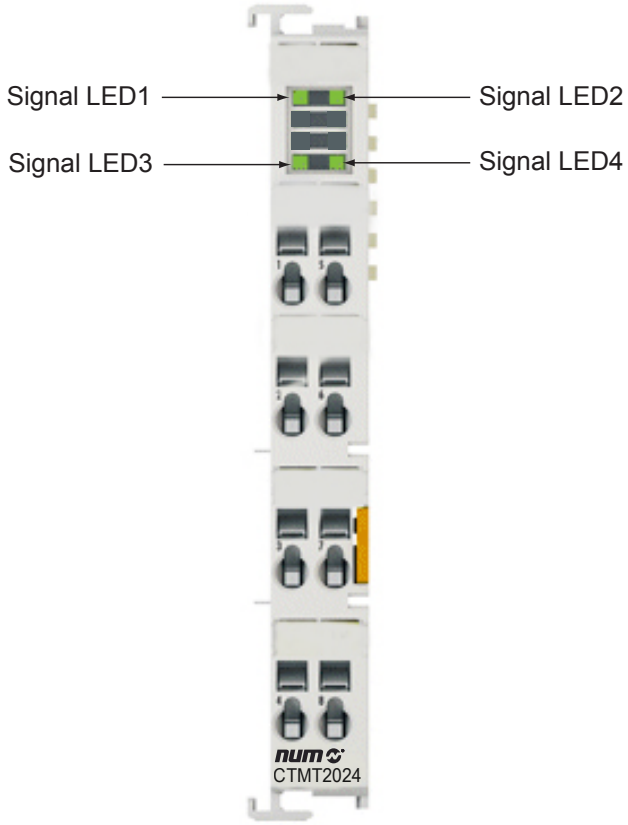
LED	Color	Meaning	
OUTPUT 1	Green	OFF	No output signal
OUTPUT 2			
OUTPUT 3		ON	Output signal 24VDC at particular output
OUTPUT 4			

6.8 CTMT2008 Diagnostic LEDs



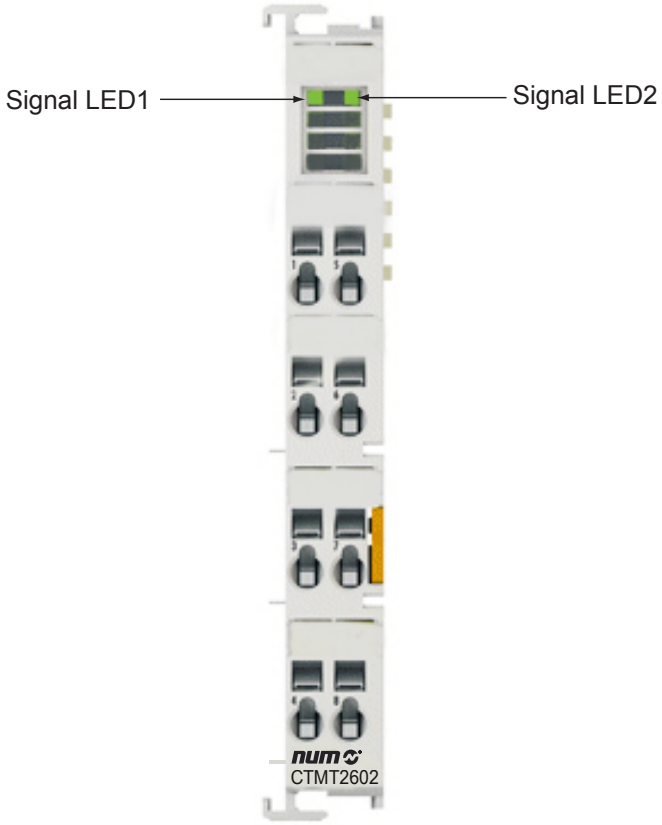
LED	Color	Meaning	
OUTPUT 1	Green	OFF	No output signal
OUTPUT 2			
OUTPUT 3			
OUTPUT 4			
OUTPUT 5		ON	Output signal 24VDC at particular output
OUTPUT 6			
OUTPUT 7			
OUTPUT 8			

6.9 CTMT2024 Diagnostic LEDs



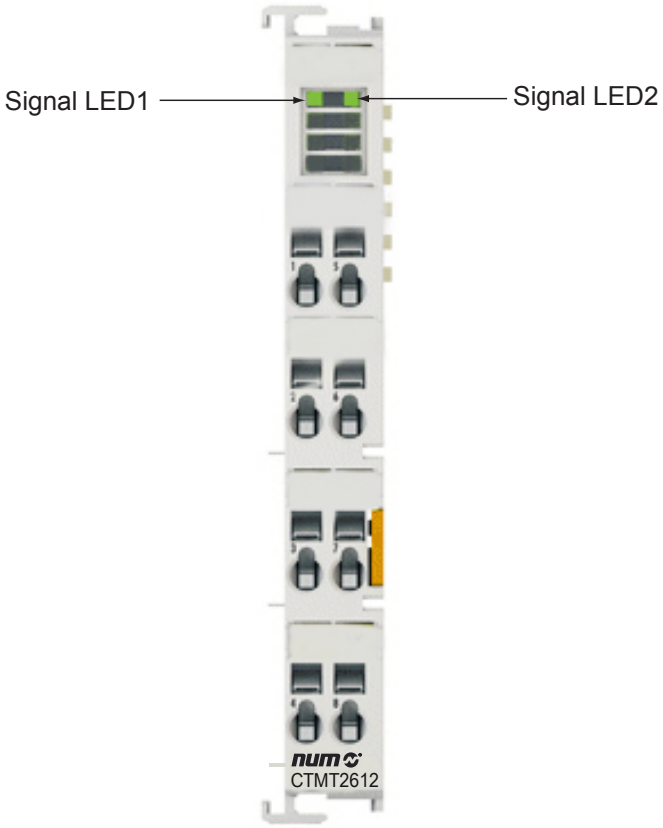
LED	Color	Meaning	
OUTPUT 1	Green	OFF	No output signal at OUTPUT 1 / OUTPUT 2 / OUTPUT 3 / OUTPUT 4
OUTPUT 2			
OUTPUT 3		ON	Output signal 24 VDC at OUTPUT 1 / OUTPUT 2 / OUTPUT 3 / OUTPUT 4
OUTPUT 4			

6.10 CTMT2602 Diagnostic LEDs



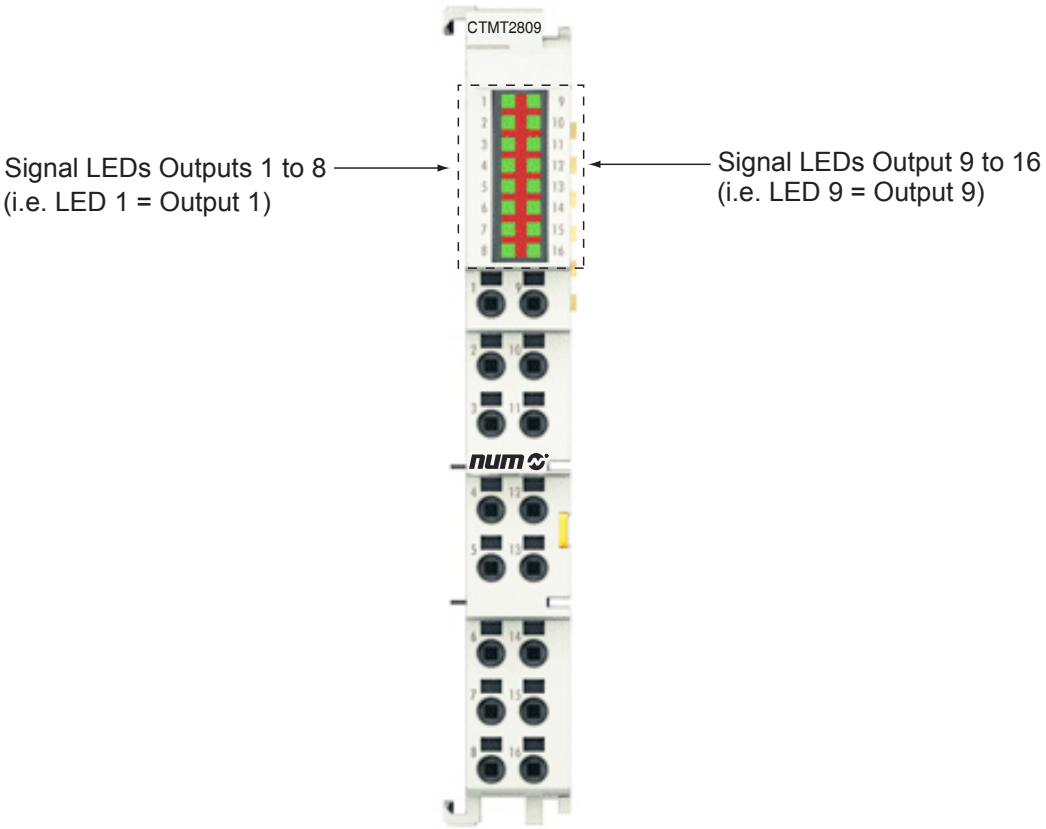
LED	Color	Meaning	
OUTPUT 1	Green	OFF	No output voltage at output 1 resp. output 2
OUTPUT 2		ON	Output voltage (≤ 230 VAC resp. ≤ 30VDC>) at output 1 resp. output 2

6.11 CTMT2612 Diagnostic LEDs



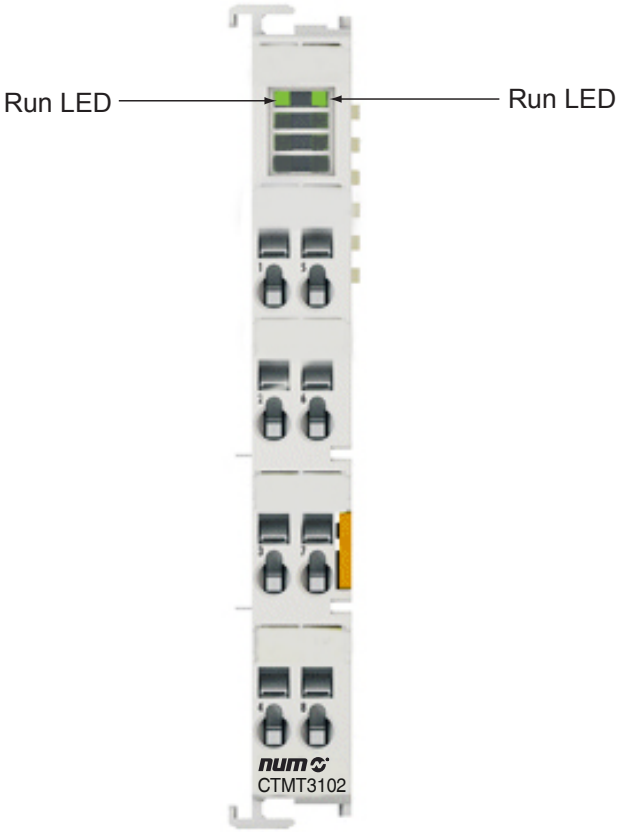
LED	Color	Meaning	
OUTPUT 1	Green	OFF	Contacts 2-3 (Ch. 1) resp. 6-7 (Ch. 2) closed
OUTPUT 2		ON	Contacts 2-1 (6-5) closed

6.12 CTMT2809 Diagnostic LEDs



LED	Color	Meaning	
OUTPUT 1 - 16	Green	OFF	No output signal
		ON	Output signal 24VDC at particular output

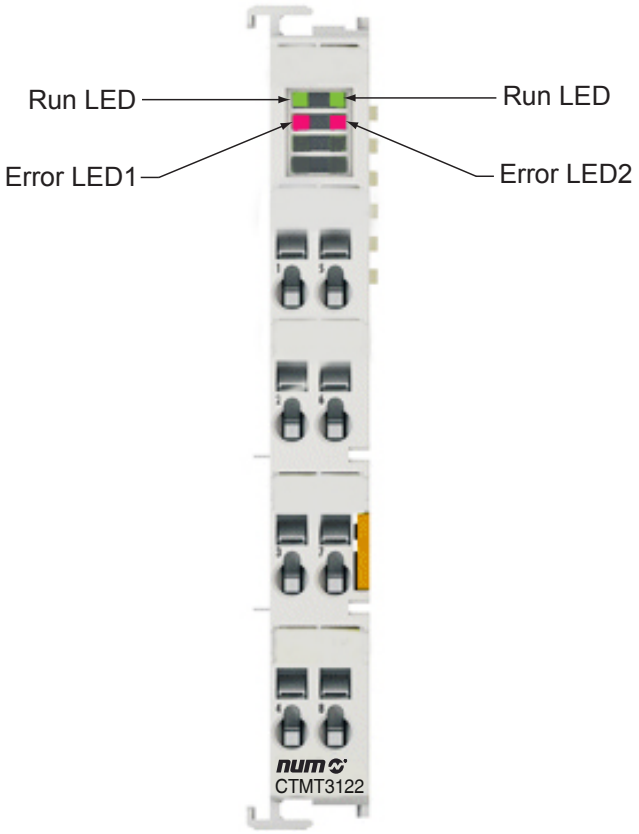
6.13 CTMT3102 Diagnostic LEDs



LED	Color	Meaning	
RUN*	Green	This LED indicates the terminal's operating state (if more than one RUN LED is present, all of them have the same function):	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.

*) If more than one RUN LED is present, all of them have the same function.

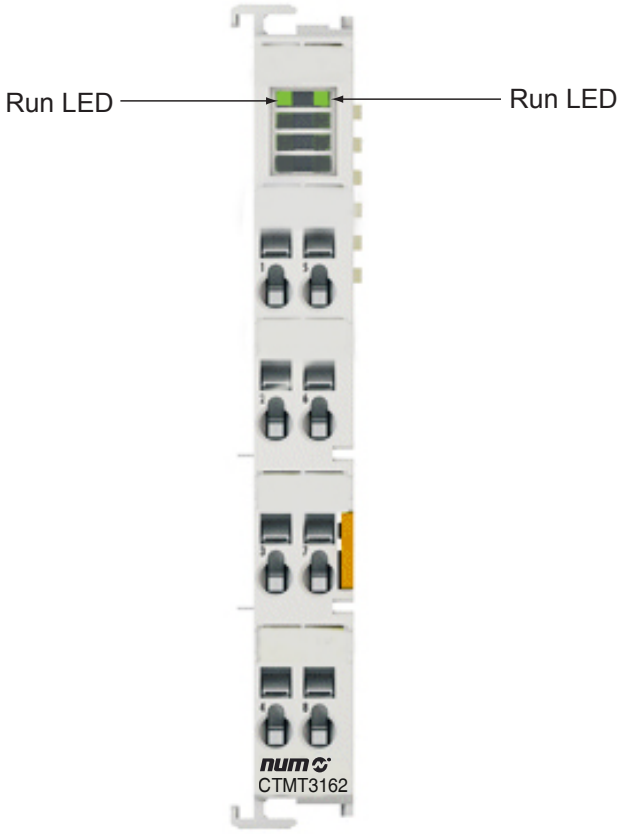
6.14 CTMT3122 Diagnostic LEDs



LED	Color	Meaning	
RUN*	Green	This LED indicates the terminal's operating state (if more than one RUN LED is present, all of them have the same function):	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.
ERROR**	Red	Indicates exceeding of measure range (under- or overrun) or broken wire of that channel.	

*) If more than one RUN LED is present, all of them have the same function.
**) The Error LEDs display the state of the signal analysis for each channel.

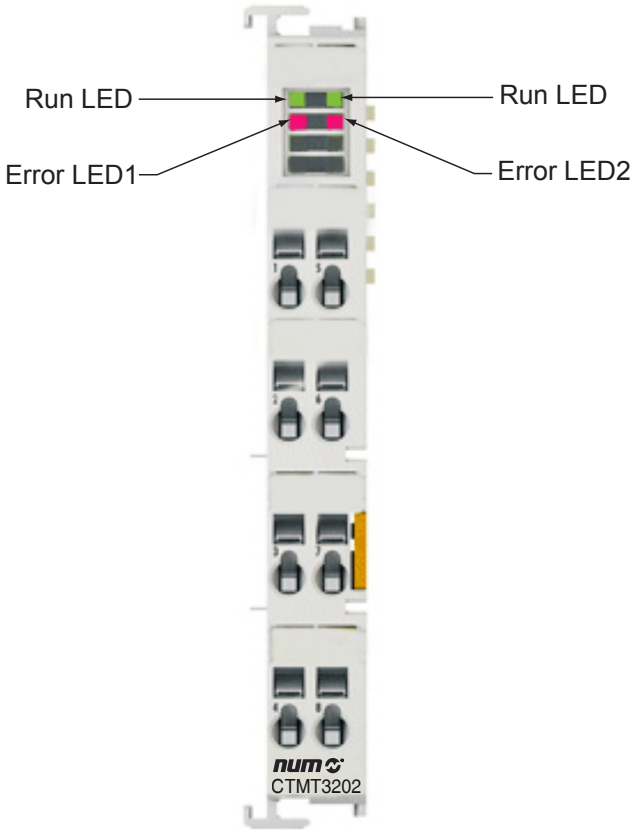
6.15 CTMT3162 Diagnostic LEDs



LED	Color	Meaning	
RUN*	Green	This LED indicates the terminal's operating state (if more than one RUN LED is present, all of them have the same function):	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.

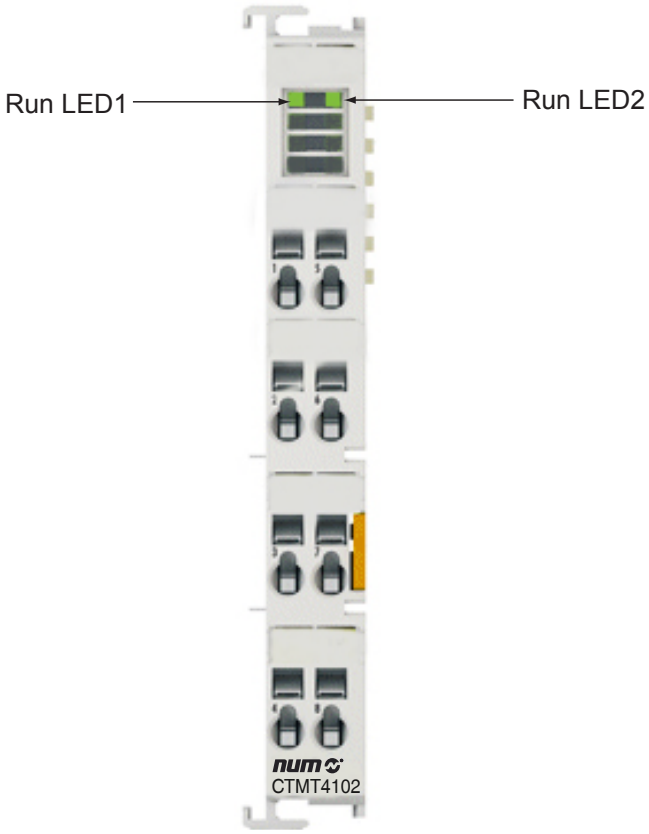
*) If more than one RUN LED is present, all of them have the same function.

6.16 CTMT3202 Diagnostic LEDs



LED	Color	Meaning	
RUN	Green	This LED indicates the terminal's operating state	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.
ERROR1 **ERROR2**	Red	ON	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve.

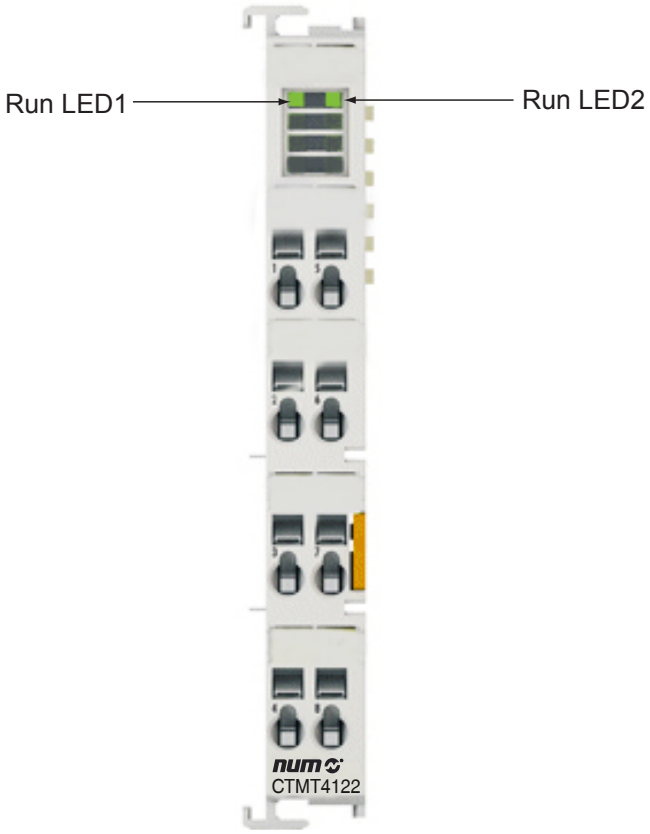
6.17 CTMT4102 Diagnostic LEDs



LED	Color	Meaning	
RUN*	Green	This LED indicates the terminal's operating state (if more than one RUN LED is present, all of them have the same function):	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.

*) If more than one RUN LED is present, all of them have the same function.

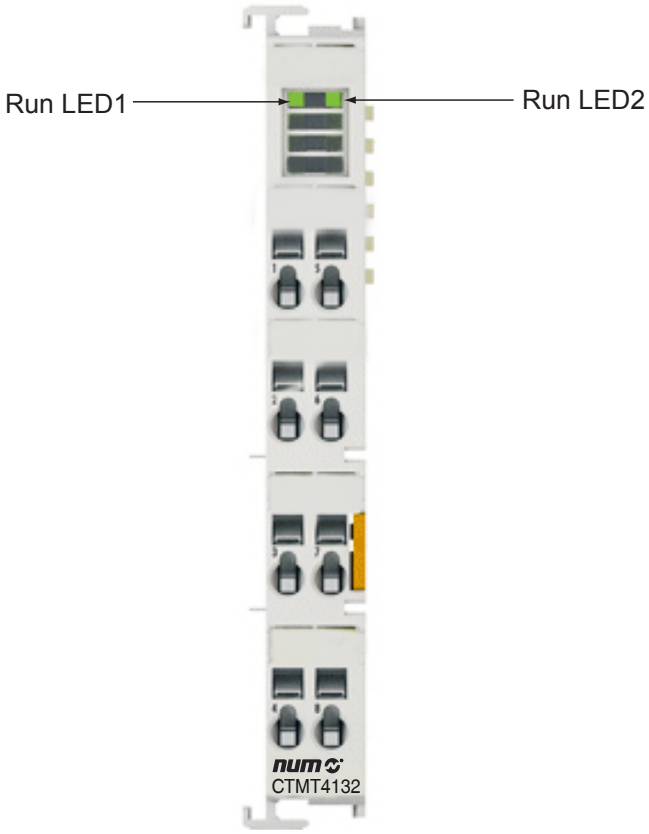
6.18 CTMT4122 Diagnostic LEDs



LED	Color	Meaning	
RUN	Green	This LED indicates the terminal's operating state:	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.

If more than one RUN LED is present, all of them have the same function.

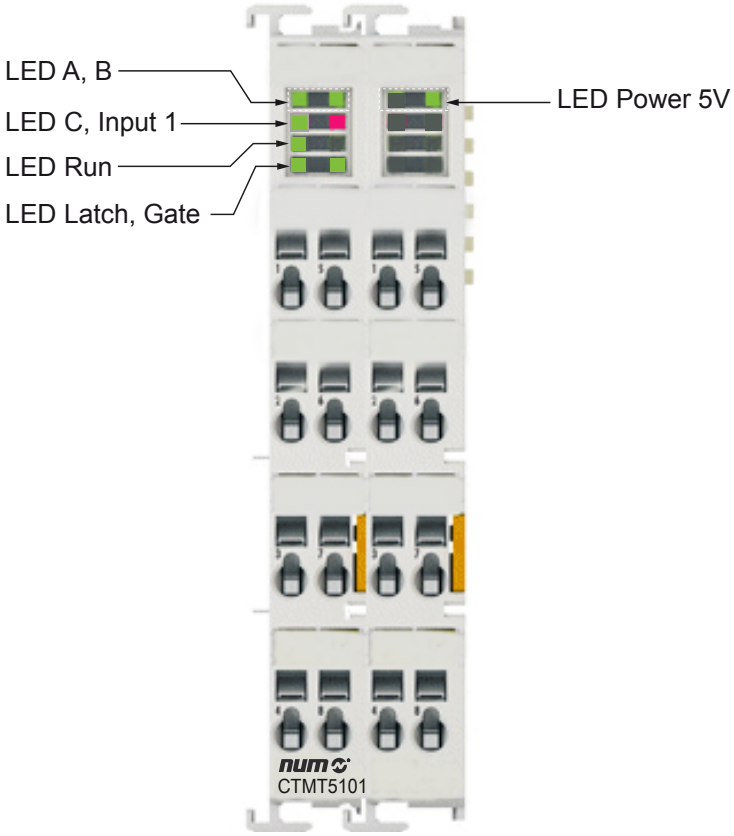
6.19 CTMT4132 Diagnostic LEDs



LED	Color	Meaning	
RUN	Green	This LED indicates the terminal's operating state:	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.

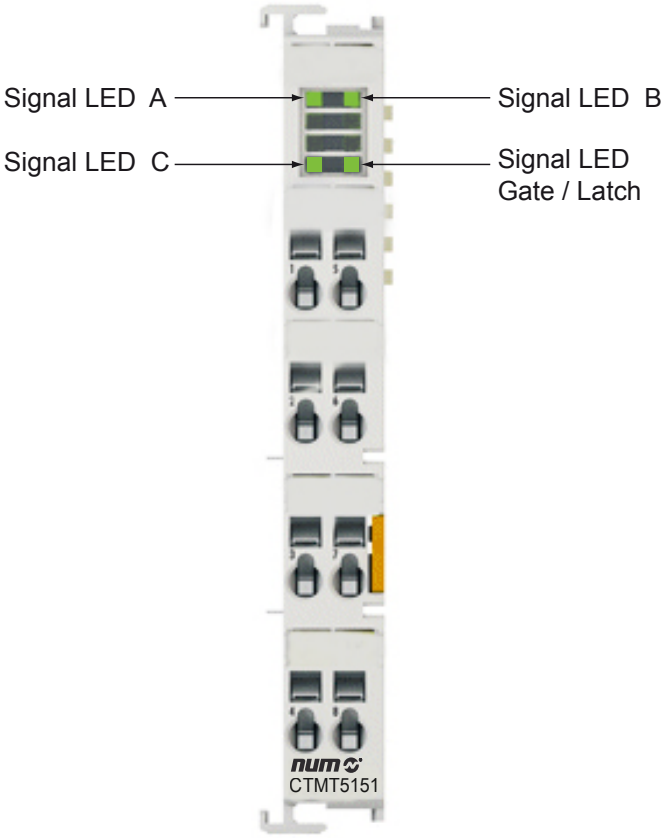
If more than one RUN LED is present, all of them have the same function.

6.20 CTMT5101 Diagnostic LEDs



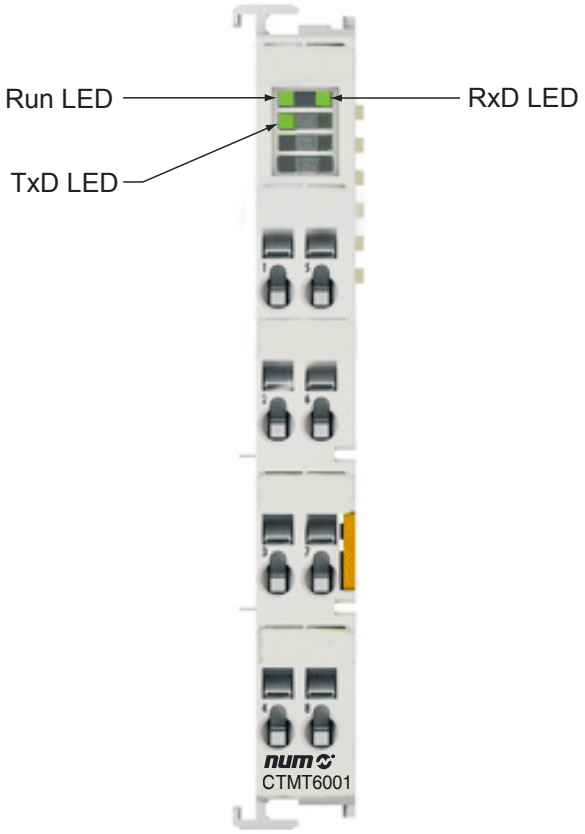
LED	Color	Meaning	
A, B, C	Green	Flashing	Indicates that impulses are present at inputs
INPUT 1	Red	ON	Indicates that the INPUT1 level is pulled to ground potential [INPUT 1 is pulled up internally to 5V-HIGH-level by default]
LATCH	Green	ON	Signal (+24V) is present at the latch input
GATE	Green	ON	Signal (+24V) is present at the gate input
RUN	Green	This LED indicates the terminal's operating state:	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.
POWER 5V	Green	ON	Indicates operation voltage for encoder is present.

6.21 CTMT5151 Diagnostic LEDs



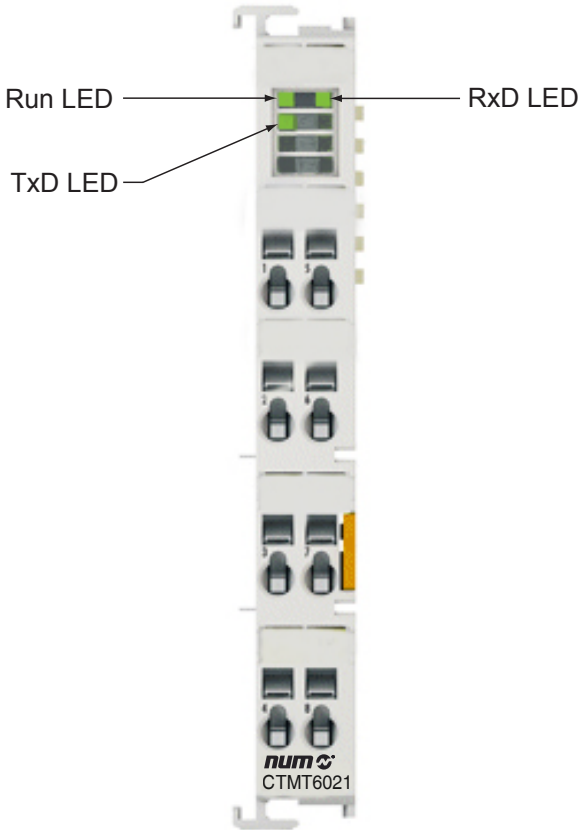
LED	Color	Meaning
A, B, C	Green	Flashing, indicates that impulses are present at inputs
Gate, Latch	Red	ON, signal is present at the Gate/Latch input

6.22 CTMT6001 Diagnostic LEDs



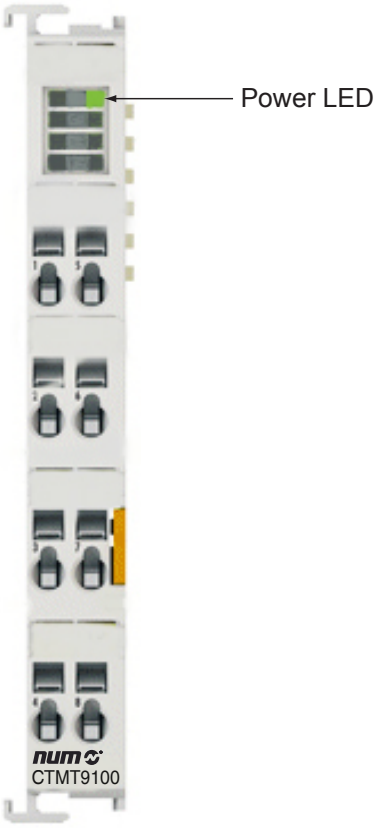
LED	Color	Meaning	
RUN	Green	This LED indicates the terminal's operating state:	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.
TxD	Green	State of the transmit signal line.	
RxD	Green	State of the receive signal line.	

6.23 CTMT6021 Diagnostic LEDs



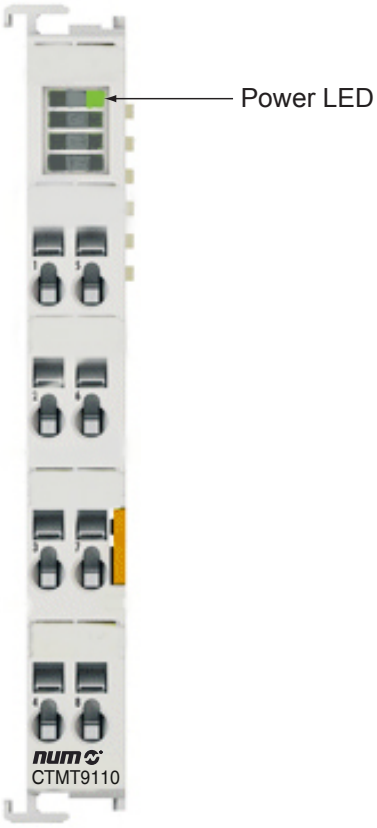
LED	Color	Meaning	
RUN	Green	This LED indicates the terminal's operating state:	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.
TxD	Green	State of the transmit signal line.	
RxD	Green	State of the receive signal line.	

6.24 CTMT9100 Diagnostic LEDs



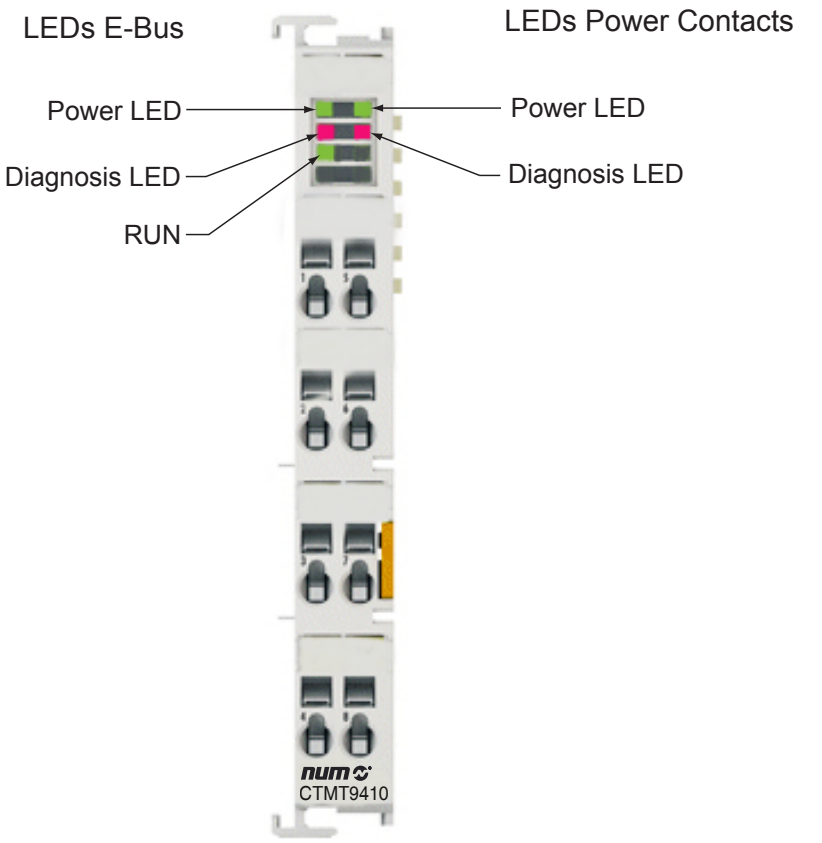
LED	Color	Meaning	
Power LED	Green	OFF	No input voltage at supply input
		ON	24VDC at supply input

6.25 CTMT9110 Diagnostic LEDs



LED	Color	Meaning	
Power LED	Green	OFF	No input voltage at supply input
		ON	24VDC at supply input

6.26 CTMT9410 Diagnostic LEDs



LED	Color	Meaning	
Power LED (E-Bus)	Green	OFF	No input voltage at supply input for the E-Bus
		ON	24VDC at supply input for the E-Bus
Power LED (Power Contacts)	Green	OFF	No input voltage at supply input
		ON	24VDC at supply input
Diagnosis LED Us	Red	OFF	No error
		ON	Undervoltage: Us less than 17V
Diagnosis LED Up	Red	OFF	No error
		ON	Undervoltage: Up less than 17V
RUN	Green	This LED indicates the terminal's operating state:	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal.
		Flashing (2Hz)	State of the EtherCAT State Machine: **PREOP** = Setting for mailbox communication and variant standard settings.
		Flashing (1Hz)	State of the EtherCAT State Machine: **SAFEOP** = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.
		ON	State of the EtherCAT State Machine: **OP** = Normal operation mode, mailbox- and process data communication possible.
		Flashing (10Hz)	State of the EtherCAT State Machine: **BOOTSTRAP** = Function for e.g. firmware updates of the terminal.

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Summary

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7 Maintenance and Service life

7.1 Maintenance

The NUMSafe terminals are maintenance-free!

 WARNING	**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.

7.1.1 Cleaning

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

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

 WARNING	**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!

7.2 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.

7.2.1 Shutting down

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

7.2.2 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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