NUM EtherCAT terminals CTMG and CTMT Operating manual

M00032EN-02

Edition 3.2022

www.num.com

CNC HighEnd Applications

Summary

Page deliberately empty

Page deliberately empty

Summary

Page deliberately empty

1 Foreword

1.1 Notes on the manual

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

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

1.1.1 Disclaimer

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

In the event that it contains technical or editorial errors, we retain the right to make alterations at any time and without warning.
No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

1.1.2 Trademarks

EtherCAT® is registered trademarks of and licensed by Beckhoff Automation GmbH.

EtherCAT®

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

1.1.3 Patent Pending

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

1.1.4 Copyright

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

1.1.5 Delivery conditions

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

1.2 Safety instructions

1.2.1 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
	**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!
	**Risk of injury!** If you **do not** adhere the safety advise adjoining this symbol, there is danger to life and health of individuals!
	**Hazard to individuals!** If you **do not** adhere the safety advise adjoining this symbol, there is obvious hazard to individuals!
	**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 or pointer** This symbol indicates information that contributes to better understanding.
c UL US	**UL Pointer** This symbol indicates important information about the UL-compliant.

1.3 NUM EtherCAT terminals

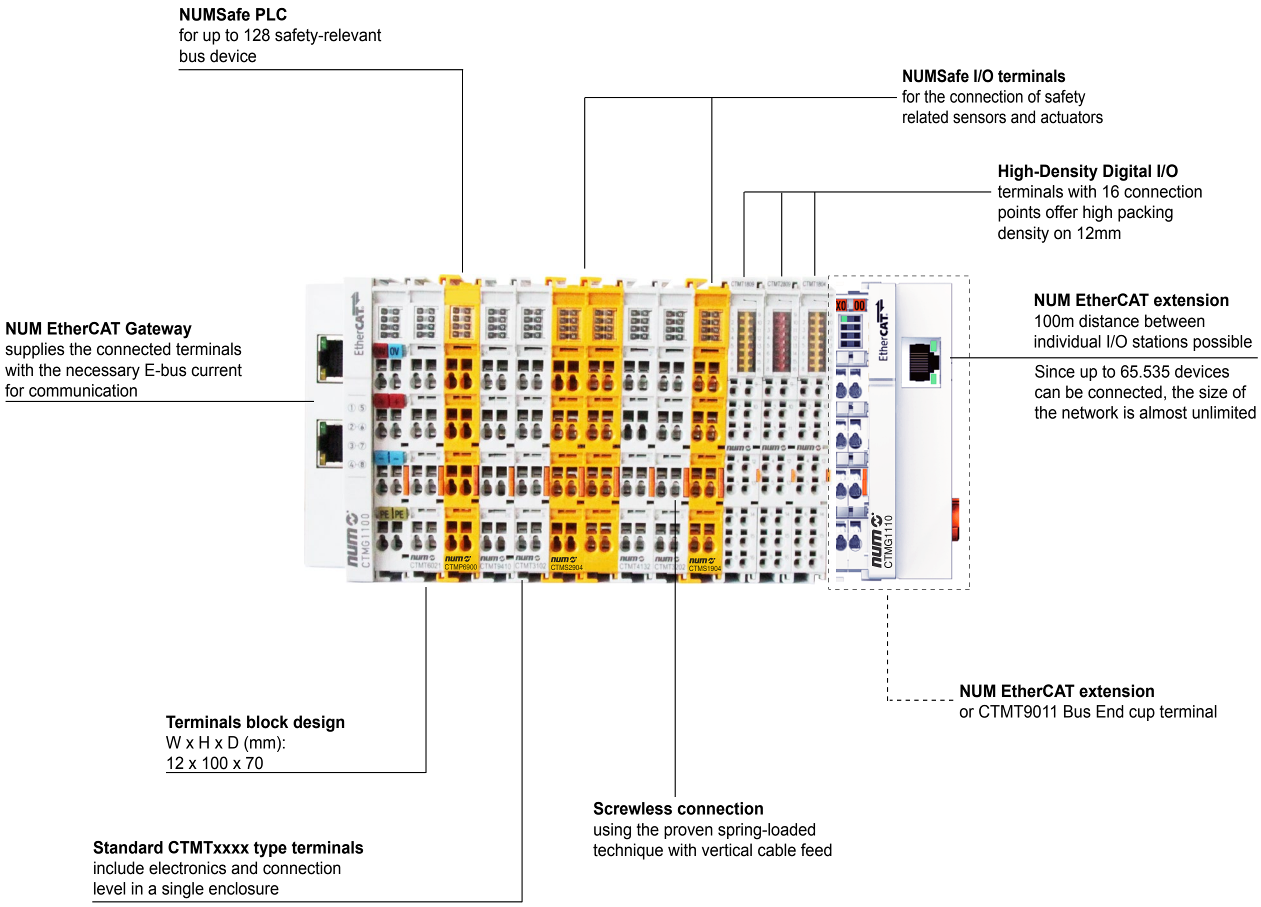
NUM EtherCAT Terminal is a modular system available with different configurable devices:

- 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

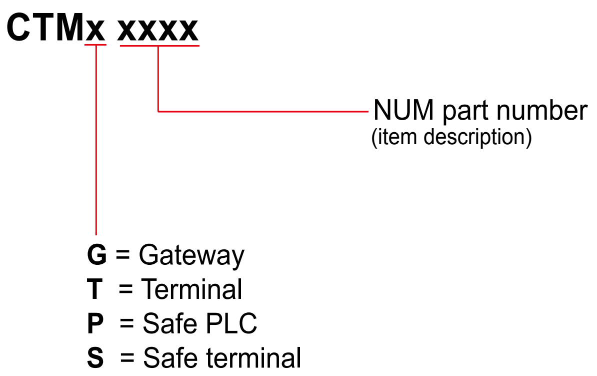
Suitable EtherCAT Terminals are available for all common digital and analog signal types encountered in the world of automation. NUM EtherCAT Terminals enables bit-precise composition of the required I/O channels.

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	- CTMT2024 4 channel digital output terminal 24VDC, 2A. - CTMT2602 2-channel relay output terminals 230VAC. - CTMT2612 2-channel relay output terminals. - CTMT5101 Incremental encoder interface (RS485). - CTMT5151 1-Channel incremental encoder interf. (24V).	3, 5, 6
	03.2022	02	- CTMT1859 8 digital Input and 8 digital Output - CTMT6224 IO-Link Terminal - CTMT6731 Master terminal for PROFIBUS - CTMT1859 Terminal connection - CTMT6224 Terminal connection - CTMT6731 Terminal connection - Terminal configuration update - CTMT1859 Diagnostic LEDs - CTMT6224 Diagnostic LEDs - CTMT6731 Diagnostic LEDs	3.7 3.25 3.26 4.6.8 4.6.25 4.6.26 5 6.7 6.25 6.26

1.7 NUM Agencies

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

Page deliberately empty

Summary

Page deliberately empty

2 EtherCAT Basics communication

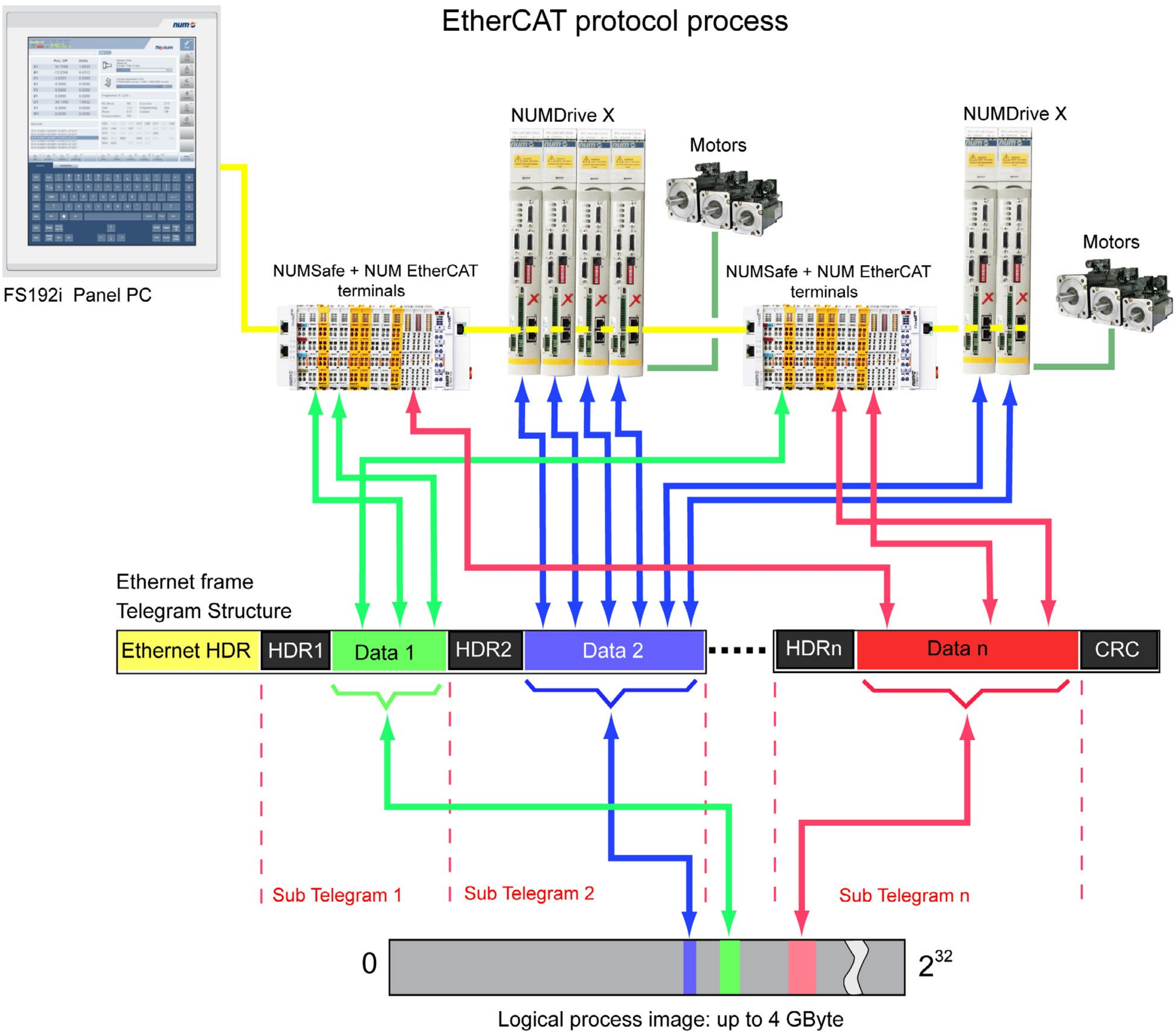
2.1 System Properties

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.

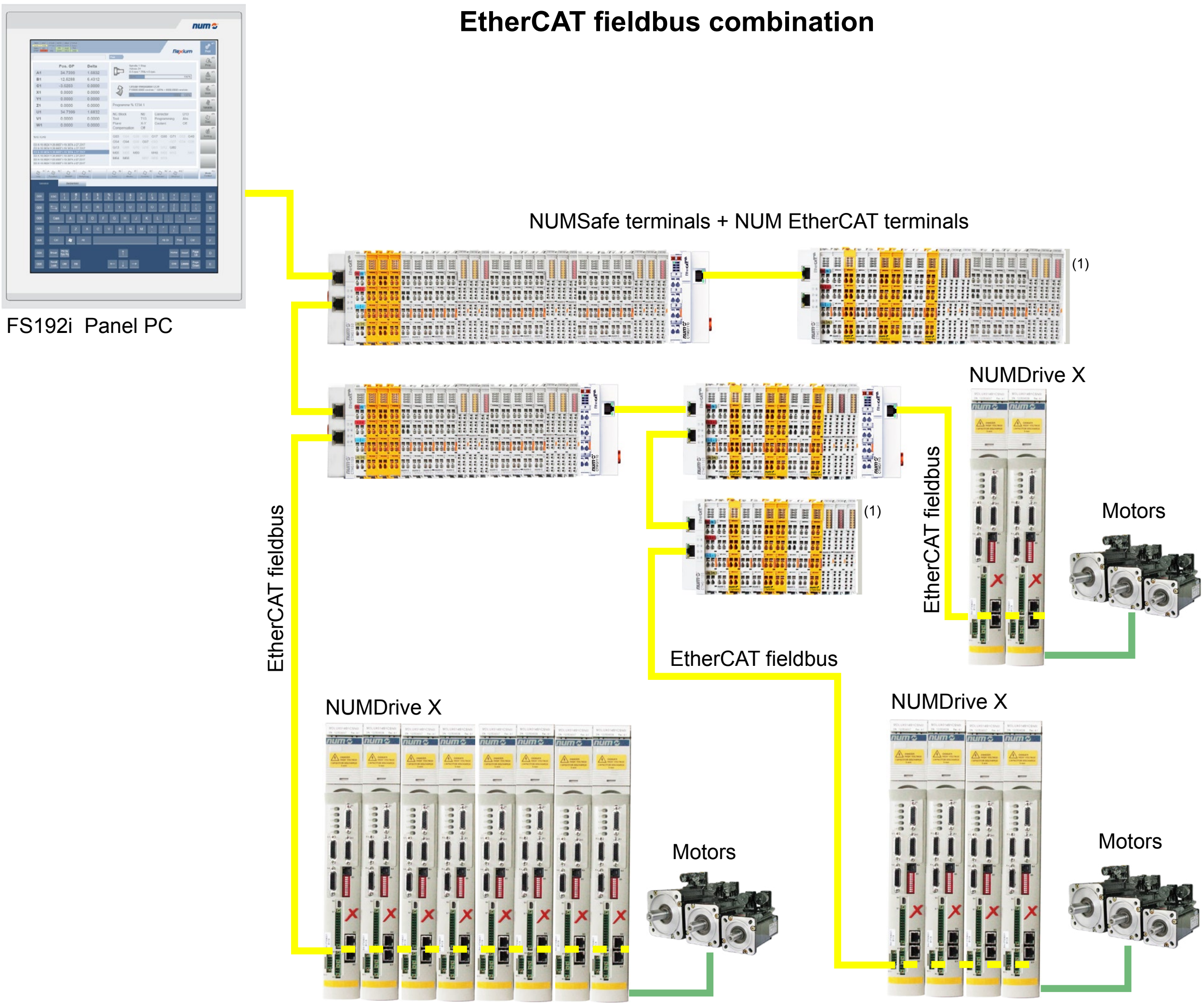


Protocol structure
The process image allocation is freely configurable.
Data are copied directly in the I/O terminal to the desired location within the process image: no additional mapping is required. The available logical address space is with very large (4 GB).

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.



(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!

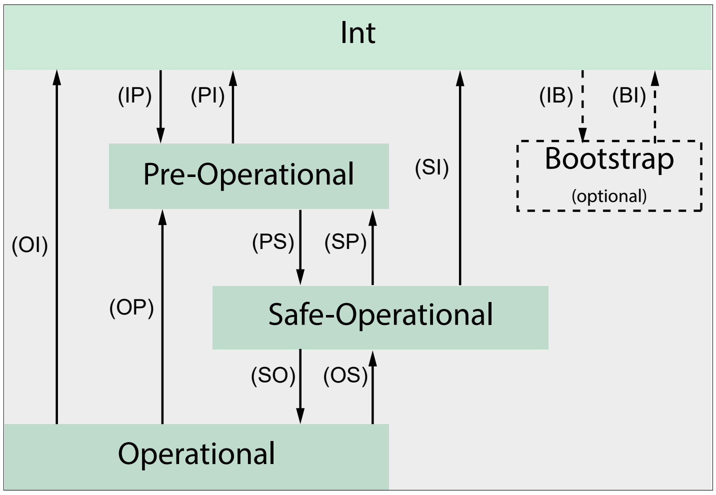
The same ground potential must be used for the E-Bus supply of all EtherCAT terminals in a terminal block!.

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.

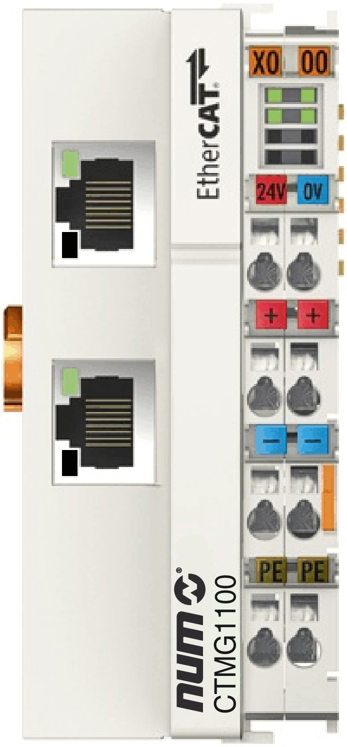
Page deliberately empty

Summary

Page deliberately empty

3 System description

3.1 CTMG1100 - NUM EtherCAT Gateway



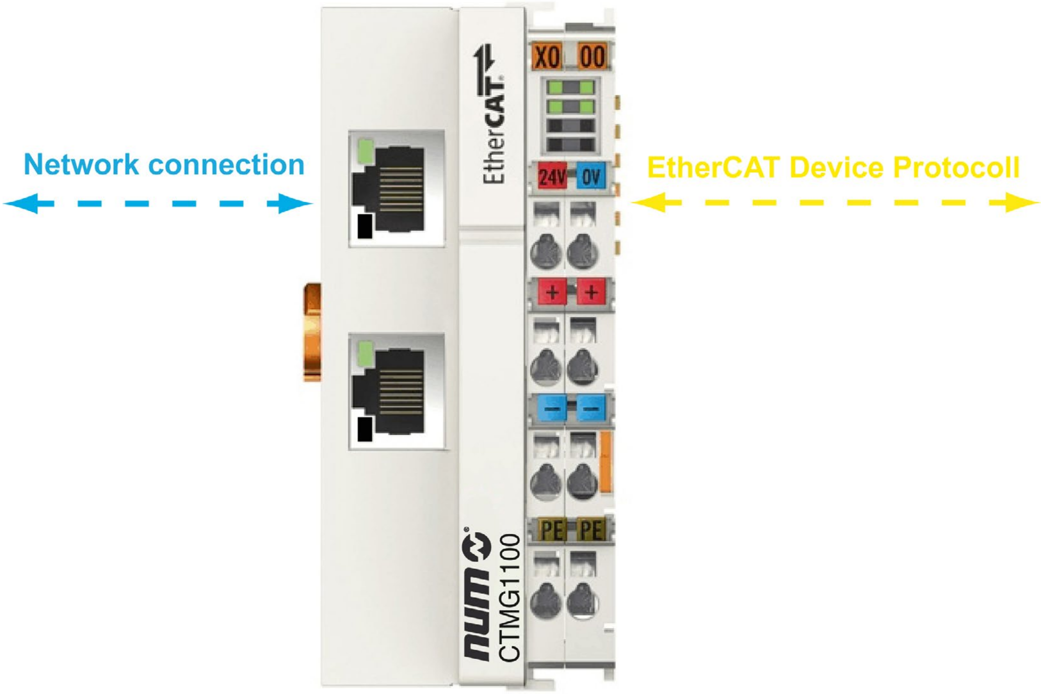
The CTMG1100 Gateway connects EtherCAT with the EtherCAT Terminals (CTMTxxxx).
One station consists of a coupler, any number of EtherCAT Terminals and a bus end terminal, e.g. CTMT9010 or CTMT9011.

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 typee 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	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 + (Σ E-bus current/4)
E-Bus supply current (5V)	Max. 2000mA (-25 °C ... +55 °C)
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

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

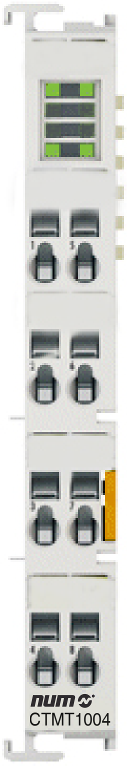
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	**CTMG1110**
Task in the EtherCAT-System	Conversion of the E-bus signals to 100BASE-TX Ether-net for extension of the EtherCAT network
Data transfer medium	Ethernet CAT 5 cable (shielded)
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	Type 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.3 CTMT1004 - 4 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

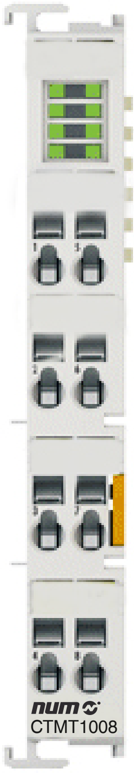
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT1004
Number of inputs	4
Connection technology	2-wires
Nominal voltage of inputs	24VDC (-15% / +20%)
Signal voltage “0”	-3V ... 5V (EN 61131-2, type 1/3)
Signal voltage “1”	11V ... 30V (EN 61131-2, type 1/3)
Input filter	3ms
Input current	Type 3mA (EN 61131-2, type 3)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Type 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.4 CTMT1008 - 8 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	CTMT1008
Number of inputs	8
Nominal voltage of inputs	24VDC (-15% / +20%)
Connection technology	1-wire
Signal voltage “0”	-3V ... 5V (EN 61131-2, type 1/3)
Signal voltage “1”	11V ... 30V (EN 61131-2, type 1/3)
Input filter	3ms
Input current	Type 3mA (EN 61131-2, type 3)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Type 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.5 CTMT1804 - 4 digital input terminal 24VDC, 3ms input filter

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 CTMT1804 EthercAT terminal have a 3ms input filter. 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	CTMT1804
Number of inputs	4
Nominal voltage of inputs	24VDC (-15% / +20%)
Connection technology	3-wires
Signal voltage “0”	-3V ... 5V (EN 61131-2, type 1/3)
Signal voltage “1”	11V ... 30V (EN 61131-2, type 1/3)
Input filter	3ms
Input current	Type 3mA (EN 61131-2, type 3)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Type. 90mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	4 input bits
Configuration	No address or configuration settings required
Conductor typees	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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.6 CTMT1809 - 16 digital input HD terminal 24VDC, 3ms input filter

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	CTMT1809
Number of inputs	16
Nominal voltage of inputs	24VDC (-15% / +20%)
Connection technology	1-wire
Signal voltage “0”	-3V ... 5V (EN 61131-2, type 1/3)
Signal voltage “1”	11V ... 30V (EN 61131-2, type 1/3)
Input filter	3ms
Input current	Type. 3mA (EN 61131-2, type 3)
Supply voltage for internal E-bus circuit	Via power contacts
Current consump. via E-bus	Type. 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 typees	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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.7 CTMT1859 - 8 digital input and 8 digital output HD terminal 24 VDC

The CTMT1859 combines eight digital inputs and eight digital outputs on a single device. The inputs have a 3.0 ms filter. The outputs handle load currents of up to 0.5 A, are short-circuit proof and protected against inverse polarity. The signal state of the channels is indicated by LEDs.

The reference ground for all inputs is the 0 V power contact, the outputs are supplied via the 24 V power contact. The conductors can be connected without tools in the case of single-wire conductors 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

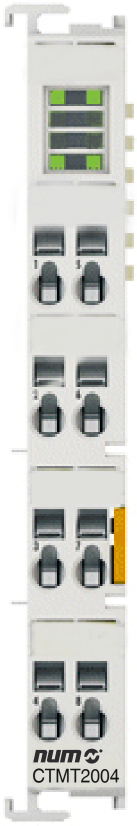
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT1859
Connection technology	1-wire
Number of inputs	8
Number of outputs	8
Nominal voltage of inputs	24 V_{DC} (-15% / +20%)
Load typee	ohmic, inductive, lamp load
Signal voltage “0”	-3 V ... 5 V (EN 61131-2, type 1/3)
Signal voltage “1”	11 V ... 30 V (EN 61131-2, type 1/3)
Input filter	3 ms
Input current	Type 3 mA (EN 61131-2, type 3)
Output current	max. 0.5 A per channel
Reverse voltage protection	yes
Breaking energy	< 150 mJ/channel
Switching times	T_{ON}: 60 µs, T_{OFF}: 300 µs type.
Supply voltage for electronic	via the power contacts
Current consumption power contacts	type. 15 mA + load
Current consumption via E-bus	type. 130 mA
Electrical isolation	500 V (E-bus/field voltage)
Bit width in the process image	8 input bits and 8 output bits
Configuration	No address or configuration settings required
Conductor typees	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…1.5 mm²; stranded wire: 0.25...1.5 mm²; ferrule: 0.14…0.75 mm²
Weight	approx. 65 g
Permissible ambient temperature range during operation	0°C ... + 55°C
Permissible ambient temperature range during storage	-25°C ... + 85°C
Permissible relative humidity	95%, no condensation
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (connected width: 12 mm)
Mounting	on 35 mm mounting rail according to EN 60715
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27,
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP20
Installation position	variable
Approval	CE, UL and cUL Listed

3.8 CTMT2004 - 4 digital output terminal 24VDC, 0.5A



The CTMT2004 channel digital output terminal connects the binary control signals of the automation device in an electrically isolated manner to the actuators of the process level. They are protected against reverse polarity at the power contacts.

The EtherCAT terminals indicate their state via a LED.

Connections and Diagnostics LEDs

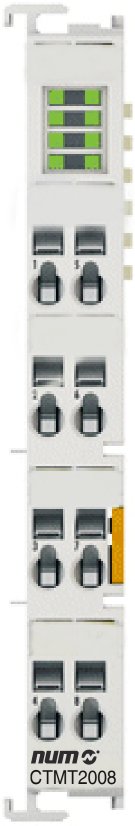
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT2004
Number of outputs	4
Connection technology	2-wires
Load typee	Ohmic, inductive, lamp load
Nominal output voltage	24VDC (-15% / +20%)
Switching times	T_{on}: 60µs type.; T_{off}: 300µs type.
Output current max. (p. channel)	Max. 0.5 A (short-circuit-proof)
Switch-off energy (ind.)	Max. 150mJ/channel
Current consumption from load voltage	Type. 15mA
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Type. 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.9 CTMT2008 - 8 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	CTMT2008
Number of outputs	8
Connection technology	1-wire
Load typee	Ohmic, inductive, lamp load
Nominal output voltage	24VDC (-15% / +20%)
Switching times	T_{ON}: 60µs type.; T_{OFF}: 300µs type.
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	Type. 15 mA
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Type. 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
Storage temperature	-25°C ... + 85°C
Relative humidity	95%, no condensation
Mounting	On 35mm mounting rail (conforms to EN 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.10 CTMT2024 - 4 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.

Connections and Diagnostics LEDs


Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT2024
Number of outputs	4
Reverse voltage protection	Yes
Load typee	Ohmic, inductive, lamp load
Nominal output voltage	24VDC (-15% / +20%)
Switching times	Ton: 40µs type.; Toff: 200µs type.
Output current max. (p. channel)	max. 2A (short-circuit-proof)
Switch-off energy (ind.)	< 1.7 J/channel
Current consumption from load voltage	Type. 13mA + load
Supply voltage for internal E-bus circuit	via E-bus
Current consump. via E-bus	Type. 120mA
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. 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.11 CTMT2602 - 2 relay output terminal 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.

Connections and Diagnostics LEDs

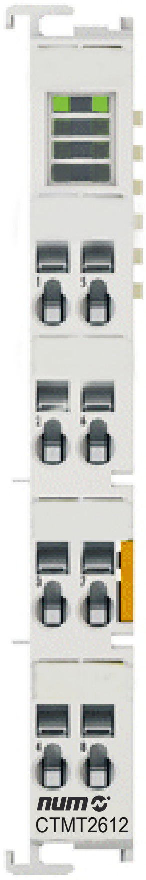
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

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 x 10^7
Operating cycles electr. (min.)	1 x 10^5 (5A / 30VDC)
Power supply	via the E-Bus
Current consump. via E-bus	Type 170mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	2 output bits
Configuration	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.12 CTMT2612 - 2 relay output terminal 125VAC / 30VDC



The CTMT2612 output terminals have two relays each of which has a change over contact which are suitable for use at up to 125VAC / 30 VDC.
The EtherCAT Terminals indicate their signal state by means of light emitting diodes.
The CTMT2612 has potential-free contacts. The power contacts are not looped through.

Connections and Diagnostics LEDs

Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT2612
Number of outputs	2 x change-over
Rated load voltage	$125V_{AC}$ / $30V_{DC}$
Ohmic switch current	0.5 A_{AC} / 2 A_{DC}
Minimum permitted load	10µA at $10mV_{DC}$
Lamp test, electronic ballasts	-
Operating cycles mech. (min.)	1 x 10^8
Operating cycles electr. (min.)	2 x 10^5 (1A /$30V_{DC}$)
Power supply	via the E-Bus
Current consump. via E-bus	Type 150mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	2 output bits
Configuration	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.13 CTMT2809 - 16 digital output HD terminal 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

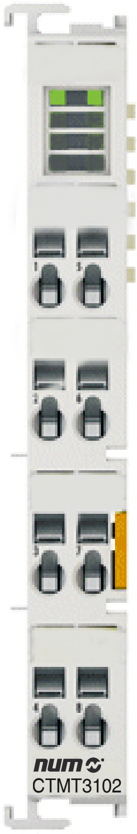
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT2809
Number of outputs	16
Connection technology	1-wire
Rated load voltage	24VDC (-15% / +20%)
Load typee	Ohmic, inductive, lamp load
Max. output current	0.5A (short-circuit-proof) per channel
Breaking energy	< 150 mJ/channel
Switching times	Type T_{ON}: 60 µs, type. T_{OFF}: 300µs
Supply voltage for internal E-bus circuit	Via power contacts
Current consumption via E-bus	Type 140mA
Curr. consumption power contacts	Type 35 mA + load
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	16 output bits
Configuration	No address or configuration settings required
Conductor typees	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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.14 CTMT3102 - 2 channel analog input terminal -10V to +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.

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

Connections and Diagnostics LEDs

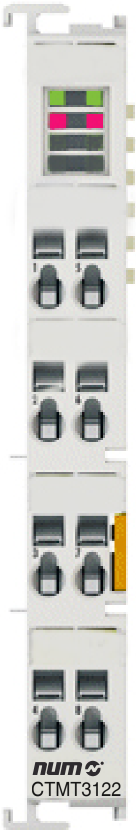
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	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}	max. 35 V (referring to internal GND)
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 % (at 0 °C ... +55 °C, relative to the full scale value)
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Type 170mA
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	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.15 CTMT3122 - 2 channel analog input terminal 4…20mA, diff. 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	CTMT3122
Number of analog inputs	2 (differential)
Signal current	4…20mA
Distributed Clocks	Yes
Distributed Clocks precision	<< 1µs
Internal resistance	85Ω type. + diode voltage
Limit frequency input filter	5kHz
Common-mode voltage U_{CM}	max. 10 V
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 % (at 0 °C ... +55 °C, relative to the full scale value)
Supply voltage for internal E-bus circuit	Via E-bus
Current consump. via E-bus	Type 170mA
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	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

Configuration of 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 CTMT3122.
- 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 GND_{int} potential in common.
- For 2-channel terminals the common GND_{int} potential (A) is connected to a terminal point and not with GND_{PC} (power contact).
- 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 (typeically ±10 or ±35V).

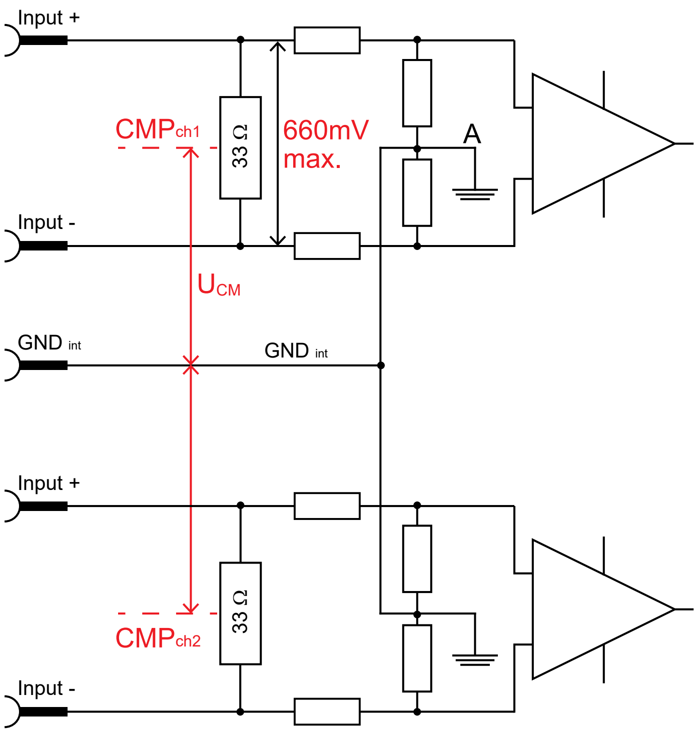


Fig.1 Internal connection diagram for a CTMT3122 terminal

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

Note

U_{CM} for 4..20mA inputs

If U_{CM} of an analog input channel is exceeded, internal equalizing currents result in erroneous measurements.
For 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 atypeical sensor configuration.

Example 1

The CTMT3122 is connected to 2 sensors, which are supplied with 5 and 24V.
Both current measurements are executed as low-side measurements.

This connection typee 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 CTMT3122) is therefore adhered to (Fig.2).

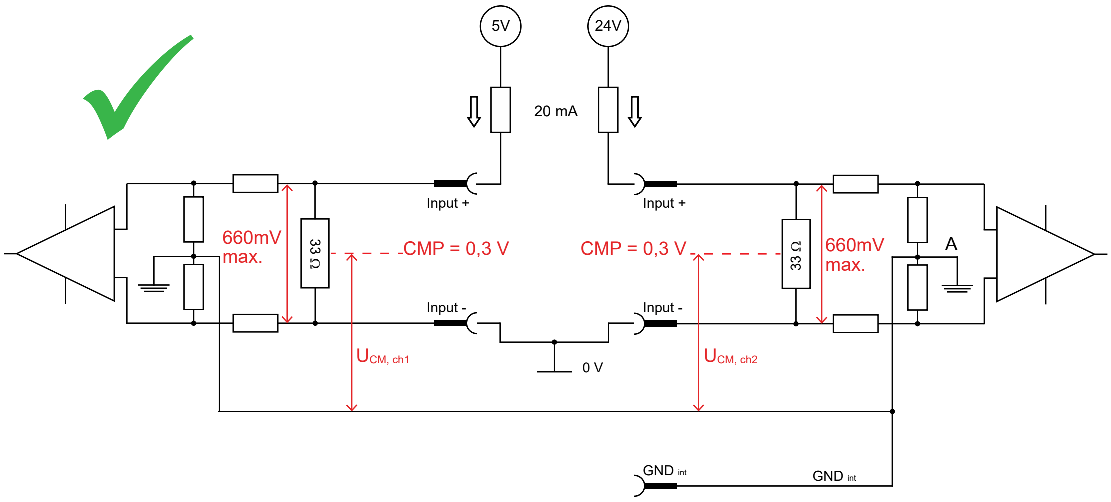


Fig.2 Example 1, low-side measurement

If the CTMT3122 terminals have no external GND_{int} connection, the GND_{int} potential can adjust itself as required (referred to as “floating”).
Please note that for this mode reduced measuring accuracy is to be expected.

Example 1a

Accordingly, this also applies if the floating point GND_{int} is connected to another potential (Fig.3).

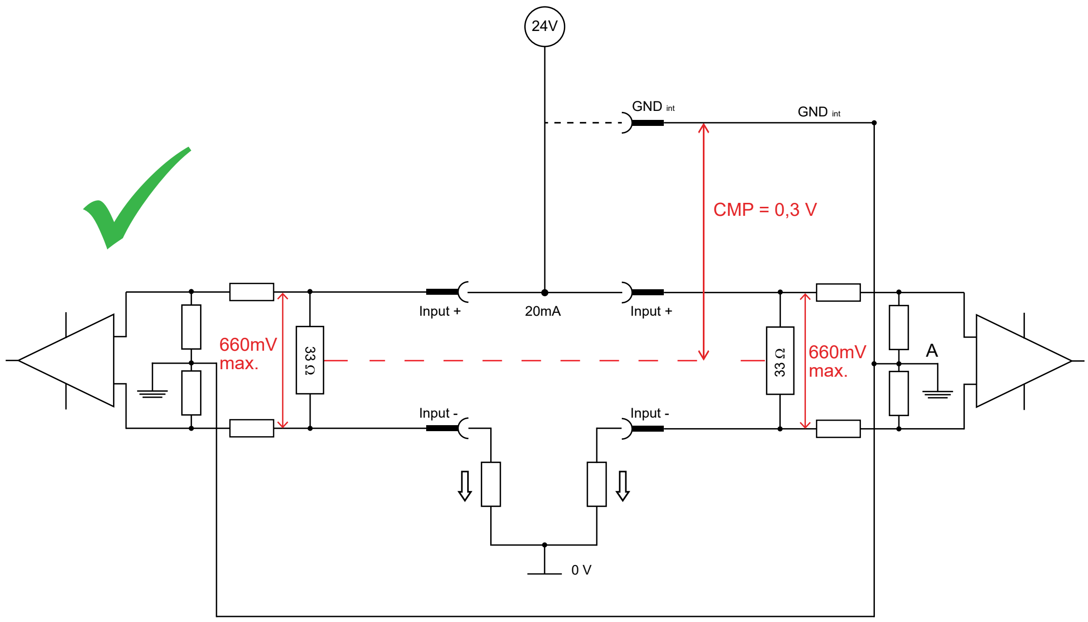


Fig.3 Example 1a, high-side measurement

Example 2
The same CTMT3122 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 (Fig.4).

This results in significant potential differences UCM > 10V (applicable to CTMT3122) between the two channels, which is not permitted.

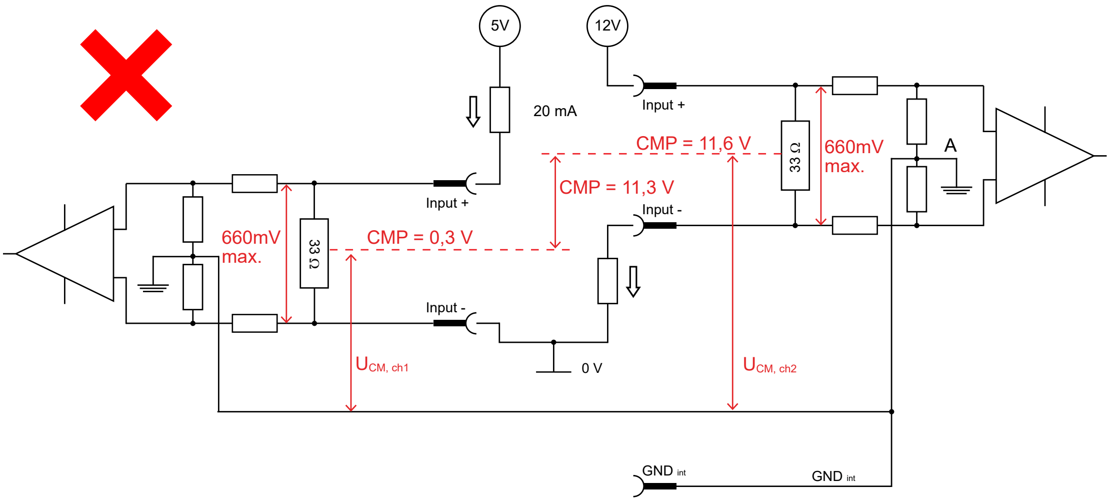


Fig.4 Example 2, high-side / low-side measurement

To rectify this, GND_{int} can in this case be connected externally with an auxiliary potential of 6V relative to “0 V”. The resulting A/GND_{int} 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 CTMT3122.
  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:
  - CTMT3122: GND_{int} is connected to terminal point for external connection.
    GND_{int} should be connected externally such that condition 2 is met.

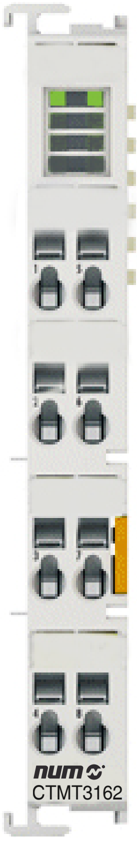
  If the sensor cable is shielded, the shield should not be connected with the GND_{int} terminal point but with a dedicated low-impedance shield point.

- If terminal points of several CTMT3122 terminals are connected with each other, ensure that condition 2 is met.

Note

Connection of GND_{int}
In the CTMT3122 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}.

3.16 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

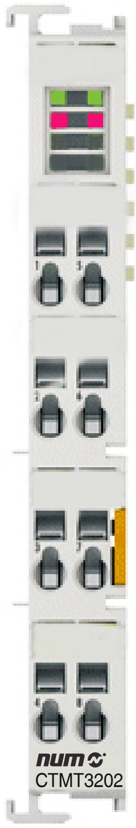
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	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	Type 170mA
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	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.17 CTMT3202 - 2 channel input terminal Pt100 (RTD)



The CTMT3202 analog input terminals allow resistance sensors to be connected directly and can operate 2-wire and 3-wire sensors. Several characteristic sensor curves (PT100, PT1000, NI120, NI1000, KTY typees 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	CTMT3202
Number of inputs	2
Sensor typees	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000, KT/KTY Resistance measurement 10Ω…1 kΩ or 10Ω 4kΩ (e.g. potentiometer)
Connection method	2-wire 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 (depending on the sensor element and temperature)	Type. < 0.5mA
Sensor supply	Continuous current (not switched)
Measuring error	< ±0.5°C for Pt sensors at ambient temperature 0°C ... +55°C
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	Type 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

General

The CTMT3202 analog input terminals allow resistance sensors in the range 0 - 4096 Ohm to be connected directly.

Functions:

- Resistance measurement
  - Measuring range 0 to 1024 Ω: Resolution 1/64 Ohm
  - Measuring range 0 to 4096 Ω: Resolution 1/16 Ohm
  - The use of the terminal in the range from 0 to 10 Ohm is not recommended due to the relatively low measuring accuracy.
  - With the CTMT3202 the external bridge must be inserted between +R and +RL in 3-wire mode

- Temperature measurement
  The measured sensor resistance is converted directly into a temperature by the internal µC via the desired linearization characteristic curve
  - Standard resolution 1/10 °C (1 digit = 0.1 °C) according to a theoretically representable temperature range [- 3276.7 to 3276.8 °C]
  - The physically specified temperature range for the respective sensor is to be observed!
  - Various PTC sensor characteristic curves are implemented over their complete measuring range for selection in the CTMT3202 terminal: Pt/Ni xxxx, KTY xx
  - Scaling and presentation can be changed

Additional notes:
- The resistance is determined by means of ratiometric voltage measurement, see below.
- The error state 'broken wire' is detected as overrange, signaled as an error to the controller and indicated by the ERROR LED.
- The error state 'short-circuit' is detected as underrange if the resistance is smaller than the smallest resistance of the measuring range, signaled as an error to the controller and indicated by the ERROR LED.
- Characteristic curves for KT/KTY sensors are implemented and selectable via the CoE directory, see index 16#80n0:19.
- In the delivery state, the measured value is displayed in increments of 1/10° C in two's complement format (integer).
- Other methods of display, e.g. high resolution with 1/100 °C can be selected via CoE 16#80n0:02. When using the high resolution a temperature range of -320 to +320 °C (-32566 to 32567) is measurable by the 2-byte PDO.

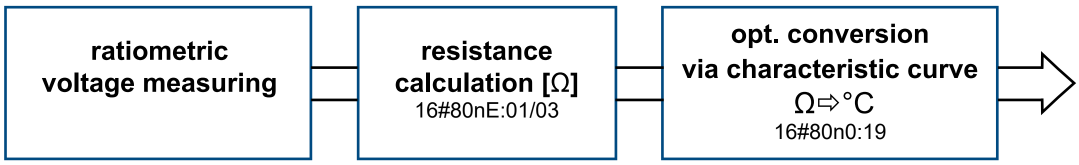


Fig.5 Display of the measurement and calculation of the resistance/temperature

Ratiometric voltage measurement

The CTMT3202 measures resistance ratiometrically by means of voltage comparison, see Fig.19 3-wire connection technique:

- A constant voltage of 2.5 V is applied through a stable known reference resistor Rref and the sensor Rt. Rref is 5 kOhm for CTMT3202
- By comparing the two voltages, U1 at Rref and U2 at Rt, the sensor resistance Rt can be determined.
- The measuring current through the sensor is thus dependent on the sensor resistance Rt, this must be taken into account in questions about sensor self-heating:
- Example: a Pt1000 causes a measuring current of 0.42 mA at 0°C and thus Rt = 1000 Ohm internal resistance at an CTMT3202 with 2.5V supply and Rref = 5 kΩ. The thermal power of 1kΩ * (0.42 mA)² = 0.17 mW is generated at the resistor.

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 CTMT3202 and can be selected via the object 16#80n0:19

Type	Resistance range	Implemented temperature range
Pt100 (0.00385 Ω/Ω/°C, IEC60751 characteristic curve Pt385)	~ 18 ... ~390 Ohm	-200 °C to 850 °C (for highprecision terminals
Ni100		-60°C to 250°C
Pt1000 (0.00385 Ω/Ω/°C,IEC60751 characteristic curve Pt385)	~180 ... ~3900 Ohm	-200°C to 850°C
Pt500		-200°C to 850°C
Pt200		-200°C to 1370°C
Ni1000		-60°C to 250°C
Ni1000 TK5000 100°C: 1500 ohm		-30 to 160°C
Ni120		-60°C to 320°C
KT100/110/130/210/230 KTY10/11/13/16/19	~500 ... ~2200 Ohm	-55 ...150°C
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		
KTY83-110,120,150	~500 ... ~2500 Ohm	-50...175°C
KTY83-121		
KTY83-122		
KTY83-151		
KTY83-152		
KTY84-130,150	~350 ... ~2500 Ohm	-40...300°C
KTY84-151		
KTY21/23-6	~500 ... ~4000 Ohm	-50...150°C
KTY1x-5		
KTY1x-7		
KTY21/23-5		
KTY21/23-7		

3.17.1 Basic principles of RTD technology

Certain materials change their electrical resistance if the temperature of the material changes. Thanks to this property they can be used as sensors for the measurement of temperature.
Such an RTD element (Resistance Temperature Detector) or thermistor then exhibits a well-known material-dependent property, i.e. how the resistance reproducible changes in relation to the temperature.
In an initial approximation this characteristic can be taken to be a linear equation:

$$\Delta R = k\Delta T$$

The factor k can be positive or negative and must be specified by the sensor manufacturer:
- positive coefficient (PTC): electrical resistance increases with increasing temperature, i.e. it conducts less well; the sensor is then referred to as a PTC thermistor,
- negative coefficient (NTC): electrical resistance increases with decreasing temperature, i.e. it conducts better; the sensor is then referred to as an NTC thermistor.

The larger the coefficient, the higher the sensitivity of the sensor.

Note

Temperature measurement
This kind of temperature measurement is to be distinguished from that with using thermocouple sensors: the latter generate a (small) voltage across the conductor by themselves, which is measured at the contact points.

Within a very small measuring range nearly all materials can be described by such a linear characteristic. However, it is often necessary to measure over a large measuring range, e.g. several tens or hundreds of Kelvin. Within such ranges the characteristic must be described for many materials by non-linear equations of a higher order or by using exponential functions. Examples of such equations are:

- Platinum/PT sensors (PTC thermistor) according to IEC 60751:
  - for the range -200.. 0 °C:

    $$R(T) = R_0\,(1+AT+BT^2+C(T-100°C)T^3)$$

  - for the range 0 °C..850 °C:

    $$R(T) = R_0\,(1+AT+BT^2)$$

The coefficients A, B and C are to be specified by the sensor manufacturer or taken from the standard. The parameter R_0 indicates the resistance in Ω of the platinum sensor at T = 0 °C.

The sensor designations are based on these characteristics, e.g. for PT100 R_0 = 100 Ω at T=0 °C.
• The equation 6th order for Ni sensors according to DIN 43760 (withdrawn), e.g. for α = 6180 ppm/K.
• Steinhart-Hart (for NTC thermistor):

$$\frac{1}{T} = a+b\,ln(R) + c\,ln^3\,(R)$$

The coefficients a, b, c should be specified by the sensor manufacturer, or they can be determined by measuring the resistance at three known temperatures.
- B-parameter equation (for NTC thermistor):

$$R_T = R(T) = A \bullet e^{B/T} = R_{T_0} \bullet e^{B\,(1/T\,-\,1/T_0)}$$

The coefficients R_{T_0} , B, T_0 and A should be specified by the sensor manufacturer, or they can be determined by measuring the resistance at two known temperatures.

The B-parameter equation is a simplified version of the Steinhart-Hart equation. The B-parameter itself is only constant in a small range, e.g. between 25°C.. 50°C or 25°C.. 85°C, which is identified as follows: $B_{25/50}$ or $B_{25/85}$. The accuracy of the equation strongly depends on the B-parameter. The larger the measuring range, the lower the accuracy. If a larger measuring range required, it is preferable to use the Steinhart-Hart
equation.

- In principle, a sensor manufacturer can, of course, also publish the characteristic curve of his sensor as a table of values without formula, as done for example, with KT/KTY sensors.

A typical characteristic is shown for each of the NTC and PTC families in following Fig.6:

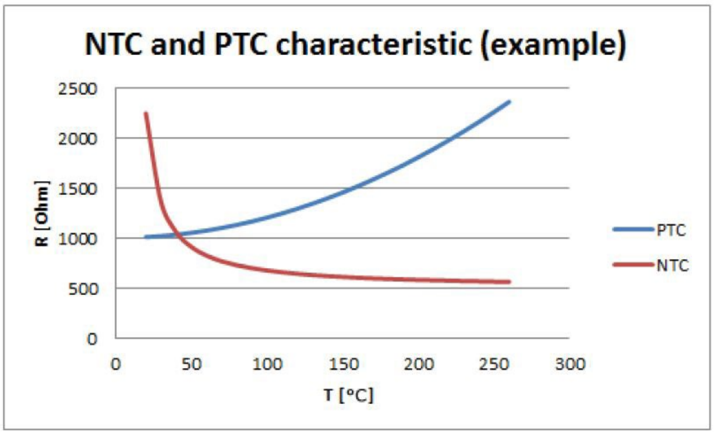


Fig.6 Examples for temperature dependent resistance values

Hence, there is no such thing as a general NTC or PTC sensor – in fact, they are names for sensor families with a certain behavior.
For common sensors/characteristics such as PT100, these characteristics are already permanently implemented into the measuring devices. The user must check whether a sensor that he intends to use is supported by the measuring device. The following criteria apply here as:
- Temperature range: does the sensor support the intended temperature range?
- Measuring range: can the sensor resistance be measured in the intended temperature range?
- Characteristic curve: can the measured resistance be converted accordingly into temperature? (base point, gradient/coefficient)
- Velocity: how often is the resistance measured?

In a quite basic way, a sensor manufacturer can of course also publish the characteristic of its sensor as a value table.

Note

Resistance measurement
To determine the resistance it is usual to let flow a measuring current I in the mA range (I < 5 mA) through the sensor and to measure the resulting voltage.

Three effects must be taken into consideration when doing this:
- the measuring current can lead to self-heating of the sensor. This usually has little effect on the measurement accuracy, but it can play a significant role in high-precision measurements; see the explanations in the following section: “Self-heating of sensors”.

Special sensors tend to be used for cryogenic applications.
- the sensor supply lines also always have a resistance and add a (usually) constant additional resistance to the measurement. This can be compensated by
  - 3-wire or 4-wire connection of the sensor,
  - manually accounting for the known wire resistance in the calculation or
  - using a sensor with a higher nominal resistance – the supply line effects are then of less consequence.

- Insulation faults or thermo voltages can affect the measurement.

For classification there follows an overview of the NTC/PTC properties of various sensors:

NTC and PTC properties

NTC	PTC
many semiconductors	many metals
various ceramics	various ceramics
NTC20, NTC100, etc.	Pt100, Pt1000, ..
	KTY ..
	Ni100, Ni1000, ..
	FeT

Note

Sensor exchange
Please note that 1:1 exchangeability is not always guaranteed, especially in the case of manufacturer-specified sensors. If necessary the new sensor must be recalibrated in the system.

Self-heating of RTD sensors

The measuring current through the resistive sensor inevitably and intentionally leads to a voltage drop across it. Thus, power is dissipated by the sensor, heating it and falsifying the measurement. The dissipation of heat to the environment via the air, the housing, as well as the object to be object to be measured via surface contact (e.g. by means of adhesive layer), can be a complex process. It is advisable to roughly check whether the self-heating reaches a level that is relevant for the required measuring accuracy.
Depending on the sensor, this can be the case with target accuracies of <100 mK.

Some sample values are used below to illustrate the effect; the method is to be transferred to the specific application if necessary.

About the sensor:

- A sensor may have a specified self-heating coefficient of 0.5 mK/µW for example, depending on the surroundings.
- The power dissipation and the self-heating can be calculated via the measuring current and the voltage drop across the resistive element. Caution: this is a nonlinear process!

About the terminal/module:

- The measuring device sends a measuring current through the RTD sensor.
- One possible measurement method, implemented for example in CTMT3202, could be the comparative measurement with a known reference resistance, shown here for the following considerations in the 2-wire connection for simplification:

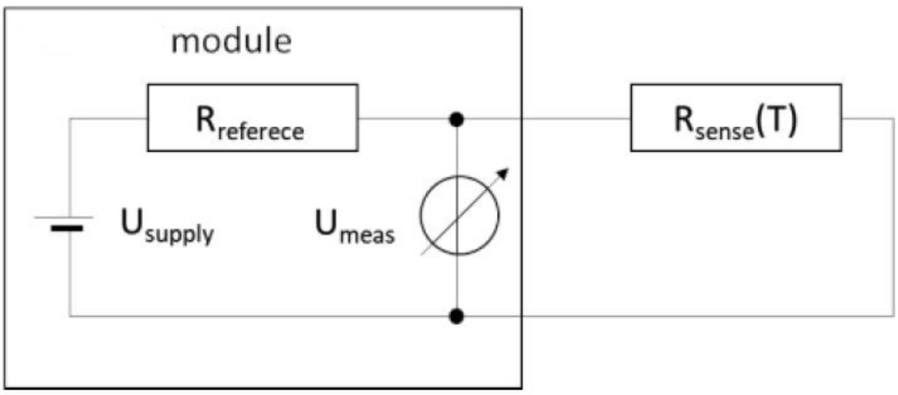


Fig. 7 Comparison measurement with a known reference resistance

- If U_{supply}, $R_{reference}$ and U_{meas} are known, then R_{sense} and thus the temperature T of the module can be calculated in the firmware.

On the basis of the values given in the device documentation, the effect on the R/RTD sensor can be calculated.

An example in numbers is shown below:
- The objective is to find out in which sensor and in which measuring range of the CTMT3202 the least heat develops at a target temperature T.
- A sensor PT100 or PT1000 is used and measured from 0 100°C, the resistance range would thus be in the range 100...138 Ω or 1000...1385 Ω.

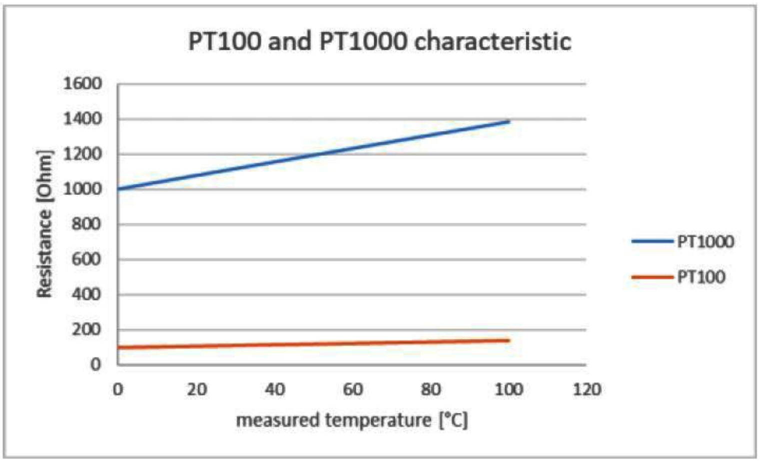


Fig.8 Diagram of resistance values at measured temperature; PT100, PT1000 sensor

- The CTMT3202 has the following properties (these are only guide values, the values given in the CTMT3202 documentation are valid):

  - measuring range 5 Ω, $R_{Reference}$ = 5 kΩ, U_{Supply} = 2.5 V
  - measuring range 2 Ω, $R_{Reference}$ = 5 kΩ, U_{Supply} = 2.5 V
  - measuring range 500 Ω, $R_{Reference}$ = 5 kΩ, U_{Supply} = 4.5 V
  - measuring range 200 Ω, $R_{Reference}$ = 5 kΩ, U_{Supply} = 4.5 V
  - measuring range 50 Ω, $R_{Reference}$ = 5 kΩ, U_{Supply} = 4.5 V

- $R_{reference}$ and R_{sense} are in series, so the measuring current and thus the power at the sensor in relation to R or T in the possible five measuring ranges of the CTMT3202 are simple to calculate:

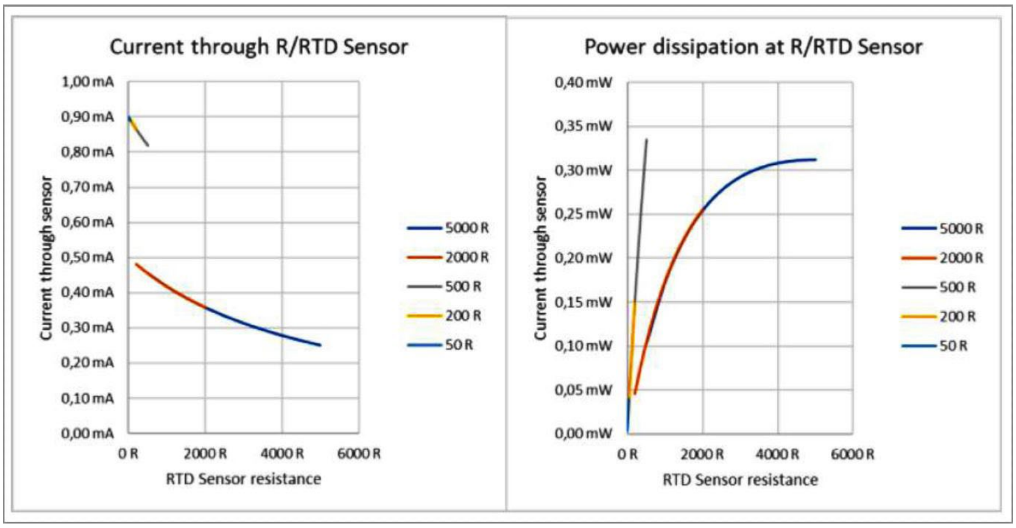


Fig.9 Diagram of measuring current or power dissipation for the different measuring ranges

- Hence, at T = 0 °C and thus R_{PT100} = 100 Ω or R_{PT1000} = 1000 Ω, the PT100 with 0.08 mW generates only half as much heat as the PT1000 with 0.17 mW.
- Nevertheless, the above sensor would heat itself by 0.17 mW * 0.5 mK/µW = 85 mK

If self-heating becomes relevant to the process under consideration, consider:
- whether the sensor can be changed,
- whether the thermal connection of the sensor can be improved,
- whether a continuous measurement is necessary or whether the measuring current of the module can be temporarily switched off from the controller, e.g. 1 second measuring, 10 seconds cooling and if the effect is numerically tangible and can thus be subsequently calculated in the controller from the temperature value.

However, this consideration focuses solely on the issue of self-heating.
To establish whether the sensor and the measuring range are suitable overall, they must also be checked with respect to other aspects such as noise, measurement uncertainty in the measuring range and the sensitivity of the sensor $\Delta T/\Delta T_{ambient}$.

3.17.2 Overview implemented RTD transformations

The following are the characteristic curves partially implemented there depending on the device. The table values given are the basis for the evaluation in the device.

- Pt, Ni, KTY: the table values are stored in the device accordingly; intermediate values are interpolated. For KL terminals the temperature is calculated deviating from this via an approximation polynomial.
- NTC: the table values were used for determination of the Steinhart-Hart coefficients and by these coefficients the terminal determines the temperature.

Pt-RTD

Values in Ω	Pt100	Pt1000	Pt500	Pt200
[°C] (ITS-90)	**-200…+850°C**	**-200…+850°C**	**-200…+850°C**	**-200…+850°C**
-200	18.520	185.200	92.600	37.040
-190	22.825	228.250	114.125	45.650
-180	27.096	270.960	135.480	54.192
-170	31.335	313.350	156.675	62.670
-160	35.543	355.430	177.715	71.086
-150	39.723	397.230	198.615	79.446
-140	43.876	438.760	219.380	87.752
-130	48.005	480.050	240.025	96.010
-120	52.110	521.100	260.550	104.220
-110	56.193	561.930	280.965	112.386
-100	60.256	602.560	301.280	120.512
-90	64.300	643.000	321.500	128.600
-80	68.325	683.250	341.625	136.650
-70	72.335	723.350	361.675	144.670
-60	76.328	763.280	381.640	152.656
-50	80.306	803.060	401.530	160.612
-40	84.271	842.710	421.355	168.542
-30	88.222	882.220	441.110	176.444
-20	92.160	921.600	460.800	184.320
-10	96.086	960.860	480.430	192.172
0	100.000	1,000.000	500.000	200.000
10	103.903	1,039.030	519.515	207.806
20	107.794	1,077.940	538.970	215.588
30	111.673	1,116.730	558.365	223.346
40	115.541	1,155.410	577.705	231.082
50	119.397	1,193.970	596.985	238.794
60	123.242	1,232.420	616.210	246.484
70	127.075	1,270.750	635.375	254.150
80	130.897	1,308.970	654.485	261.794
90	134.707	1,347.070	673.535	269.414
100	138.506	1,385.060	692.530	277.012
110	142.293	1,422.930	711.465	284.586
120	146.068	1,460.680	730.340	292.136
130	149.832	1,498.320	749.160	299.664
140	153.584	1,535.840	767.920	307.168
150	157.325	1,573.250	786.625	314.650
160	161.054	1,610.540	805.270	322.108
170	164.772	1,647.720	823.860	329.544
180	168.478	1,684.780	842.390	336.956
190	172.173	1,721.730	860.865	344.346
200	175.856	1,758.560	879.280	351.712
210	179.528	1,795.280	897.640	359.056
220	183.188	1,831.880	915.940	366.376
230	186.836	1,868.360	934.180	373.672
240	190.473	1,904.730	952.365	380.946
250	194.098	1,940.980	970.490	388.196
260	197.712	1,977.120	988.560	395.424
270	201.314	2,013.140	1,006.570	402.628
280	204.905	2,049.050	1,024.525	409.810
290	208.484	2,084.840	1,042.420	416.968
300	212.052	2,120.520	1,060.260	424.104

Values in Ω	Pt100	Pt1000	Pt500	Pt200
[°C] (ITS-90)	-200…+850°C	-200…+850°C	-200…+850°C	-200…+850°C
310	215.608	2,156.080	1,078.040	431.216
320	219.152	2,191.520	1,095.760	438.304
330	222.685	2,226.850	1,113.425	445.370
340	226.206	2,262.060	1,131.030	452.412
350	229.716	2,297.160	1,148.580	459.432
360	233.214	2,332.140	1,166.070	466.428
370	236.701	2,367.010	1,183.505	473.402
380	240.176	2,401.760	1,200.880	480.352
390	243.640	2,436.400	1,218.200	487.280
400	247.092	2,470.920	1,235.460	494.184
410	250.533	2,505.330	1,252.665	501.066
420	253.962	2,539.620	1,269.810	507.924
430	257.379	2,573.790	1,286.895	514.758
440	260.785	2,607.850	1,303.925	521.570
450	264.179	2,641.790	1,320.895	528.358
460	267.562	2,675.620	1,337.810	535.124
470	270.933	2,709.330	1,354.665	541.866
480	274.293	2,742.930	1,371.465	548.586
490	277.641	2,776.410	1,388.205	555.282
500	280.978	2,809.780	1,404.890	561.956
510	284.303	2,843.030	1,421.515	568.606
520	287.616	2,876.160	1,438.080	575.232
530	290.918	2,909.180	1,454.590	581.836
540	294.208	2,942.080	1,471.040	588.416
550	297.487	2,974.870	1,487.435	594.974
560	300.754	3,007.540	1,503.770	601.508
570	304.010	3,040.100	1,520.050	608.020
580	307.254	3,072.540	1,536.270	614.508
590	310.487	3,104.870	1,552.435	620.974
600	313.708	3,137.080	1,568.540	627.416
610	316.918	3,169.180	1,584.590	633.836
620	320.116	3,201.160	1,600.580	640.232
630	323.302	3,233.020	1,616.510	646.604
640	326.477	3,264.770	1,632.385	652.954
650	329.640	3,296.400	1,648.200	659.280
660	332.792	3,327.920	1,663.960	665.584
670	335.932	3,359.320	1,679.660	671.864
680	339.061	3,390.610	1,695.305	678.122
690	342.178	3,421.780	1,710.890	684.356
700	345.284	3,452.840	1,726.420	690.568
710	348.378	3,483.780	1,741.890	696.756
720	351.460	3,514.600	1,757.300	702.920
730	354.531	3,545.310	1,772.655	709.062
740	357.590	3,575.900	1,787.950	715.180
750	360.638	3,606.380	1,803.190	721.276
760	363.674	3,636.740	1,818.370	727.348
770	366.699	3,666.990	1,833.495	733.398
780	369.712	3,697.120	1,848.560	739.424
790	372.714	3,727.140	1,863.570	745.428

Ni-RTD

Values in Ω	Ni100	Ni120	Ni1000	Ni1000 TK5000
α according to DIN43760	**typ. 6180 pmm/K**	**typ. 6720 pmm/K**	**typ. 6180 pmm/K**	**typ. 5000 pmm/K**
[°C] (ITS-90)	**-60..50°C**	**-60..320°C**	**-60..250°C**	**-30..160°C**
-60	69.52	80.943	695.200	
-50	74.255	87.011	742.550	
-40	79.131	93.251	791.310	
-30	84.146	99.667	841.460	871.690
-20	89.296	106.261	892.960	913.480
-10	94.582	113.038	945.820	956.240
0	100	120.000	1,000.000	1,000.000
10	105.552	127.151	1,055.520	1,044.790
20	111.236	134.494	1,112.360	1,090.650
30	117.056	142.033	1,170.560	1,137.620
40	123.011	149.772	1,230.110	1,185.710
50	129.105	157.712	1,291.050	1,234.950
60	135.34	165.859	1,353.400	1,285.450
70	141.721	174.214	1,417.210	1,337.150
80	148.25	182.783	1,482.500	1,390.120
90	154.934	191.567	1,549.340	1,444.390
100	161.779	200.572	1,617.790	1,500.000
110	168.789	209.798	1,687.890	1,556.980
120	175.972	219.251	1,759.720	1,615.370
130	183.335	228.934	1,833.350	1,675.190
140	190.887	238.850	1,908.870	1,736.470
150	198.635	249.002	1,986.350	1,799.270
160	206.589	259.394	2,065.890	1,863.600
170	214.758	270.029	2,147.580	
180	223.153	280.911	2,231.530	
190	231.783	292.042	2,317.830	
200	240.66	303.427	2,406.600	
210	249.795	315.069	2,497.950	
220	259.2	326.971	2,592.000	
230	268.887	339.136	2,688.870	
240	278.868	351.569	2,788.680	
250	289.156	364.271	2,891.560	
260		377.247		
270		390.501		
280		404.035		
290		417.853		
300		431.958		
310		446.354		
320		461.044		

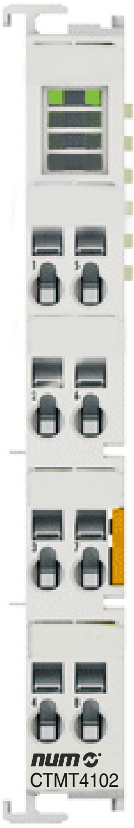
KT/KTY-RTD

Values in Ω	KT100..	KTY81/82-110…	KTY81-121	KTY81-122	KTY81-151	KTY81-152
[°C] (ITS-90)	**-50..150°C**	**-50..150°C**	**-50..150°C**	**-50..150°C**	**-50..150°C**	**-50..150°C**
-50	518	515	510	520	502	528
-40	570	567	562	573	553	582
-30	625	624	617	630	608	639
-20	685	684	677	690	667	701
-10	748	747	740	755	729	766
0	815	815	807	823	794	835
10	886	886	877	895	864	908
20	961	961	951	971	937	985
30	1,040	1,040	1,029	1,050	1,014	1,066
40	1,123	1,122	1,111	1,134	1,094	1,150
50	1,209	1,209	1,196	1,221	1,178	1,239
60	1,300	1,299	1,286	1,312	1,266	1,331
70	1,394	1,392	1,378	1,406	1,357	1,427
80	1,492	1,490	1,475	1,505	1,453	1,527
90	1,594	1,591	1,575	1,607	1,551	1,631
100	1,700	1,696	1,679	1,713	1,654	1,738
110	1,810	1,805	1,786	1,823	1,759	1,850
120	1,923	1,915	1,896	1,934	1,867	1,963
130	2,041	2,023	2,003	2,044	1,973	2,074
140	2,128	2,124	2,103	2,146	2,071	2,178
150	2,235	2,211	2,189	2,233	2,156	2,266

NTC-RTD

Values in Ω	NTC1K8	NTC1K8_TK	NTC2K2	NTC3K	NTC5K	NTC10K
	R0=4940	**R0=5200**	**R0=7373**	**R0=9822**	**R0=16325**	**R0=32650**
[°C] (ITS-90)	-40..130°C	-30..150°C	-50..130°C	-30..80°C	-30..150°C	-30..150°C
-50			154,464	205,800	333,914	6,678,300
-40	35,480		77,081	102,690	167,836	335,670
-30	20,659	24,500	40,330	53,730	88,342	176,680
-20	12,443	14,000	22,032	29,346	48,487	96,970
-10	7,730	8,400	12,519	16,674	27,649	55,300
0	4,940	5,200	7,373	9,822	16,325	32,650
10	3,241	3,330	4,487	5,976	9,952	19,900
20	2,177	2,200	2,814	3,750	6,247	12,490
25	1,800	1,800	2,252	3,000	5,000	10,000
30	1,496	1,480	1,814	2,417	4,028	8,060
40	1,049	1,040	1,199	1,598	2,662	5,320
50	750	740	812	1,081	1,801	3,600
60	545	540	561	747	1,244	2,490
70	403	402	396	527	876	1,750
80	303	306	284	378	628	1,260
90	230	240	207		458	920
100	178	187	154		339	680
110	139	149	116		255	510
120	110	118	88		194	390
130	87	95	68		150	300
140	71	77			117	230
150		64			92	180

3.18 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.

The CTMT4102 do not support oversampling, therefore the output rate is equal to the EtherCAT cycle time.

Connections and Diagnostics LEDs

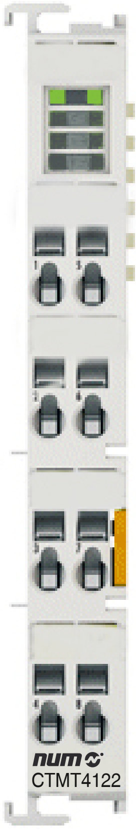
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT4102
Number of outputs	2
Signal voltage	0V to +10V (short-circuit-proof)
Connection technology	2-wires, single-ended
Accuracy	< ± 0.1% (at 0 °C ... +55 °C, relative to the 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	Type 210mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	Outputs: 2 x 16 bit data
Configuration	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.19 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

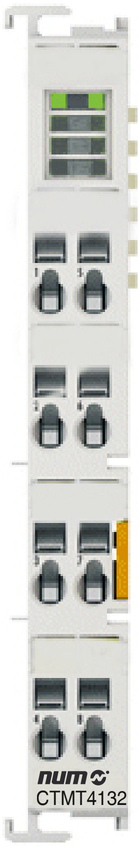
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT4122
Number of outputs	2
Signal current per channel	4 to 20mA (short-circuit-proof)
Accuracy	± 0.1 % 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)	Type 15mA + output current
Supply voltage for internal E-bus circuit	Via E-Bus
Current consumption via E-bus	Type 160mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	Outputs: 2 x 16 bit data
Configuration	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.20 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

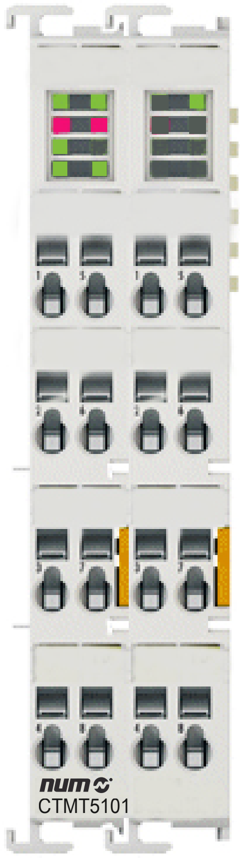
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT4132
Number of outputs	2
Signal current per channel	-10V to +10V (short-circuit-proof)
Connection technology	2-wires, single-ended
Accuracy	< ± 0.1% (at 0 °C ... +55 °C, relative to the 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	Type 210mA
Electrical isolation	500Veff (E-Bus/Field voltage)
Bits width in process image	Outputs: 2 x 16 bit data
Configuration	No address or configuration settings required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.21 CTMT5101 - 1 channel incremental encoder interface terminal (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.

Connections and Diagnostics LEDs

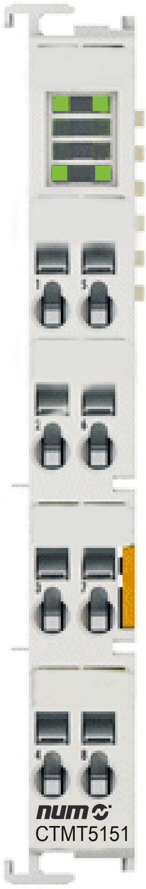
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the 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	Type 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	No address setting, configuration via Flexium Tools
Weight	approx. 100g
Bits width in process image	Outputs: 2 x 16 bit data
Dimensions (W x H x D)	Approx. 27mm x 100mm x 70mm (width aligned: 24mm)
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class / Installation position	IP 20 / variable
Approvals	CE, UL and cUL Listed

3.22 CTMT5151 - 1 channel incremental encoder interface terminal (24VDC)



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 measurement of period and frequency is possible. The gate input allows the locking of the counter, selectively with a high or low level. The latch input is similarly configurable and evaluates high or low levels.

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.

Connections and Diagnostics LEDs

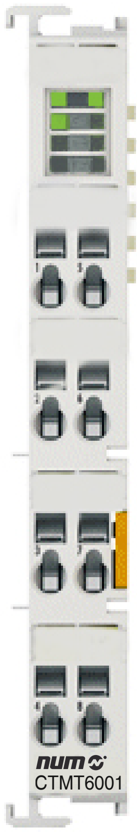
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the 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	24 V (-15 %/+20 %), (generated from the 24 VDC power contacts)
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	Type 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.23 CTMT6001 - 1 channel serial interface terminal (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 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	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 from FW08: 250 byte transmit buffer
Level interface	RS232
Bit distortion	< 3%
Cable length	Max. 15m
Diagnosis	Status LEDs
Power supply	Via the E-Bus
Current consumption via E-bus	Type 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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

Technology

The CTMT6001 serial interface terminals enable the connection of devices with an RS232 interface. The data is exchanged with the controller in full duplex mode. The receive buffer has 864 bytes, the send buffer has 128 bytes (250 bytes from FW08).
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, RTS/CTS control is active.

Level interfaces

The CTMT6001 terminal operate at an RS232 level with reference to GND (Fig.10).

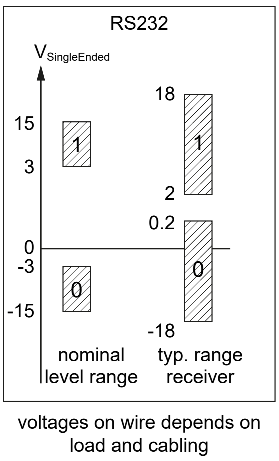
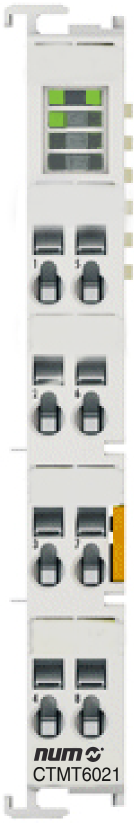


Fig.10 Level interfaces RS232

3.24 CTMT6021 - 1 channel serial interface terminal (RS422/RS485)



The CTMT6021 serial interfaces enable the connection of devices with RS422/RS485 interface.

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	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
Cable length	Max. 1000m (Twisted Pair)
Line impedance	120Ω
Diagnosis	Status LEDs
Power supply	Via the E-Bus
Current consumption via E-bus	Type 170mA
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

Technology

The CTMT6021 serial interface terminals enable the connection of devices with an RS485 / RS422 interface.

The data is exchanged with the controller in full duplex mode; 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 and operates in full duplex mode with deactivated point to point connection.

Level interfaces

The CTMT6021 terminal operate with a differential RS485/422 level (Fig.11).

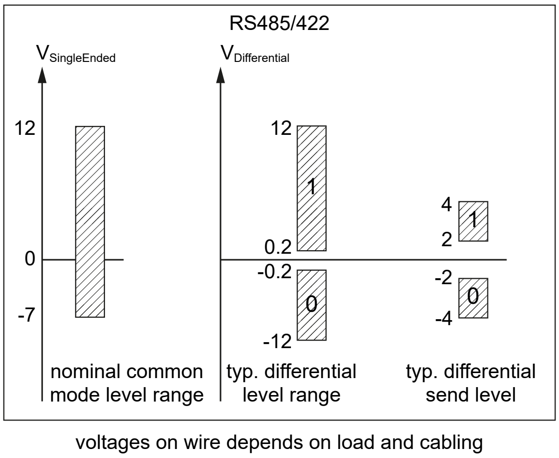


Fig.11 Level interfaces RS485/422

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, which is the minimum voltage required.

In RS422 mode each line must be terminated with 120Ω at the receiver (Fig.12).

Fig.12 RS422 termination

In RS485 mode with several devices, termination resistors are only used at the two end devices (Fig.13).

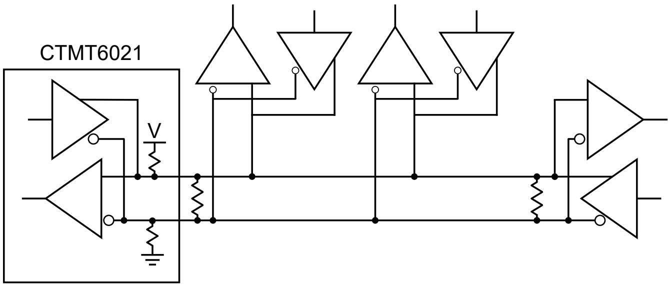


Fig.13 RS485 termination

Termination with CTMT6021

The CTMT6021 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 CTMT6021 devices feature integrated bias-failsafe resistors, which bring the bus lines to defined levels, even if the line is disconnected.

3.25 CTMT6224 - IO-Link Terminal

The CTMT6224 IO-Link terminal enables the connection of up to four IO-Link devices. These can be actuators, sensors or a combination of both. A point-to-point connection is used between the terminal and the device.

The terminal is parameterized via the EtherCAT master. IO-Link is designed as an intelligent link between the fieldbus level and the sensor, wherein parameterization information can be exchanged bidirectionally via the IO-Link connection. The parameterization of the IO-Link devices with service data can be done from Flexium Tools.

In the standard setting, the CTMT6224 functions as a 4-channel input terminal, 24 VDC, which communicates if necessary with connected IO-Link devices, parameterizes them and, if necessary, changes their mode of operation.
The direct plug-in technique enables toolless construction.

Connections and Diagnostics LEDs

Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT6224
IO-Link interfaces	4
Specification version	IO-Link V1.1
Housing	HD housing with 16 connection points (from hardware version 04)
Field voltage	24 V_{DC} via the power contacts
Connection	3-wire
Data transfer rates	4.8 kbaud, 38.4 kbaud and 230.4 kbaud
Cable length between IO-Link Master and Device	max. 20 m
Supply voltage for electronics	via E-bus and power contacts
Current consumption via E-bus	Type 120 mA
Electrical isolation	500 V (E-bus/field voltage)
Supply current for devices	500 mA per device
Configuration	via TwinCAT System Manager
Weight	approx. 60 g
Permissible ambient temperature range during operation	0°C ... + 55°C
Permissible ambient temperature range during storage	-25°C ... + 85°C
Permissible relative humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15mm x 100mm x 70mm (width aligned:12mm)
Mounting	on 35 mm mounting rail conforms to EN 60715
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP20
Installation position	variable
Approval	CE, UL and cUL Listed

3.26 CTMT6731 - Master terminal for PROFIBUS

The CTMT6731 can run the PROFIBUS protocol with all features; in the EtherCAT Terminal network it enables integration of any Profibus devices. Thanks to the in-house development of the PROFIBUS chip, the terminals are equipped with the latest version of the PROFIBUS technology – including high-precision isochronous mode for axis control and extended diagnostic options. This masters are the only ones that support different poll rates for the slaves.

Features:

- Cycle times from 200 µs are possible
- PROFIBUS DP, PROFIBUS DP-V1, PROFIBUS DP-V2
- Master, slave and Profibus monitor up to 12 Mbit/s
- Powerful parameter and diagnostics interfaces
- Error management freely configurable for each bus device
- It is possible to read the bus configuration and automatically assign the “GSD” files

Connections and Diagnostics LEDs

Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

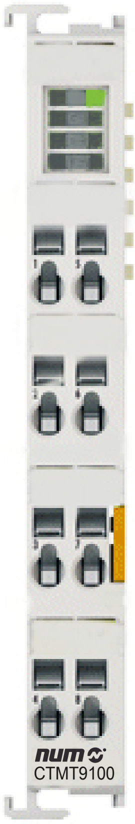
Technical data	CTMT6731
Bus system	PROFIBUS DP (standard), PROFIBUS DP-V1 (Cl. 1+2: acyclic services, alarms), PROFIBUS DP-V2, PROFIBUS MC (equidistance)
Version	Master
Number of fieldbus channels	1
Data transfer rate	9.6 kBit/s to 12 MBit/s
Bus interface	1 x D-Sub socket, 9-pin, galvanically isolated
Bus nodes	maximum 125 slaves with up to 244 bytes input, output, parameter, configuration or diagnostic data per slave
Cycle time	Differing DP cycle times per slave are possible using the CDL concept
Process image	Sum max.: 1.4 kbyte input and 1.4 kbyte output data
Diagnostics	Status LEDs
Power supply	via the E-bus
Current consumption via E-bus	Type 350 mA
Electrical isolation	500 V (E-bus/Profibus)
Configuration	with Flexium Tools
Weight	approx. 70 g
Permissible ambient temperature range during operation	0°C ... + 55°C
Permissible ambient temperature range during storage	-25°C ... + 85°C
Permissible relative humidity	95 %, no condensation
Dimensions (W x H x D)	approx. 26 mm x 100 mm x 52 mm (width aligned: 23 mm)
Mounting	on 35 mm mounting rail conforms to EN 60715
Vibration/shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP20
Installation position	variable
Approvals	CE, UL and cUL Listed

3.27 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	CTMT9011
Electrical isolation	Yes
Bits width in process image	0
Configuration	No address or configuration settings required
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
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.28 CTMT9100 - Potential supply terminal 24VDC



The CTMT9100 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.

Connections and Diagnostics LEDs

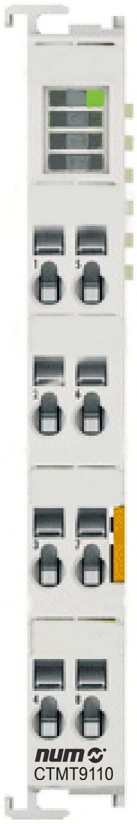
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT9100
Nominal voltage	24VDC
Power contact current load	Max. 10A
Electrical isolation	Yes
Current consumption from E-Bus	-
Bit width in the process image	-
Configuration	No address or configuration settings required
Power LED	Yes
Diagnosis	No
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.29 CTMT9110 - Potential supply terminal 24VDC



The 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

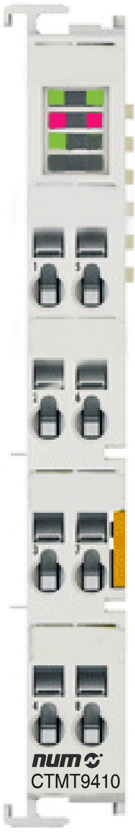
Note

Terminal connections: please refer to the chapter 4.

Diagnostics LEDs: please refer to the chapter 6.

Technical data	CTMT9110
Nominal voltage	24VDC
Power contact current load	Max. 10A
Electrical isolation	Yes
Current consumption from E-Bus	Type 90mA
Bit width in the process image	1 bit (diagnosis)
Configuration	No address or configuration settings required
Power LED	Yes
Diagnosis	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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

3.30 CTMT9410 - Power supply terminal 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	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	-
Electrical isolation	500 V (E-bus/field potential)
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 required
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 60715)
Vibration/shock resistance	Conforms to EN 60068-2-6 / EN 60068-2-27
EMC resistance burst/ESD	Conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	Variable
Approvals	CE, UL and cUL Listed

Page deliberately empty

1
2
3
4
5
6
7

Summary

Page deliberately empty

4 Installation and connections

4.1 Installation on mounting rails

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

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.

4.1.3 Instruction for ESD protectio

Note

Destruction of the devices by electrostatic discharge possible!
The devices contain components at risk from electrostatic discharge caused by improper handling.

- Please ensure you are electrostatically discharged and avoid touching the contacts of the device directly.
- Avoid contact with highly insulating materials (synthetic fibers, plastic film etc.).
- Surroundings (working place, packaging and personnel) should by grounded probably, when handling with the devices.
- Each assembly must be terminated at the right hand end with an CTMT9011 bus end cap, to ensure the protection class and ESD protection.

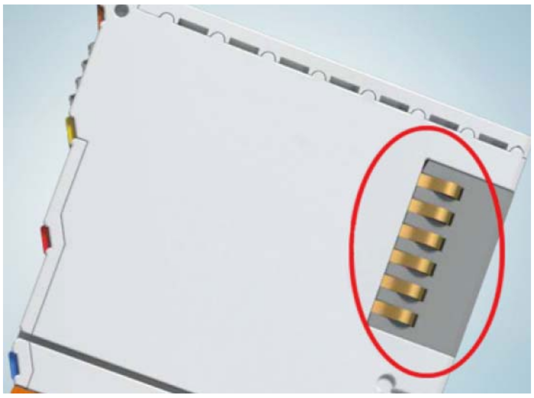


Fig.14 Spring contacts of the NUM I/O components

4.1.4 Recommended mounting rails

Recommended mounting rails:
- DIN Rail TH 35-7.5 with 1 mm material thickness (according to EN 60715)
- DIN Rail TH 35-15 with 1,5 mm material thickness

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.15).

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

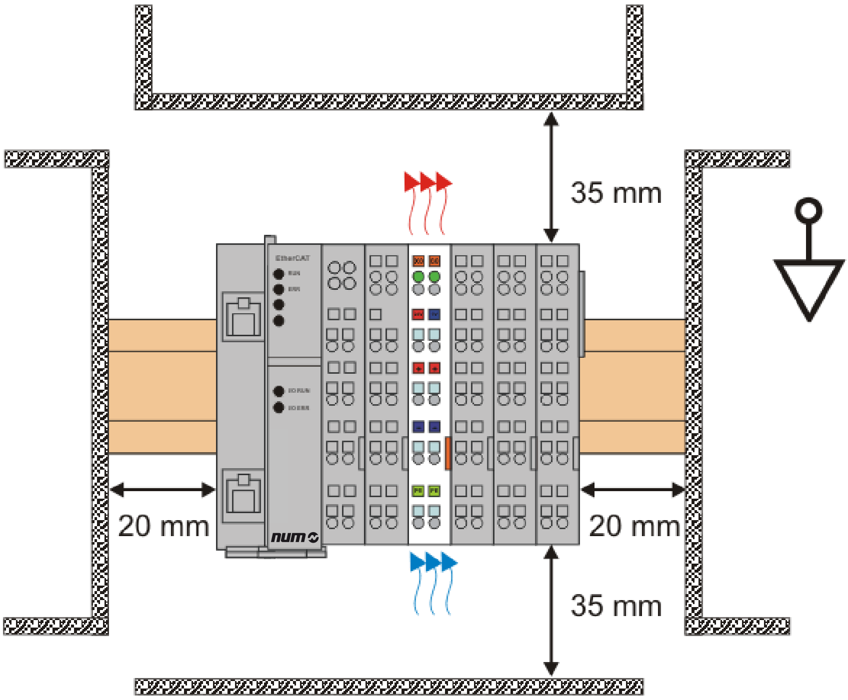


Fig.15 Recommended distances for standard installation position.

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

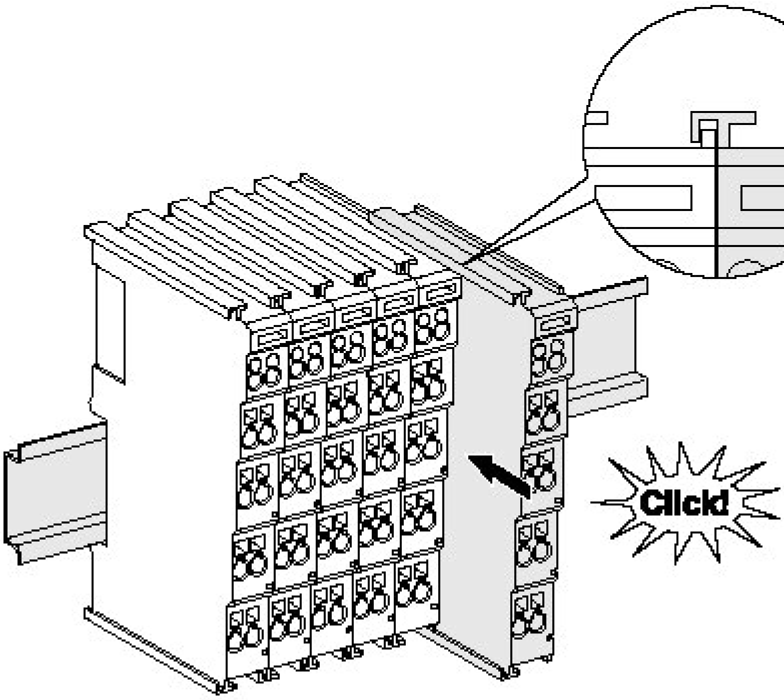
WARNING

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 60715) 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.

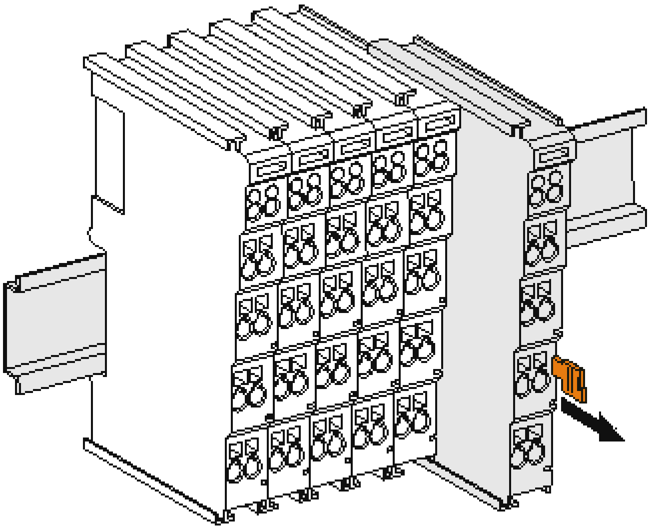
Note

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 Electrical installation

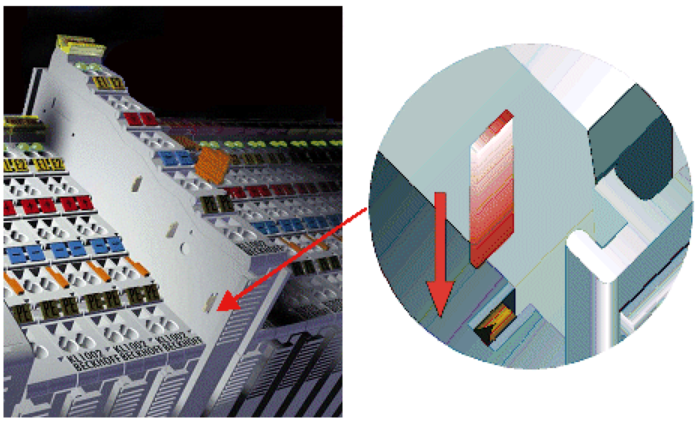
4.4.1 Connections within a EtherCAT terminal block

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

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

- 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.

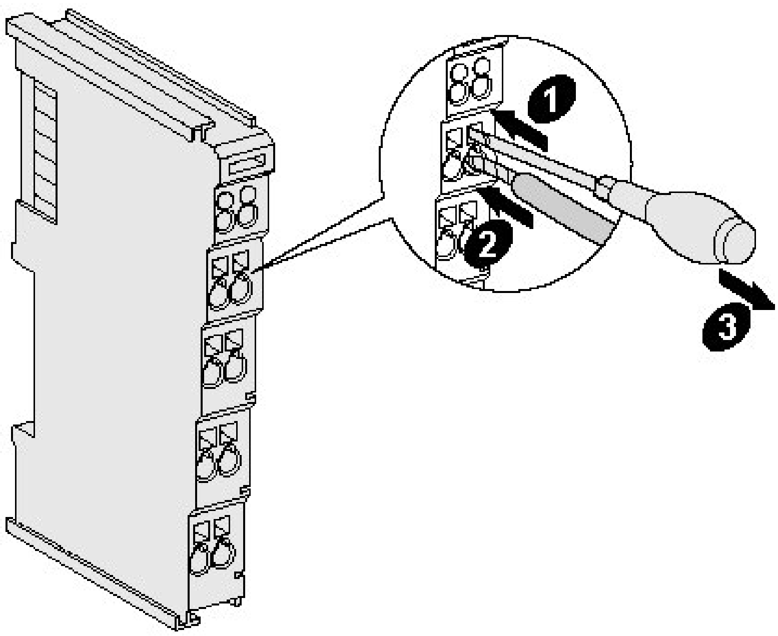
DANGER

Serious risk of injury!

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

4.5 Terminal connections

4.5.1 Terminals for standard wiring



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

1. Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.

2. The wire can now be inserted into the round terminal opening without any force.

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

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

4.5.2 High Density Terminals with 16 terminal points

The conductors of the HD Terminals are connected without tools for single-wire conductors using the direct plug-in technique, i.e. after stripping the wire is simply plugged into the terminal point. The cables are released, as usual, using the contact release with the aid of a screwdriver. See the following table for the suitable wire size width.

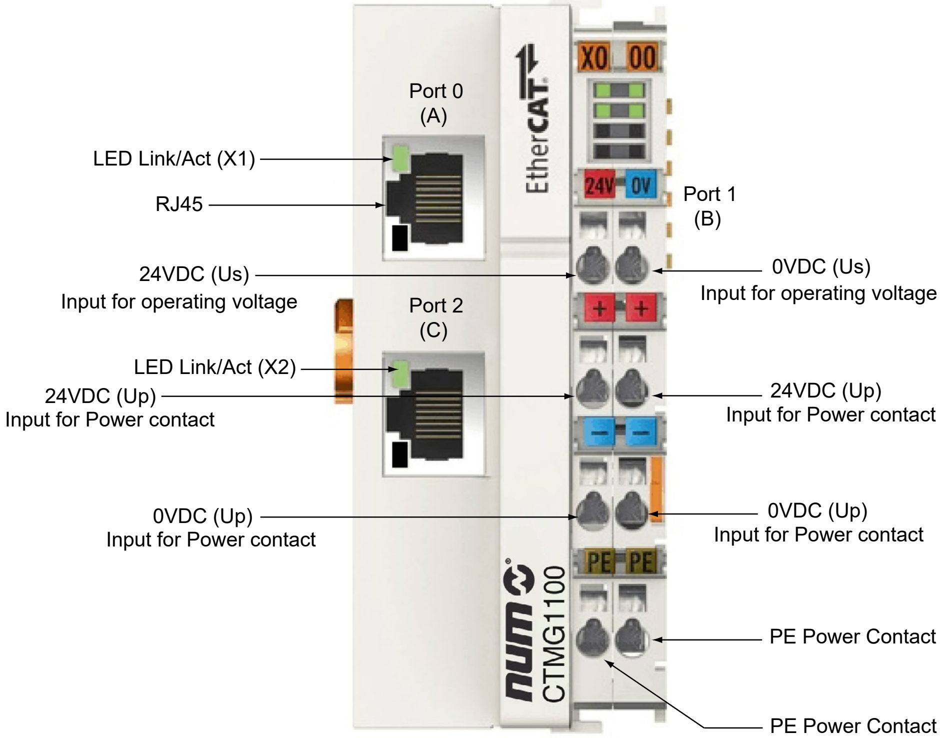
Wire cross section	0.08 ... 1.5mm²
Strip length	8 ...9mm

4.5.3 Shielding

Note

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

4.5.4 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.16

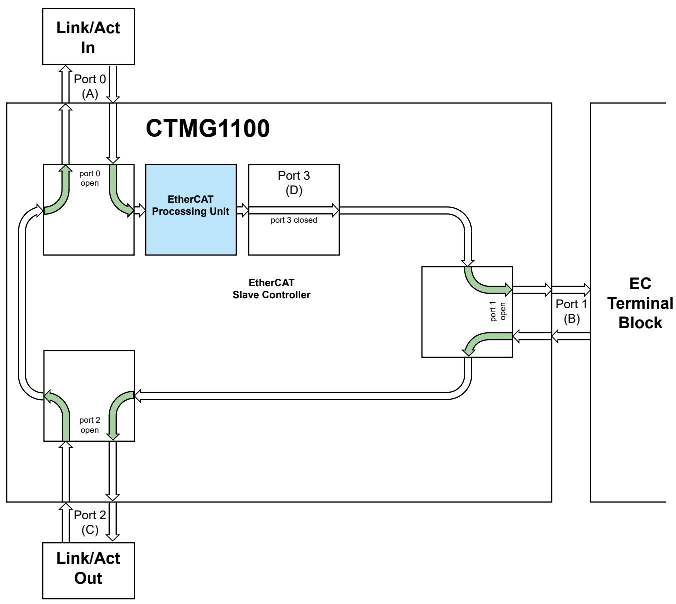


Fig.16 Internal and external port assignment - CTMG1100 bus coupler

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).

4.5.4.1 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. 2000mA 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).

Power contacts
On the right hand face of the Bus Coupler there are three spring contacts for the power contact connections. The spring contacts are hidden in slots so that they can not be accidentally touched. By attaching a Bus Terminal the blade contacts on the left hand side of the Bus Terminal are connected to the spring contacts.
The tongue and groove guides on the top and bottom of the Bus Coupler and of the Bus Terminals guarantees that the power contacts mate securely.
The current load of the power contacts may not permanently exceed 10 A.

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.

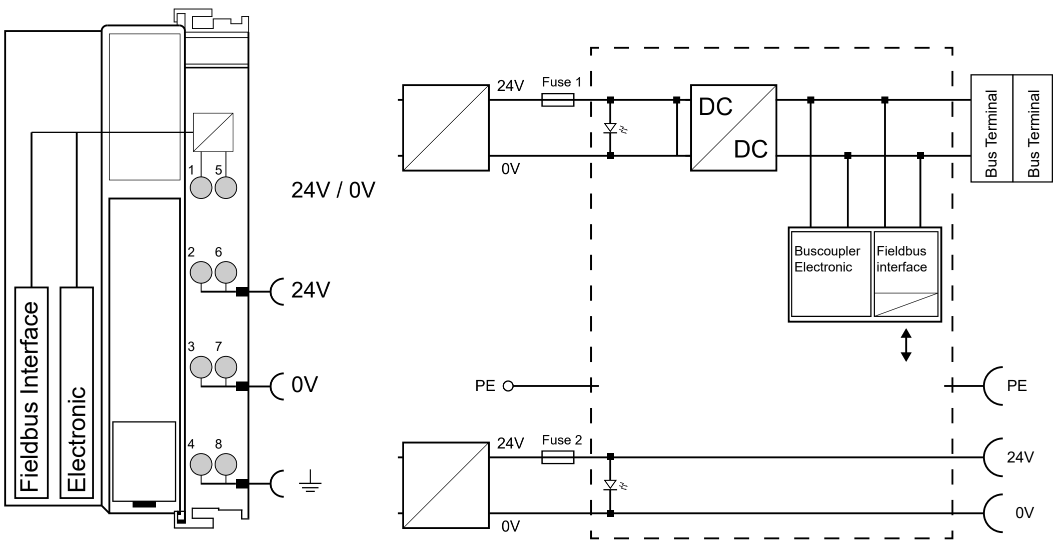
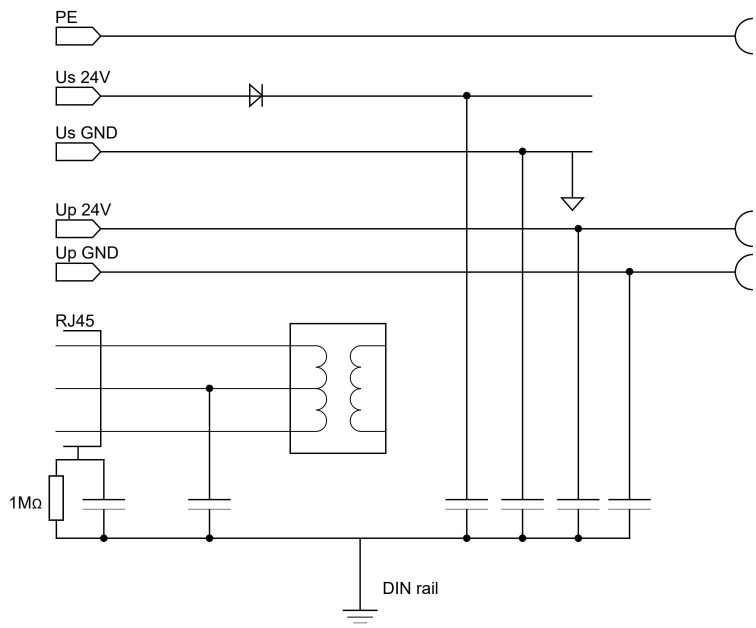


Fig.17 Potential diagram CTMG1100

Ground concept

Ground concept



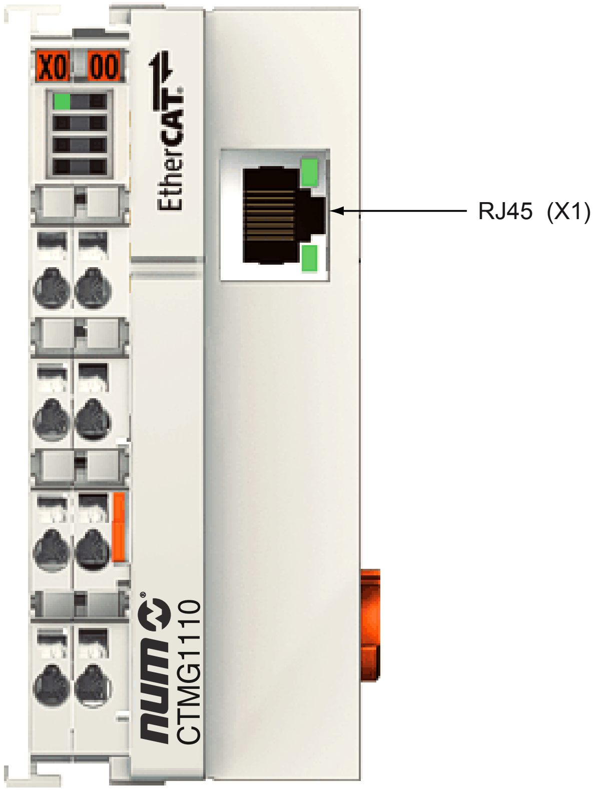
Fusing

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.

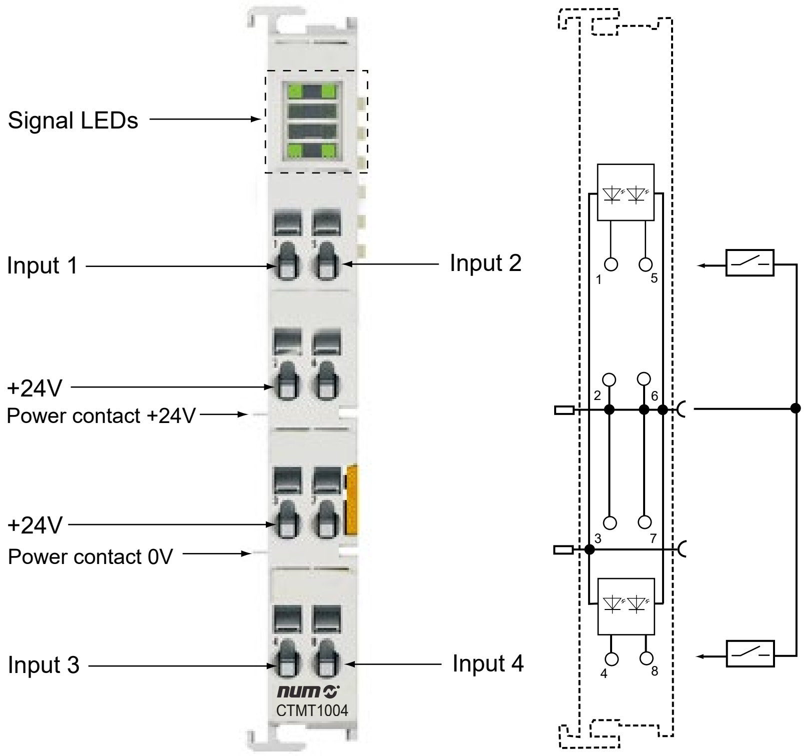
4.5.5 CTMG1110 NUM EtherCAT extension connections



Connections

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

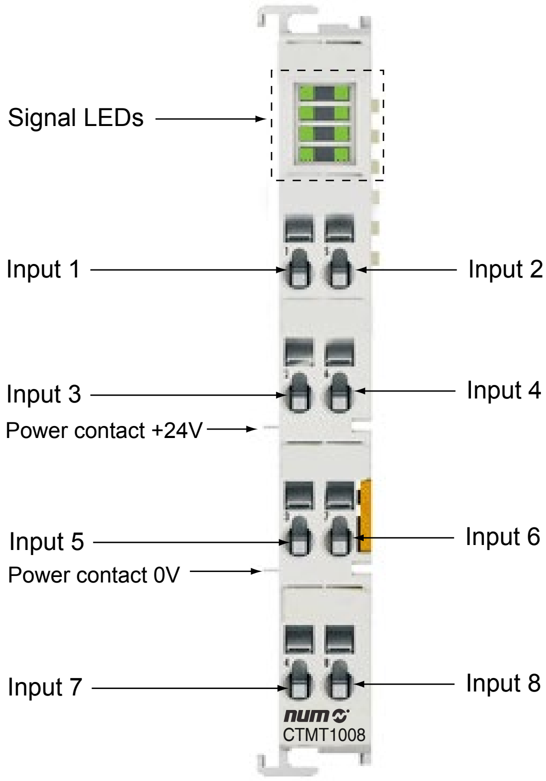
4.5.6 CTMT1004 Terminal connections

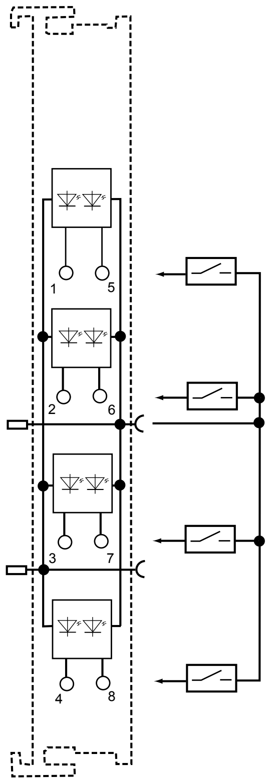


Connections

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

4.5.7 CTMT1008 Terminal connections

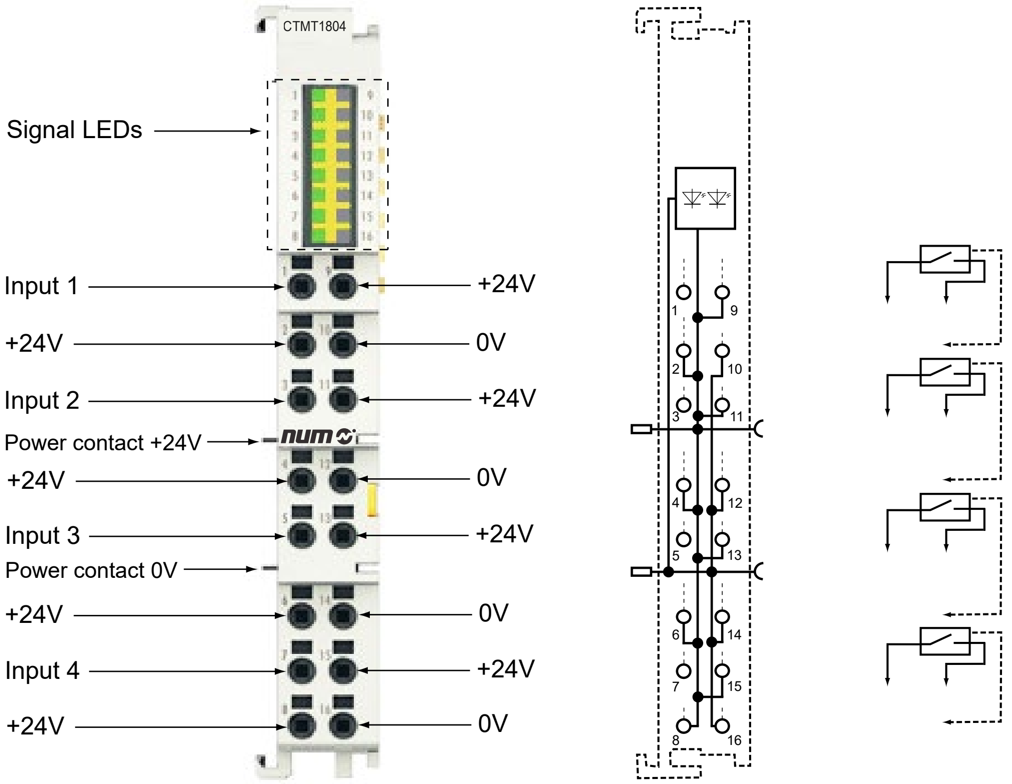




Connections

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

4.5.8 CTMT1804 Terminal connections



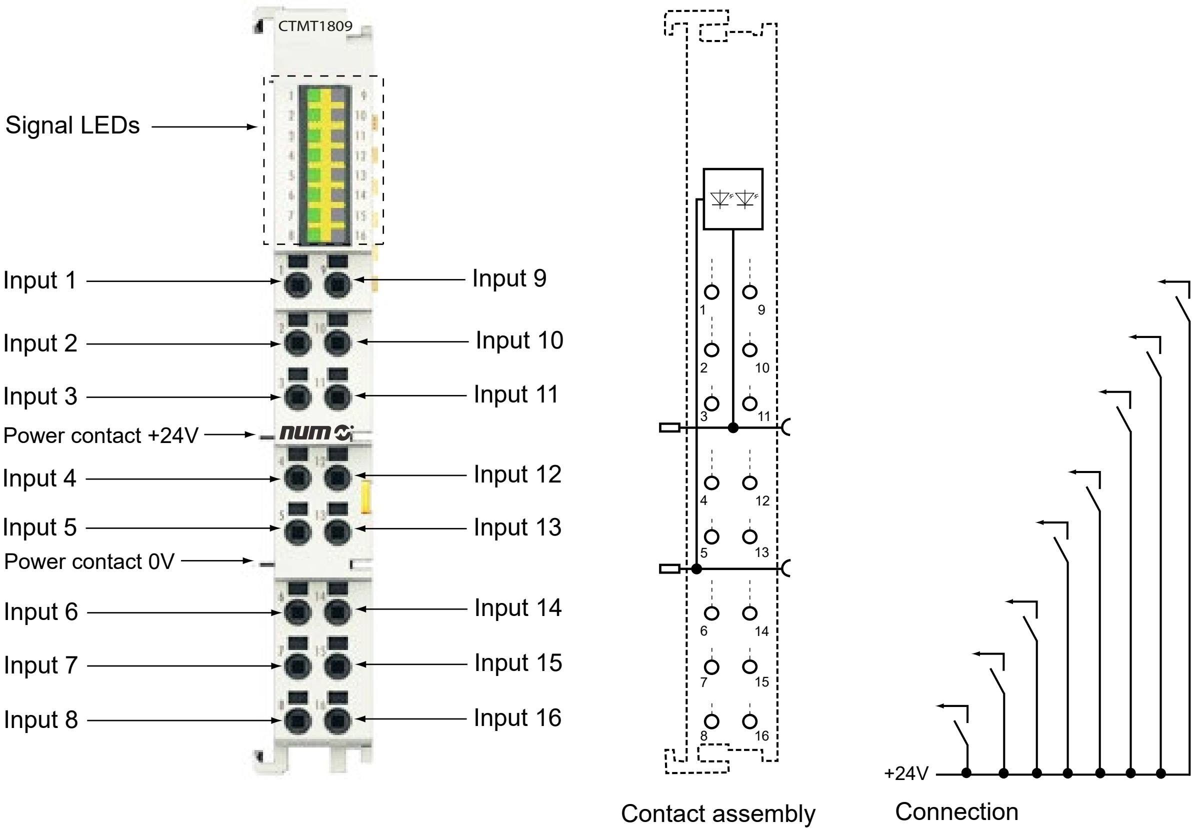
Contact assembly

Connection

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)

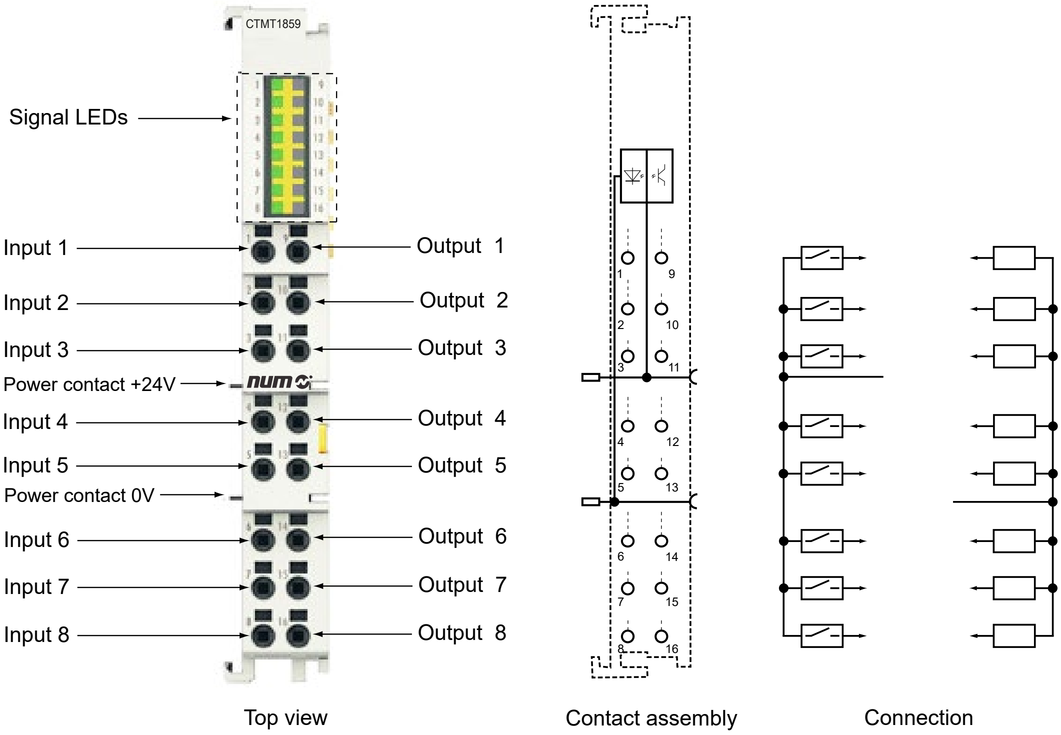
4.5.9 CTMT1809 Terminal connections



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

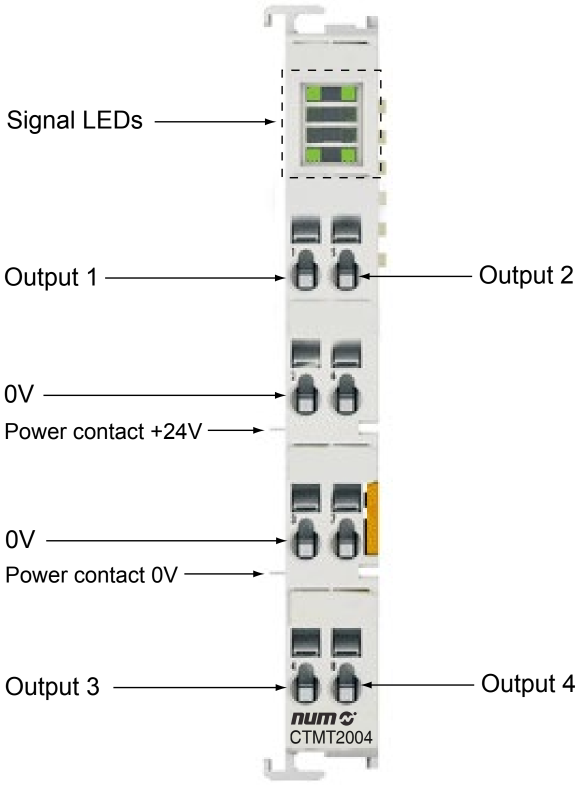
4.5.10 CTMT1859 Terminal connections

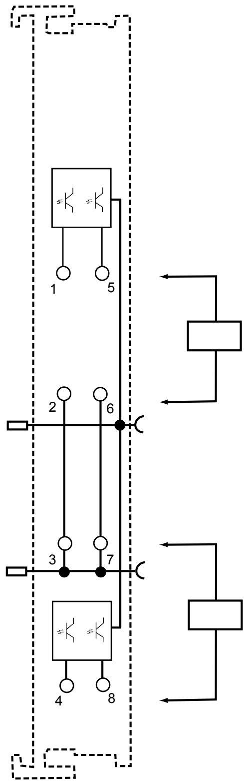


Connections

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
Output 1	9	**Output 1**
Output 2	10	**Output 2**
Output 3	11	**Output 3**
Output 4	12	**Output 4**
Output 5	13	**Output 5**
Output 6	14	**Output 6**
Output 7	15	**Output 7**
Output 8	16	**Output 8**

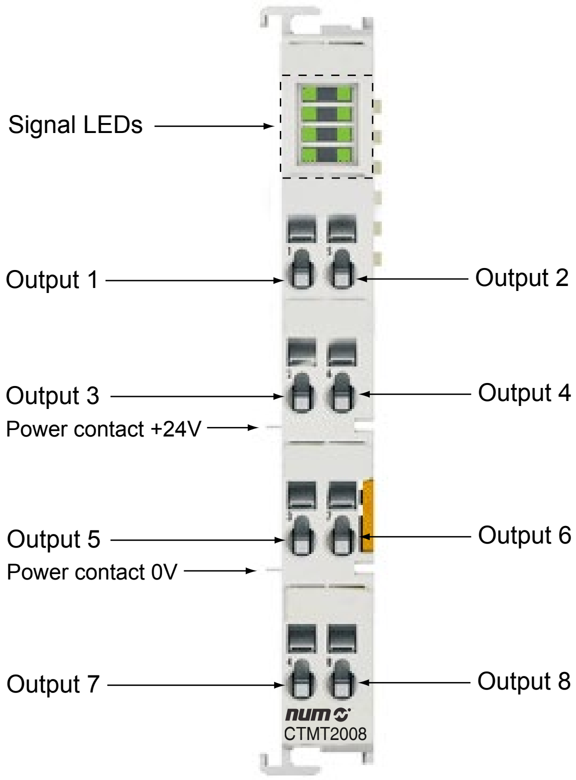
4.5.11 CTMT2004 Terminal connections

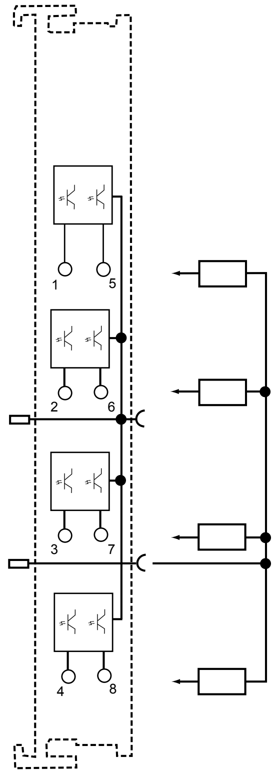




Terminal	No	Description
Output 1	1	Ouput 1
0V	2	Ground for output 1 (connected internally with terminal 3, 6, 7 and negative power contact)
0V	3	Ground for output 3 (connected internally with terminal 2, 6, 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
0V	6	Ground for output 2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

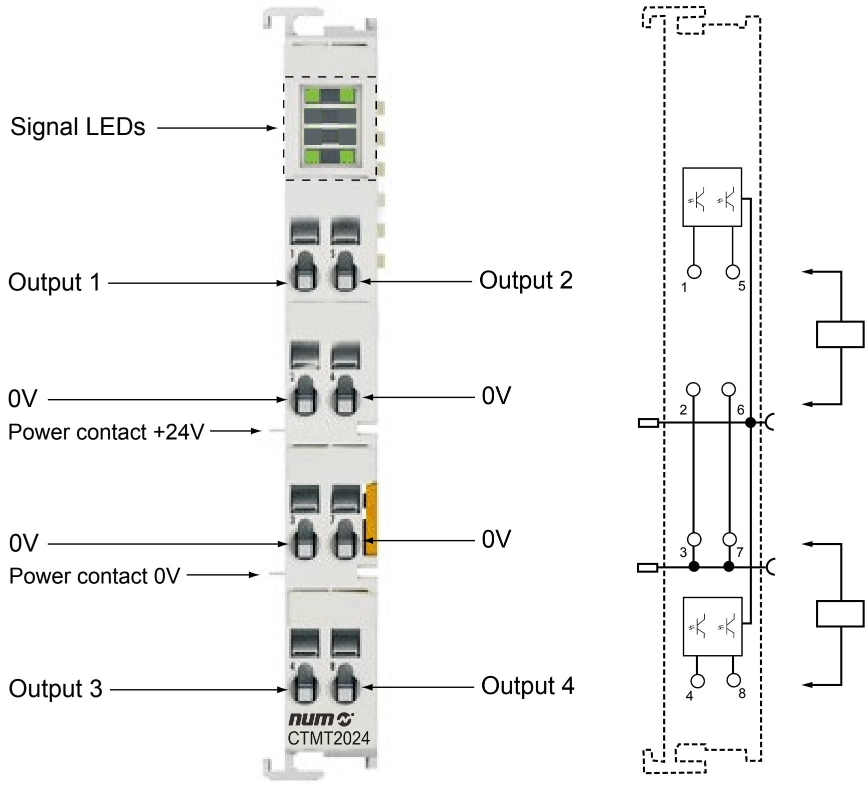
4.5.12 CTMT2008 Terminal connections





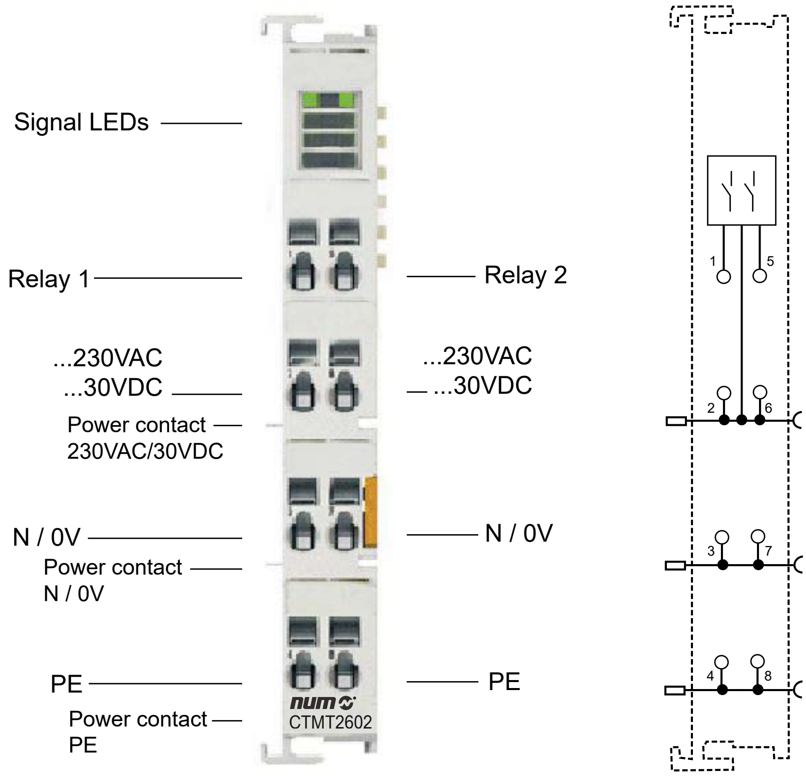
Terminal	No	Description
Output 1	1	Ouput 1
Output 3	2	Ouput 3
Output 5	3	Ouput 5
Output 7	4	Output 7
Output 2	5	Output 2
Output 4	6	Ouput 4
Output 6	7	Ouput 6
Output 8	8	Output 8

4.5.13 CTMT2024 Terminal connections



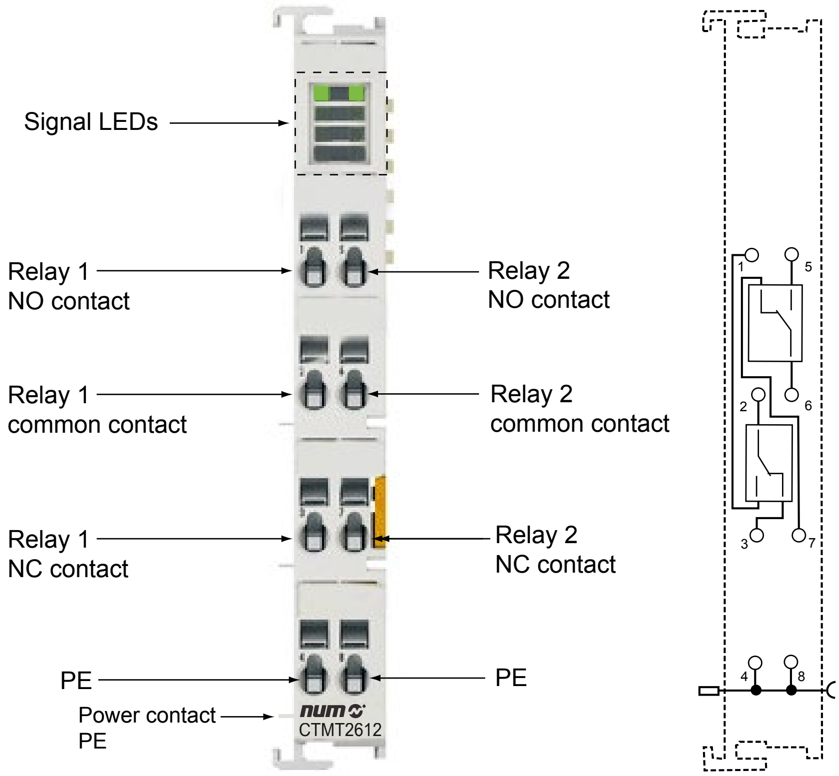
Terminal	No	Description
Output 1	1	Ouput 1
0V	2	Ground for output 1 (connected internally with terminal 3, 6, 7 and negative power contact)
0V	3	Ground for output 3 (connected internally with terminal 2, 6, 7 and negative power contact)
Output 3	4	Output 3
Output 2	5	Output 2
0V	6	Ground for output 2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

4.5.14 CTMT2602 Terminal connections



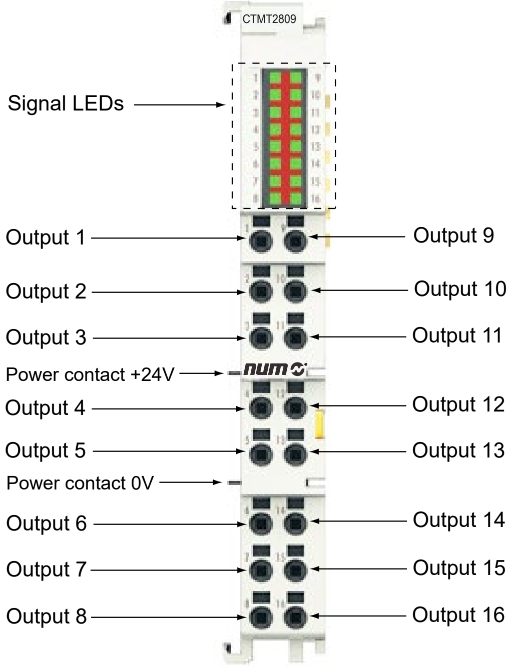
Terminal	No	Description
Relay 1	1	Ouput 1
.. 230 VAC /..30 VDC	2	≤ 230 VAC resp. ≤ 30VDC (internally connected with terminal 6 und L power contact)
N / 0V	3	Neutral line / 0V (internally connected with terminal 7 and N power contact)
PE	4	PE (internally connected with terminal 8)
Relay 2	5	Output 2
..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

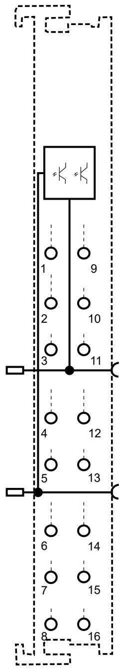
4.5.15 CTMT2612 Terminal connections



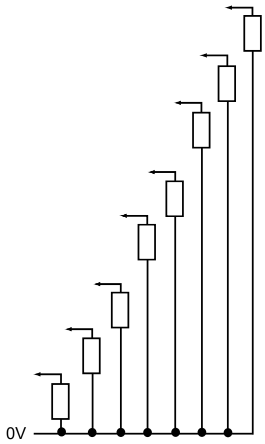
Terminal	No	Description
Relay 1	1	Relay 1, NO contact
Relay 1	2	Relay 1, Common contact (..125 VAC/..30 VDC)
Relay 1	3	Relay 1, NC contact
PE	4	PE (internally connected with terminal 8)
Relay 2,	5	Relay 2, NO contact
Relay 2,	6	Relay 2, Common contact (..125 VAC/..30 VDC)
Relay 2	7	Relay 2, NC contact
PE	8	PE (internally connected with terminal 4)

4.5.16 CTMT2809 Terminal connections





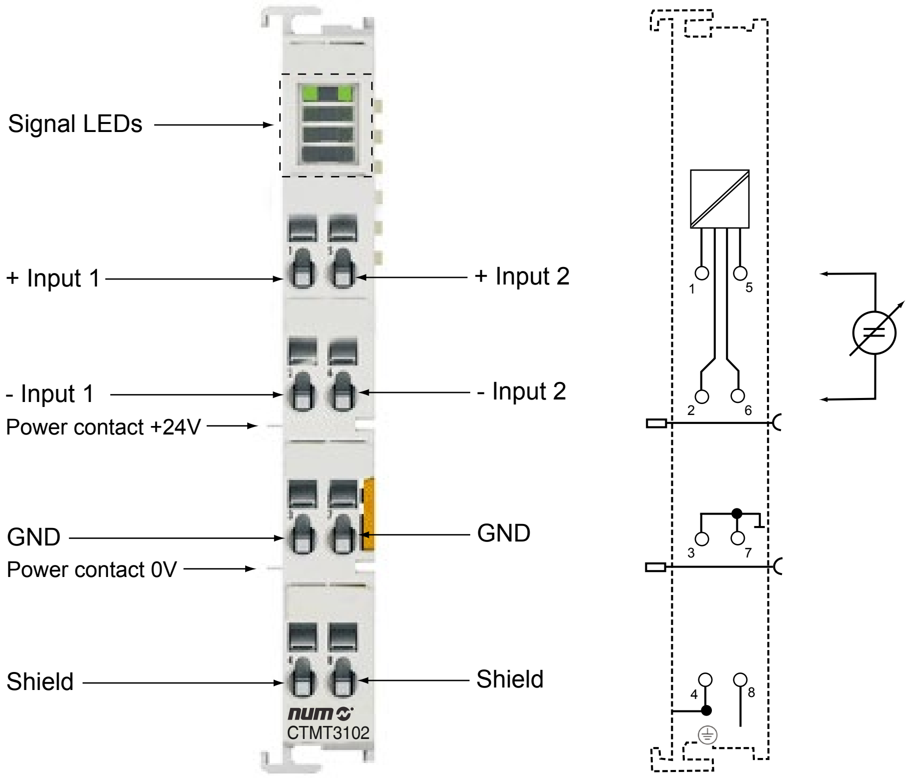
Contact assembly



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

4.5.17 CTMT3102 Terminal connections



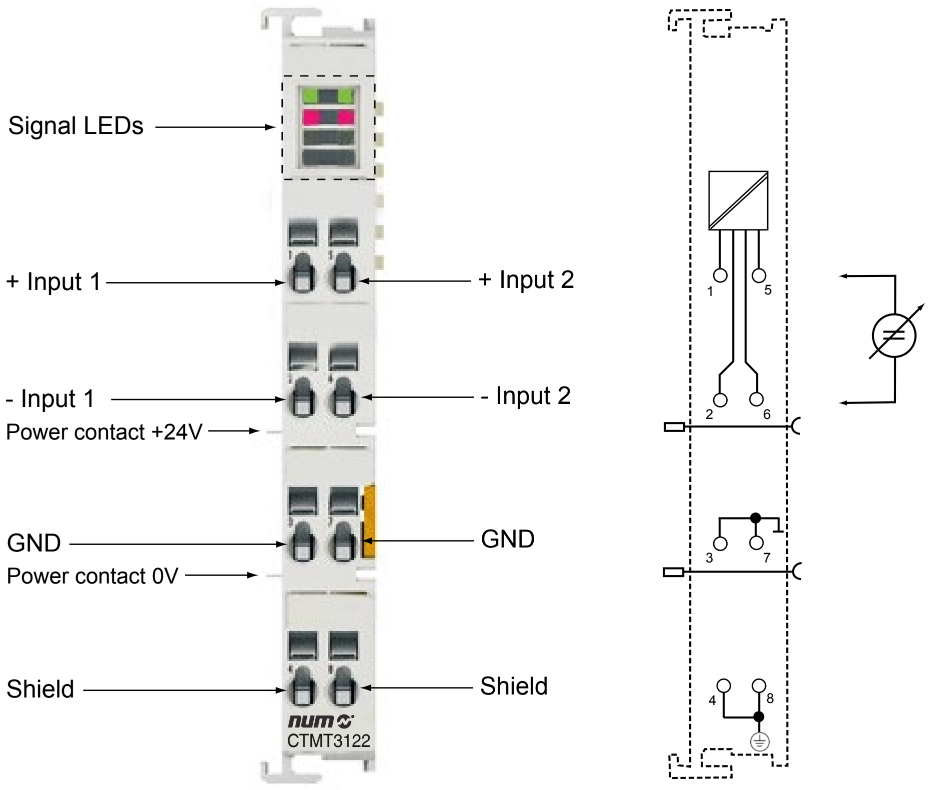
Terminal	No	Description
+ Input 1	1	+ Input channel 1
- Input 1	2	- Input channel 1
GND	3	Signal ground (internally connected with terminal point 7)
Shield	4	Shield (internally connected with terminal point 8)
+ Input 2	5	+ Input channel 2
- Input 2	6	- Input channel 2
GND	7	Signal ground (internally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

Terminal GND and system GND

The signal ground GND of this terminal is not internally connected to the negative power contact. This design allows GND to be connected to a ground other than the negative power contact “Power contact 0V” if necessary.

If disturbing potential differences occur, GND must be electrically connected to the system GND or another suitable ground.

4.5.18 CTMT3122 Terminal connections

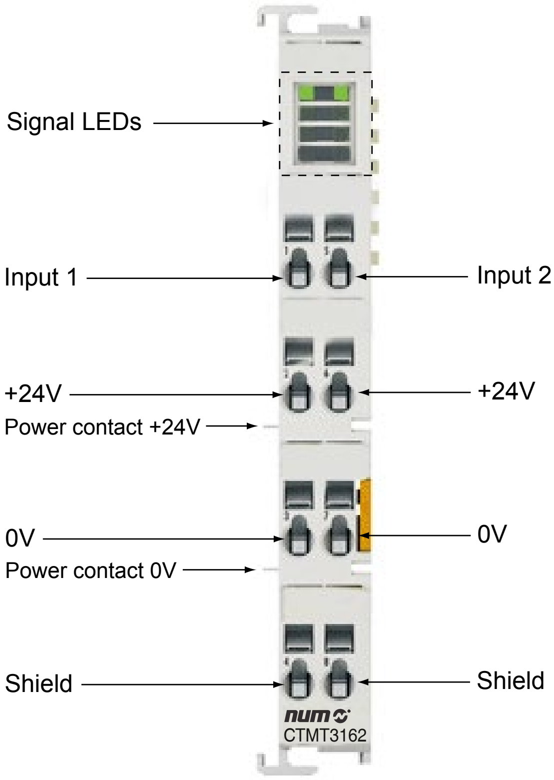


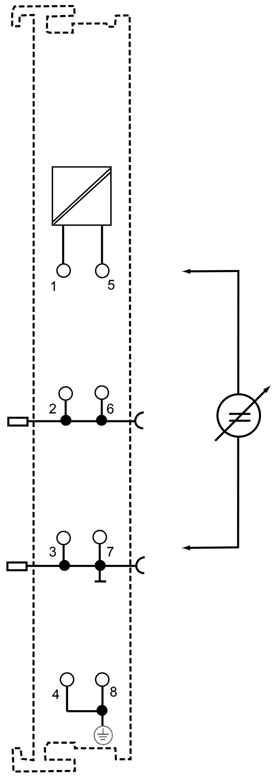
Terminal	No	Description
+ Input 1	1	+ Input channel 1
- Input 1	2	- Input channel 1
GND	3	Signal ground (internally connected with terminal point 7)
Shield	4	Shield (internally connected with terminal point 8)
+ Input 2	5	+ Input channel 2
- Input 2	6	- Input channel 2
GND	7	Signal ground (internally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

Terminal GND and system GND
The signal ground GND of this terminal is not internally connected to the negative power contact. This design allows GND to be connected to a ground other than the negative power contact “Power contact 0V” if necessary. If disturbing potential differences occur, GND must be electrically connected to the system GND or another suitable ground.

Overcurrent protection of the 20 mA inputs
The current inputs are protected against damage by overcurrent by an internal current limitation,
currents > 30mA may occur. In the event of a fault, the current limiter must not be overloaded by a voltage > 30V from the source device.
Overcurrent is displayed in the process image as “Overrange”. After occurrence, the error condition must be stopped immediately, the source device switched off or disconnected from the input terminal.
If the error condition persists for a longer period of time, the internal terminal current limitation reduces the absorbed signal current for thermal reasons, depending on the ambient conditions also below 20 mA.

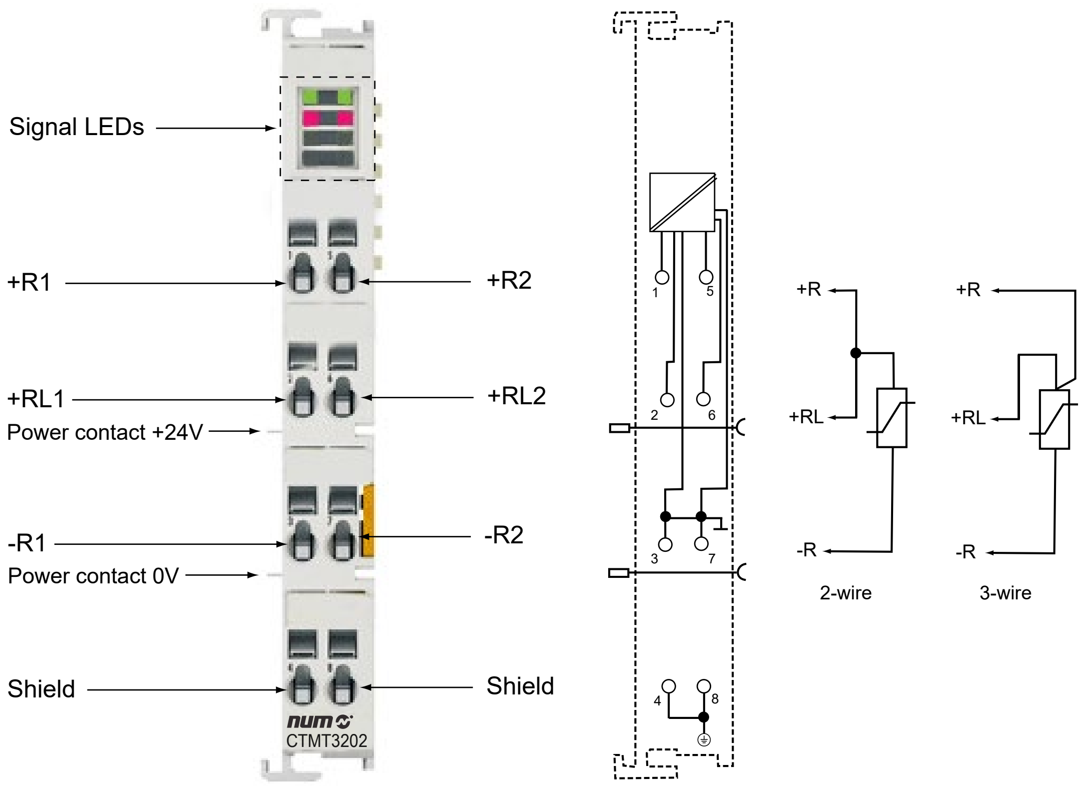
4.5.19 CTMT3162 Terminal connections





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)

4.5.20 CTMT3202 Terminal connections



2-wire connection
If the CTMT3202 is operated with a 2-wire connection, the inputs +R and +RL must be bridged by the user.

Terminal	No	Description
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, currentless sense line
-R1	3	Input -R1, current-carrying
Shield	4	Shield (internally connected to terminal point 8)
+R2	5	Input +R2, current-carrying
+RL2	6	Input +RL2, currentless sense line
-R2	7	Input -R2, current-carrying
Shield	8	Shield (internally connected to terminal point 4)

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.

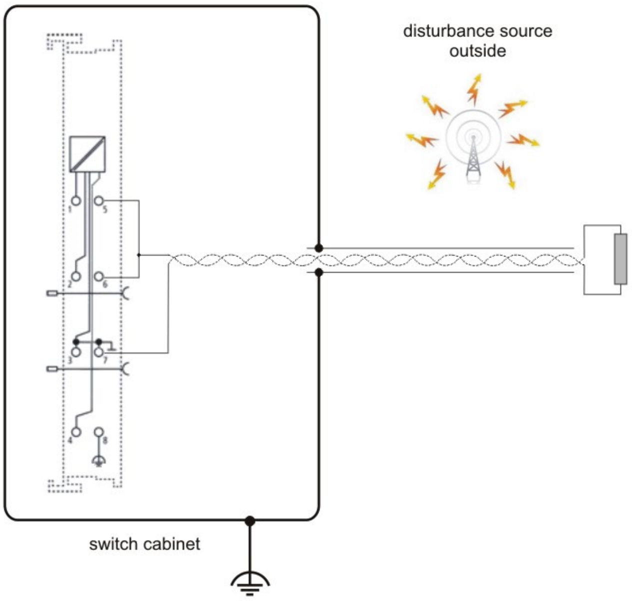
The following notes on shielding are to be understood as technical suggestions that have proven themselves from time to time in practical use. It must be checked in each case which measures can be applied, depending on the installation and plant. The effectiveness of each measure must be checked individually.
The formal transferability of measures to other types of plant is in general not possible.

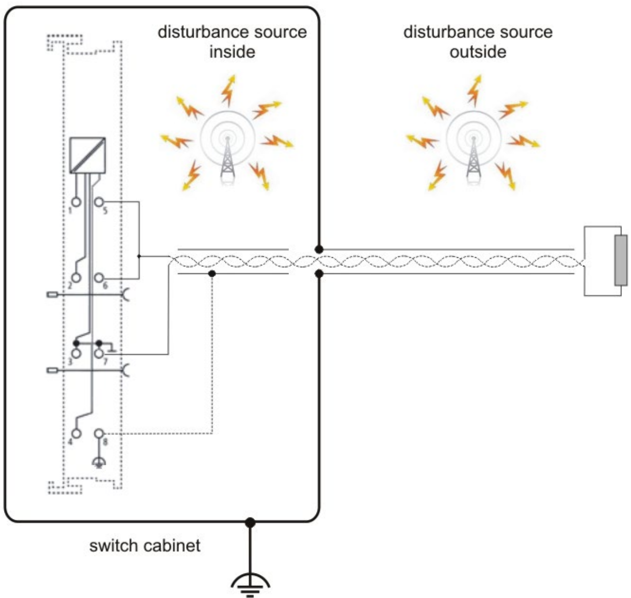
Priority is to be given to typical national or general normative specifications.

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





4.5.20.1 Connection techniques

The electrical connection of a resistance sensor to the CTMT3202 can take place using the 2-wire or 3-wire method, 4-wire method is not foreseen for such terminal. In the 3-wire method, the error caused by the sensor connecting wires' own resistance should be eliminated.
To this end, in the 3-wire method one end is fitted with two connecting wires.

2-wire technique
If the two-wire technique is used to connect the CTMT3202, the terminal is connected via a two-core cable, whose own resistance RL is connected in series with the resistance sensor Rt (Fig.18).

The addition of these resistances causes a systematically increased temperature display, making compensation necessary. Compensation is performed by the compensation resistor R_A, which is represented internally in the terminal by the object 16#80x0:1B and which can be adjusted with a resolution of 1/32 Ohm.

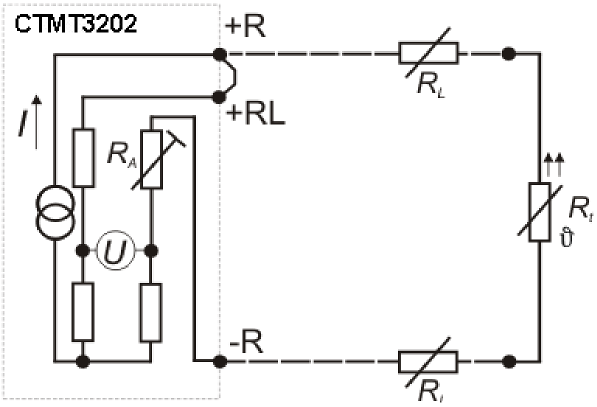


Fig.18 2-wire connection technique with internal compensation in the terminal

Example:
The cross-sectional area of the 50m long copper wire connecting cable is 0.5 mm². The specific resistance of copper is 0.0175 Ohm mm² m⁻¹.

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

For a resistance change of the Pt100 of ˜0.39 O/K, the resulting temperature deviation is:
$\boldsymbol{3.5\Omega / (0.39\ \Omega/°C) = 8.97\ °C}$

Note

2-wire connection

If the CTMT3202 is operated with a 2-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 16#80n0:1B.

For the compensation, the resistance value R_{Ltotal} (3.5Ω in the example) is entered in the index 16#80n0:1B. At a resolution of 1/32Ω, this results in a value to be entered of:

$\boldsymbol{3.5\Omega / (1/32)\ \Omega = 112_{dec}}$

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

3**-wire technique**
The 3-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.19).

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.

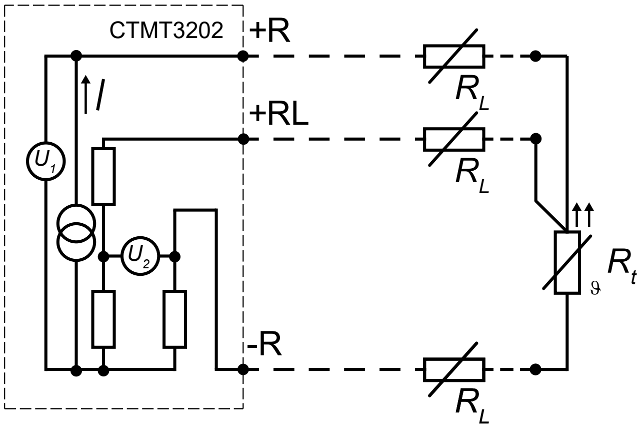
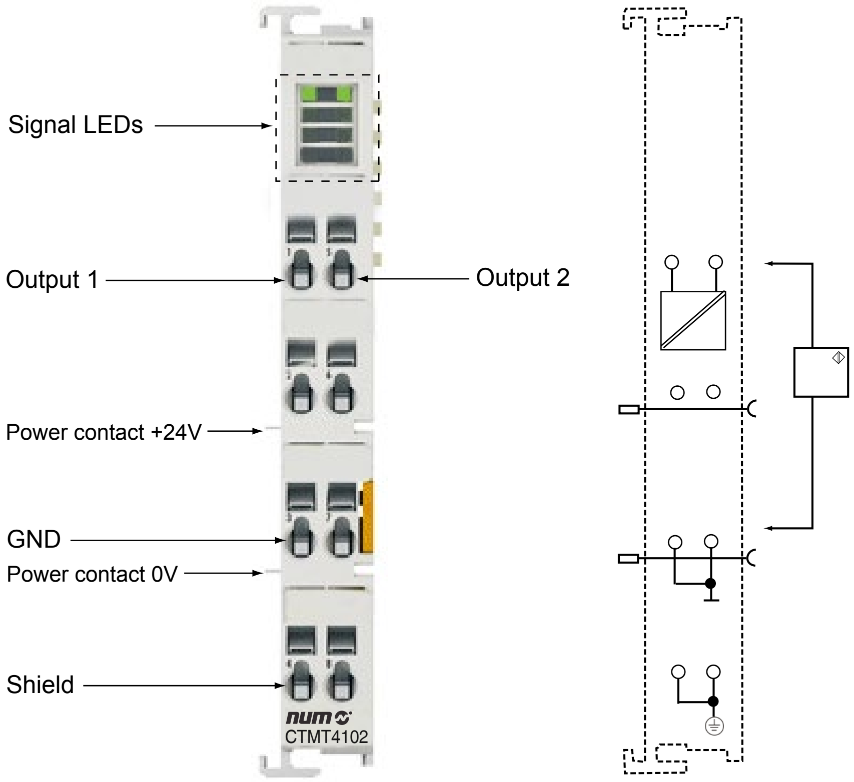


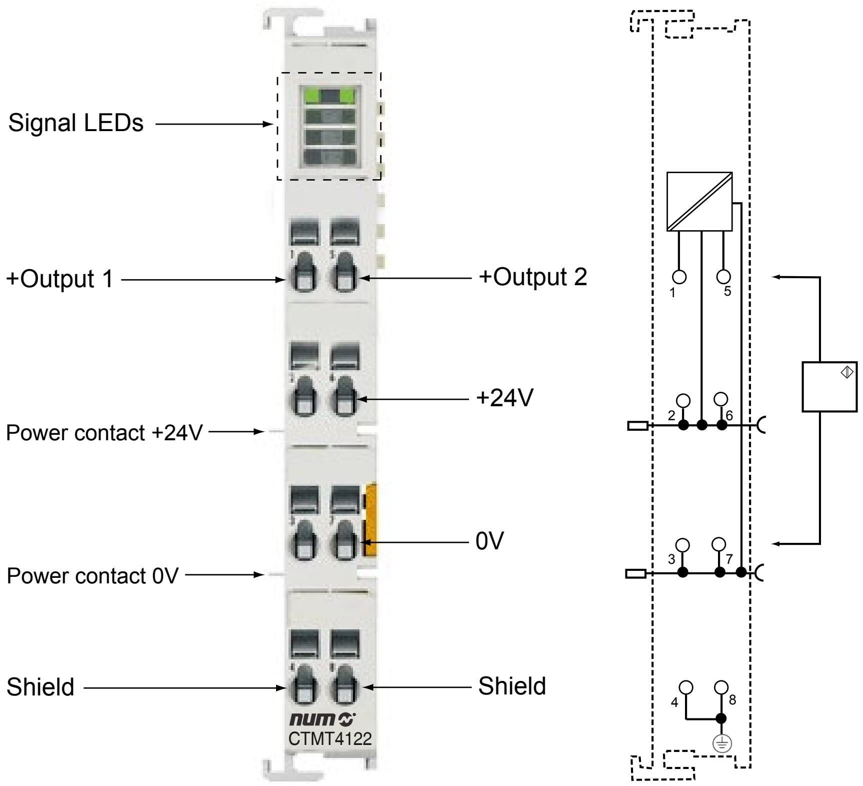
Fig.19 3-wire connection technique

4.5.21 CTMT4102 Terminal connections



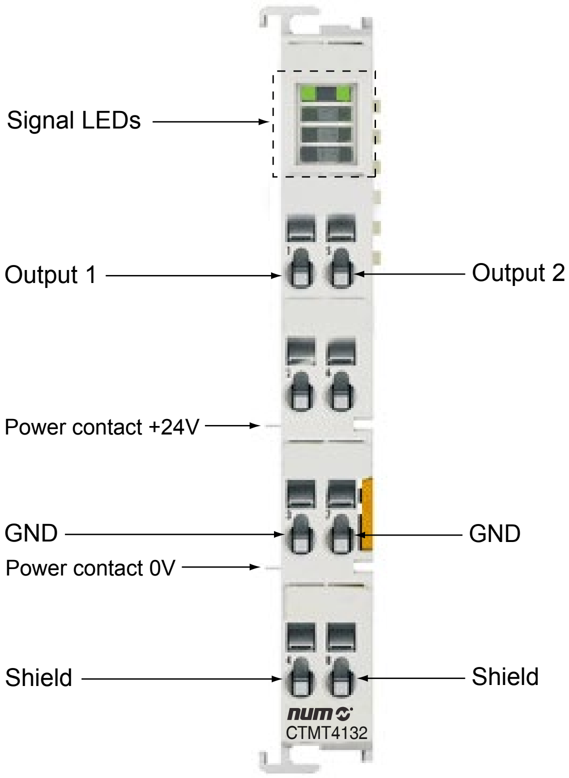
Terminal	No	Description
Output 1	1	Output 1
-	2	Not connected
GND	3	Internal ground (internally connected with terminal point 7)
Shield	4	PE contact (internally connected with terminal point 8)
Output 2	5	Output 2
-	6	Not connected
GND	7	Internal ground (internally connected with terminal point 3)
Shield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

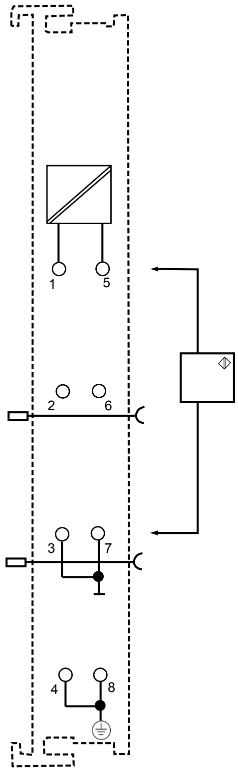
4.5.22 CTMT4122 Terminal connections



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)

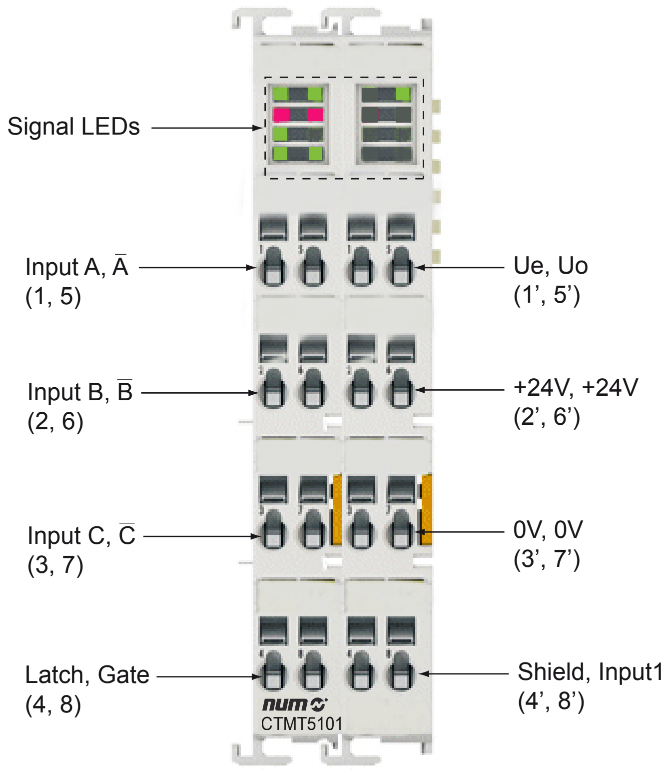
4.5.23 CTMT4132 Terminal connections

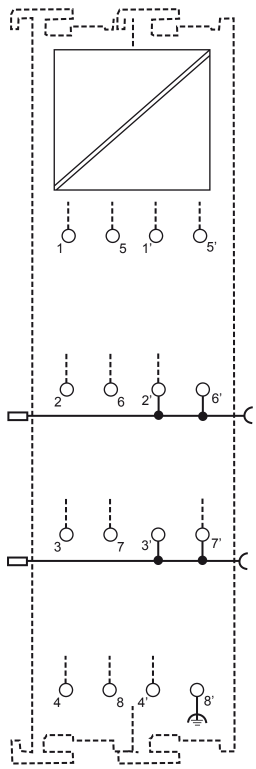




Terminal	No	Description
Output 1	1	Output 1
-	2	Not connected
GND	3	Internal ground (internally connected with terminal point 7)
Shield	4	PE contact (internally connected with terminal point 8)
Output 2	5	Output 2
-	6	Not connected
GND	7	Internal ground (internally connected with terminal point 3)
Shield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

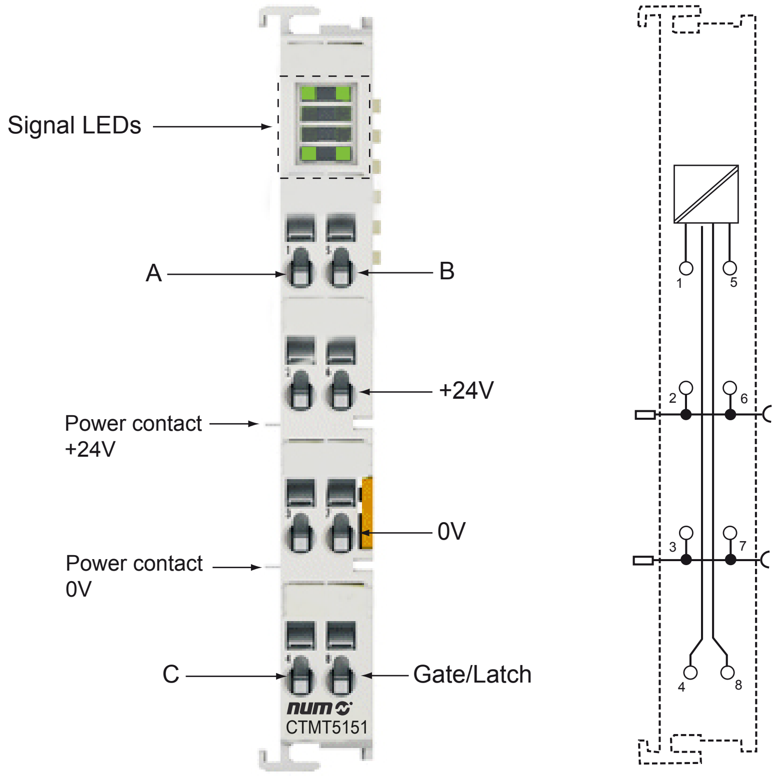
4.5.24 CTMT5101 Terminal connections





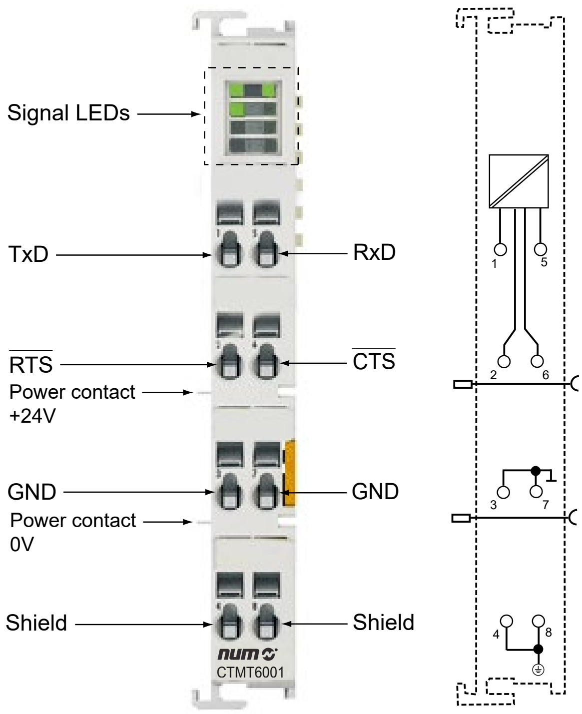
Terminal	No	Description
A	1	Encoder input A
B	2	Encoder input B
C	3	Encoder input C
Latch 24V	4	Latch input
$\overline{A}$	5	Encoder input / A
$\overline{B}$	6	Encoder input / B
$\overline{C}$	7	Encoder input / C
Gate 24V	8	Gate input
Ue = +5V	1'	+5V Encoder supply
+24V	2'	+24V (connected internally 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

4.5.25 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

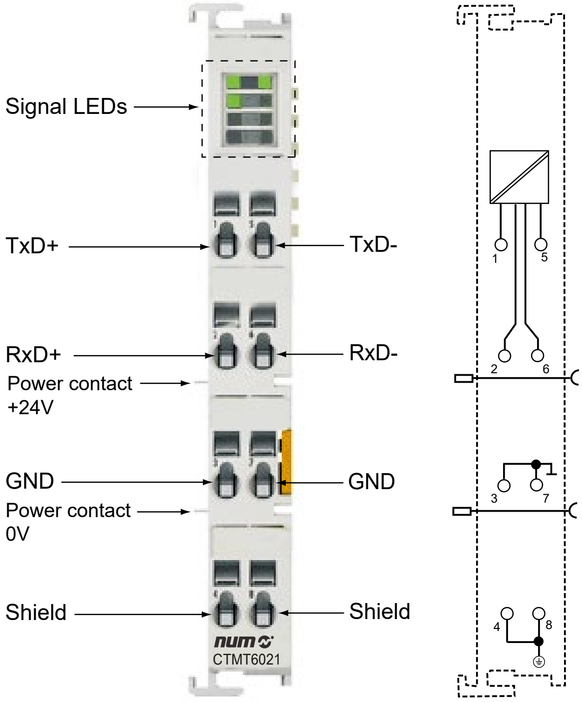
4.5.26 CTMT6001 Terminal connections



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)

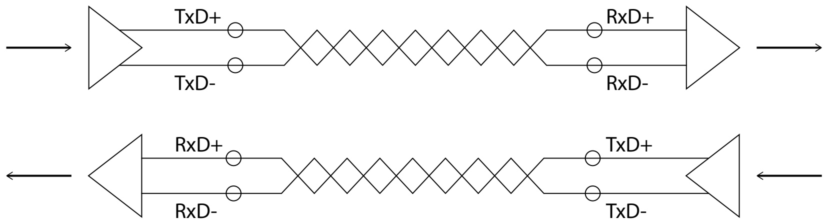
4.5.27 CTMT6021 Terminal connections



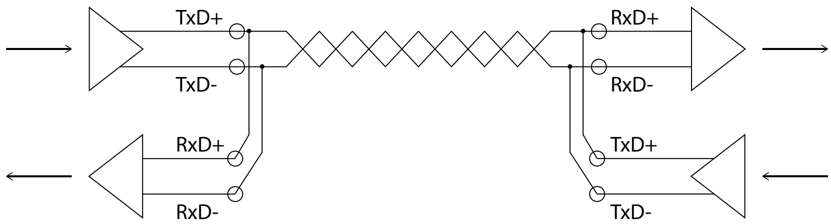
Connections with CTMT6021

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.

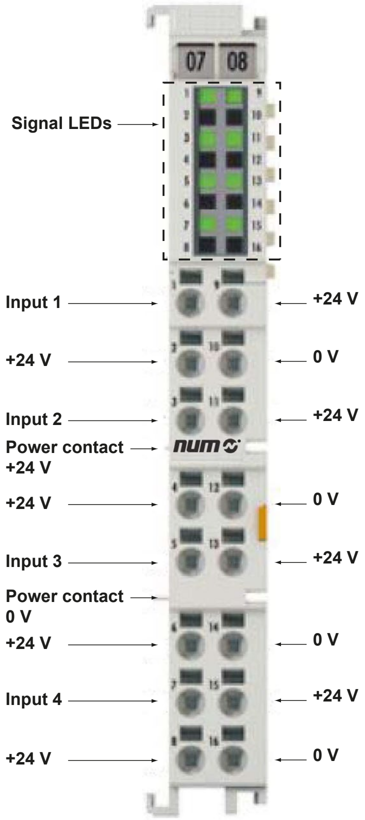


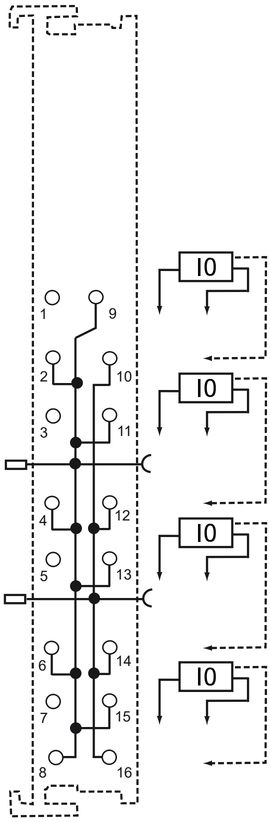
The transmit and receive lines are connected to one another in RS485 operating mode.
As a result, the terminal receives not only the data from other devices, but also its own transmitted data.

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.

4.5.28 CTMT6224 Terminal connections



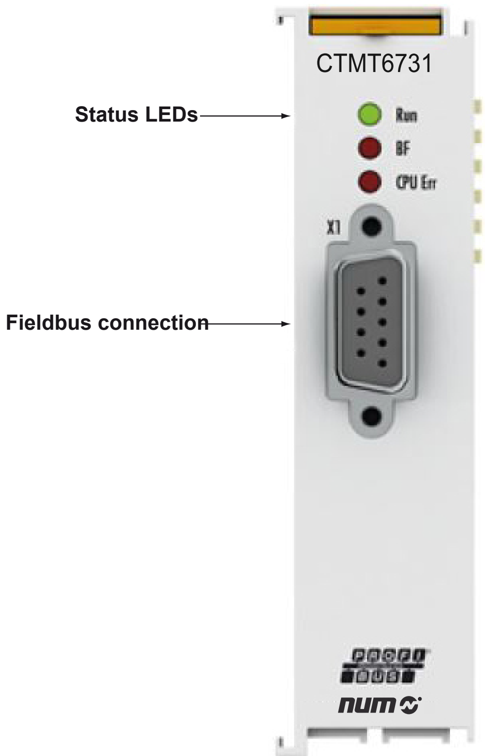


Connections

Terminal	No	Description
Input 1	1	**Input 1**
+ 24 V	2	**+ 24 V**
Input 2	3	**Input 2**
+ 24 V	4	**+ 24 V**
Input 3	5	**Input 3**
+ 24 V	6	**+ 24 V**
Input 4	7	**Input 4**
+ 24 V	8	**+ 24 V**
+ 24 V	9	**+ 24 V**
0 V	10	**0 V**
+ 24 V	11	**+ 24 V**
0 V	12	**0 V**
+ 24 V	13	**+ 24 V**
0 V	14	**0 V**
+ 24 V	15	**+ 24 V**
0 V	16	**0 V**

Damage to the devices possible!
The IO-Link Devices must be powered from the 24 V supply of the CTMT6224 otherwise the IO-Link port may be damaged!

4.5.29 CTMT6731 Terminal connections



Nine-pin D-Sub

Pin 6 transfers 5 VDC, pin 5 transfers GND for the active termination resistor. These must never be misused for other functions, as this can lead to destruction of the device.

Pins 3 and 8 transfer the PROFIBUS signals. These must never be swapped over, as this will prevent communication (Fig.20).

Pin assignment of the PROFIBUS D-sub socket

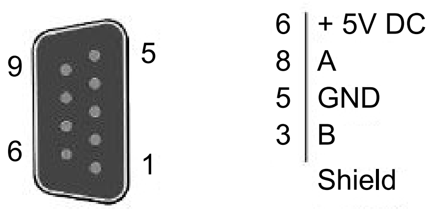
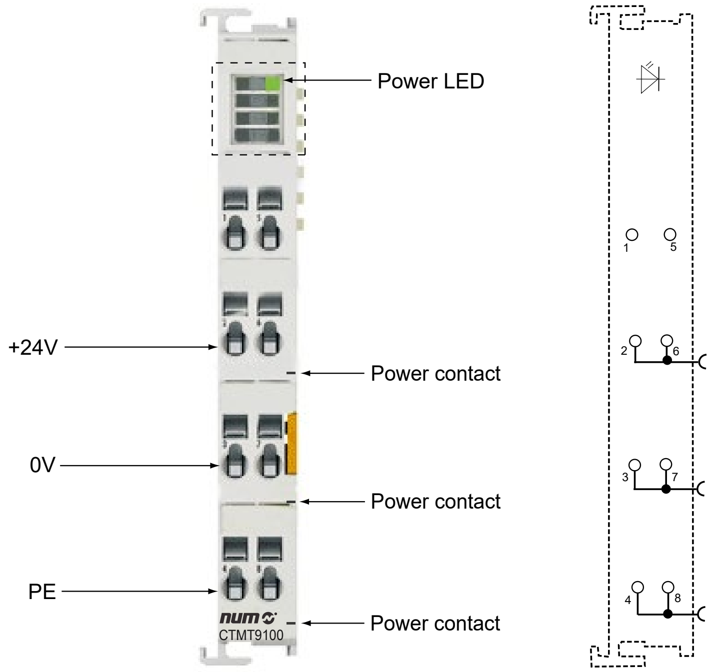


Fig.20 Pin assignment of the PROFIBUS D-sub socket

PROFIBUS line	M12	D-Sub
B red	Pin 4	Pin 3
A green	Pin 2	Pin 8

4.5.30 CTMT9100 Terminal connections



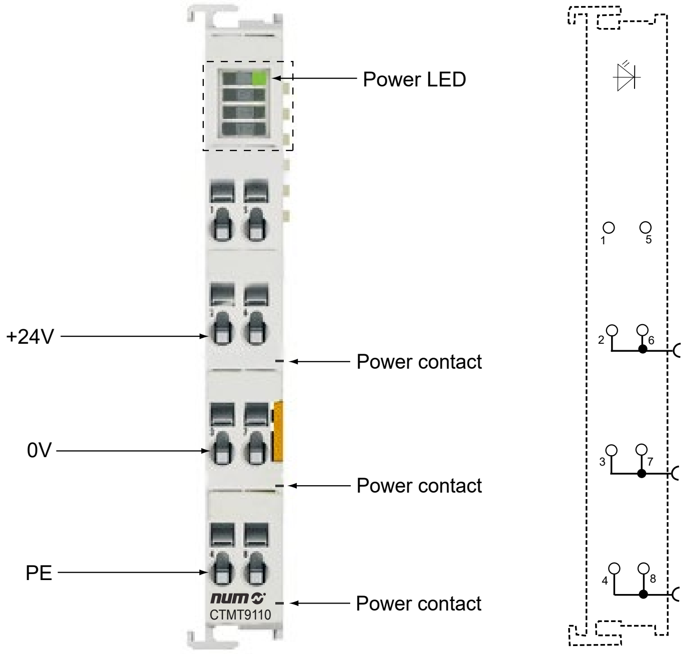
CTMT9100 Connections

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)

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!

4.5.31 CTMT9110 Terminal connections



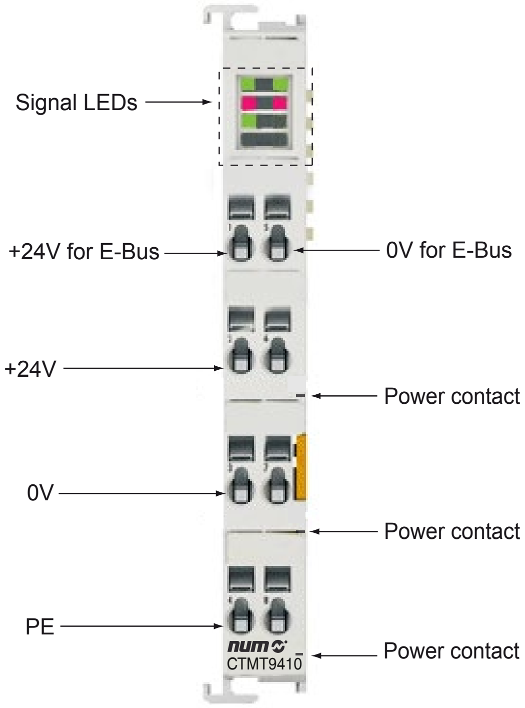
CTMT9110 Connections

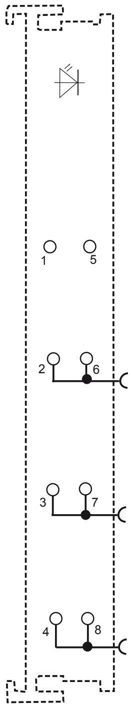
Terminal	No	Description
-	1	Not used
+24V	2	Supply input +24V
0V	3	0V for supply input
PE	4	PE (connected internally with terminal 8 and PE power contact)
-	5	Not used
+24V	6	Supply input +24V
0V	7	0V for supply input
PE	8	PE (connected internally with terminal 4 and PE power contact)

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!

4.5.32 CTMT9410 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)

4.6 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.

Page deliberately empty

1
2
3
4
5
6
7

Summary

Page deliberately empty

5 Terminal configuration with Flexium Tools

5.1 Entering the terminals configuration

All the NUM EtherCAT terminals are sold with a default configuration, that usually satisfy the standard application. For the NUM EtherCAT terminals that could assume different setup configuration the Flexium Tools coud be used to perform that in a fixed mode. This could be done via dedicated CoE object that are described in this chapter.

The following NUM EtherCAT terminals don't need and so don't offer setup configuration.

CTMT1004	4 channel digital input terminal 24VDC, 3ms input filter
CTMT1008	8 channel digital input terminal 24VDC, 3ms input filter
CTMT1804	4 digital inputs 24VDC, 3ms input filter
CTMT1809	16 digital inputs 24VDC, 3ms input filter
CTMT1859	8 digital inputs and 8 digital outputs 24 VDC
CTMT2004	4 channel digital output terminal 24VDC, 0.5A
CTMT2008	8 channel digital output terminal 24VDC, 0.5A
CTMT2024	4 channel digital output terminal 24VDC, 2A
CTMT2602	2 channel relay output terminals 230VAC
CTMT2612	2 channel relay output terminals
CTMT2809	16 digital output HD terminal 24VDC

For the others NUM EtherCAt terminals you will found tabs in FlexiumTools like in the following

example

Selecting a device on the EtherCAT tree, a Process Data configuration (Fig.21) could be modified, so the related EtherCAT I/O Mapping (Fig.22) will be configured

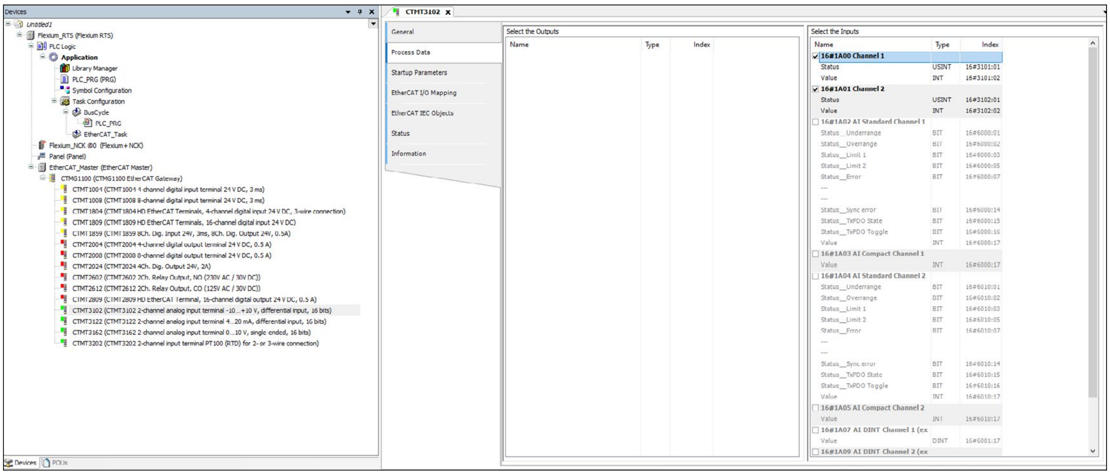


Fig.21 Process Data configuration

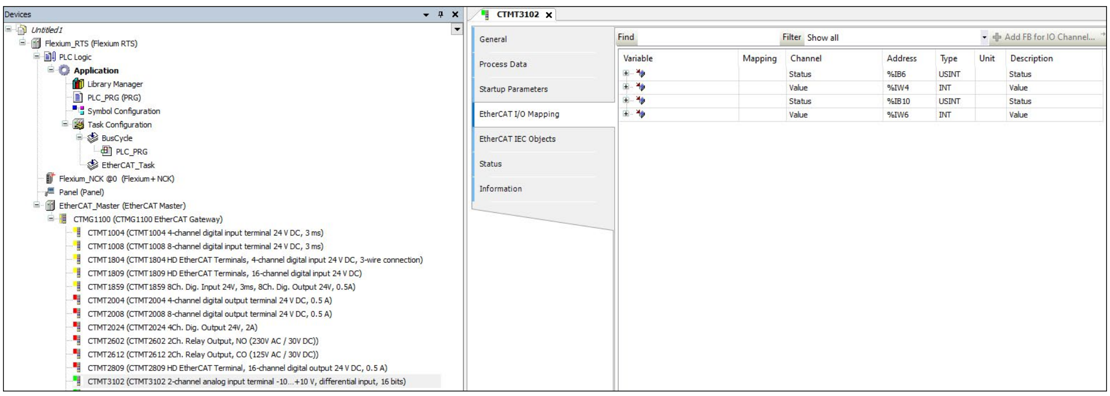


Fig.22 EtherCAT I/O Mapping

Unselecting for example 16#1A00 different options are offered: 16#1A02, 16#1A03, 16#1A07 (Fig.23)

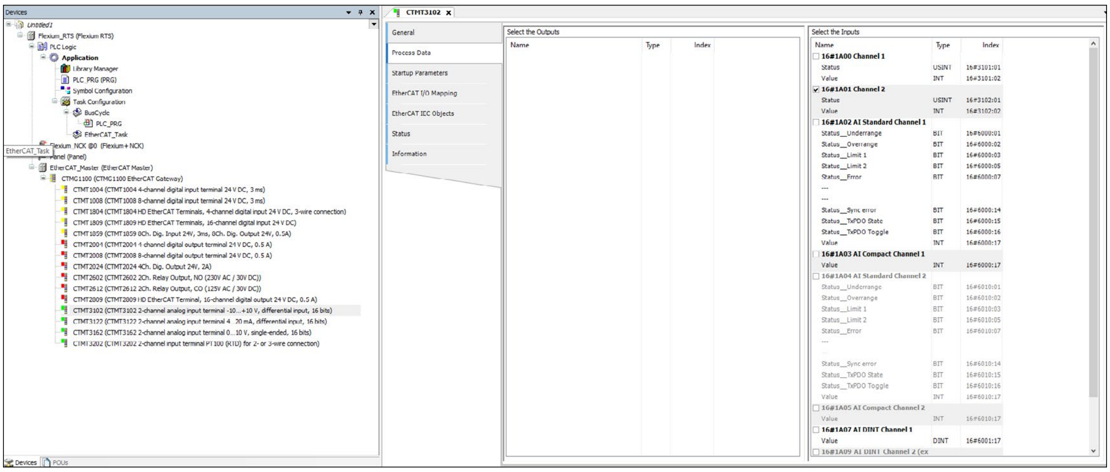


Fig.23 Optional EtherCAT I/O Mapping configuration

and selecting 16#1A02 (Fig.24) we will obtain the new EtherCAT I/O Mapping (Fig.25)

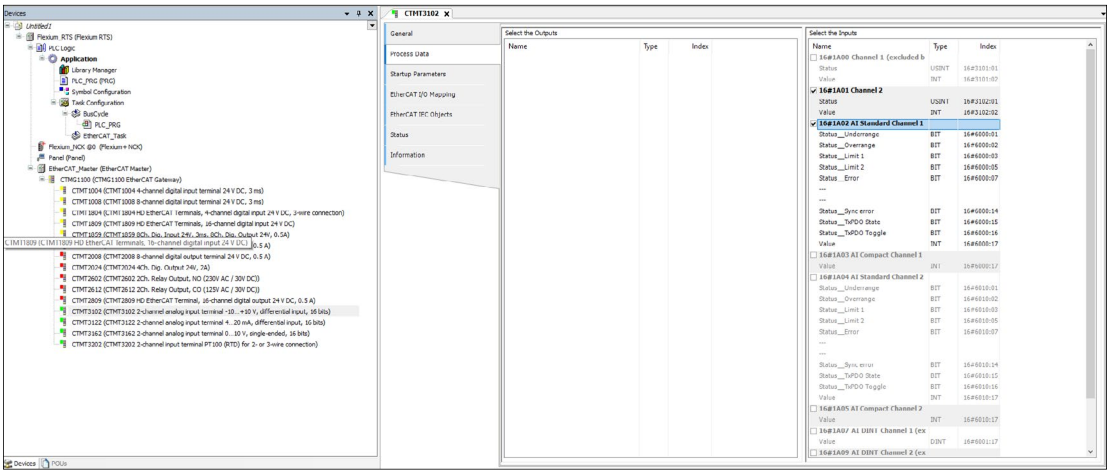


Fig.24 EtherCAT I/O Mapping selection

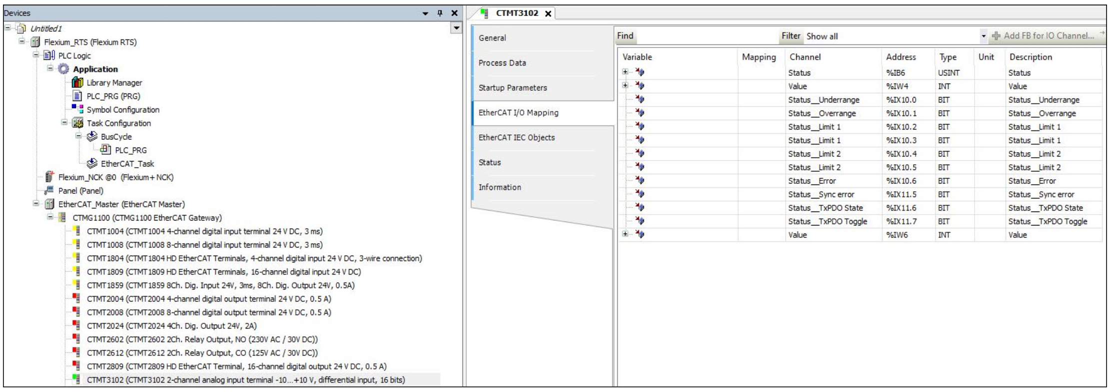


Fig.25 EtherCAT I/O Mapping configuration

5.2 Data management and function “NoCoEStorage”

Some parameters, particularly the setting parameters of the slave, are configurable and writeable. This can be done:
- via Flexium Tools - Startup Parameters
- from the control system/PLC via ETC_CO_SdoWrite blocks from the IODrvEtherCAT library

This is recommended for modifications while the system is running or if no Startup Parameters or operating staff are available.

Data management
If slave CoE parameters are modified online, NUM EtherCAT terminals devices store any changes in a fail-safe manner in the EEPROM, i.e. the modified CoE parameters are still available after a restart.

The situation may be different with other manufacturers.
An EEPROM is subject to a limited lifetime with respect to write operations. From typically 100000 write operations onwards it can no longer be guaranteed that new (changed) data are reliably saved or are still readable. This is irrelevant for normal commissioning. However, if CoE parameters are continuously changed via SdoWrite at machine runtime, it is quite possible for the lifetime limit to be reached.

Support for the NoCoEStorage function, which suppresses the saving of changed CoE values, depends on the firmware version.

Please refer to the technical data in this documentation as to whether this applies to the respective device.
- If the function is supported: the function is activated by entering the code word 16#12345678 (305419896$_{dec}$) once in CoE 16#F008 and remains active as long as the code word is not changed. After switching the device on it is then inactive. Changed CoE values are not saved in the EEPROM and can thus be changed any number of times.
- Function is not supported: continuous changing of CoE values is not permissible in view of the lifetime limit.

5.3 Startup list

Changes in the local CoE list of the terminal are lost if the terminal is replaced. If a terminal is replaced with a new NUM EtherCAT terminal, it will have the default settings. It is therefore advisable to link all changes in the CoE list of an EtherCAT slave with the Startup list of the slave, which is processed whenever the EtherCAT fieldbus is started. In this way a replacement EtherCAT slave can automatically be parameterized with the specifications of the user.

If EtherCAT slaves are used which are unable to store local CoE values permanently, the Startup list must be used.

The configuration of the NUM EtherCAT terminal by means of Startup Parameters starts selecting the device on the Flexium Tools EtherCAT tree, then selecting the “Startup Parameters” tab (Fig.26) and after selecting “+Add” that opens the list of the configurable parameters (Fig.27).

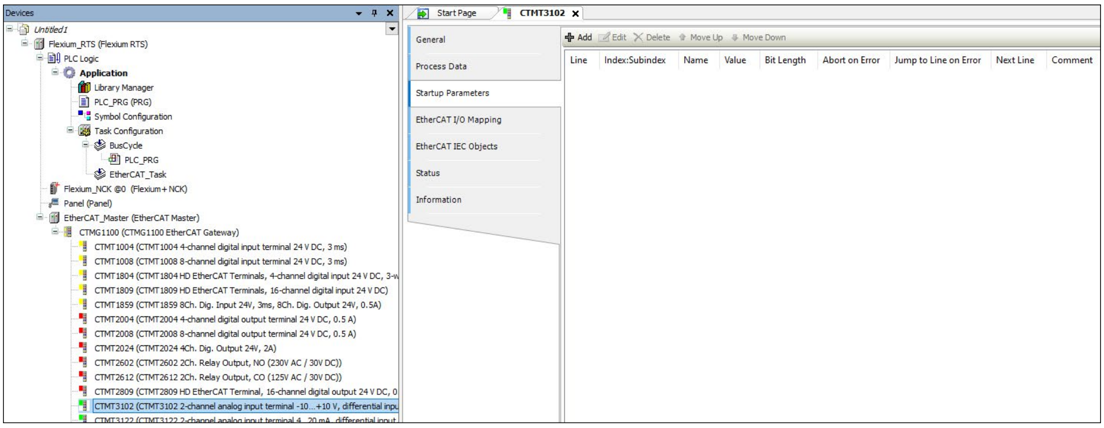


Fig.26 Startup Parameters

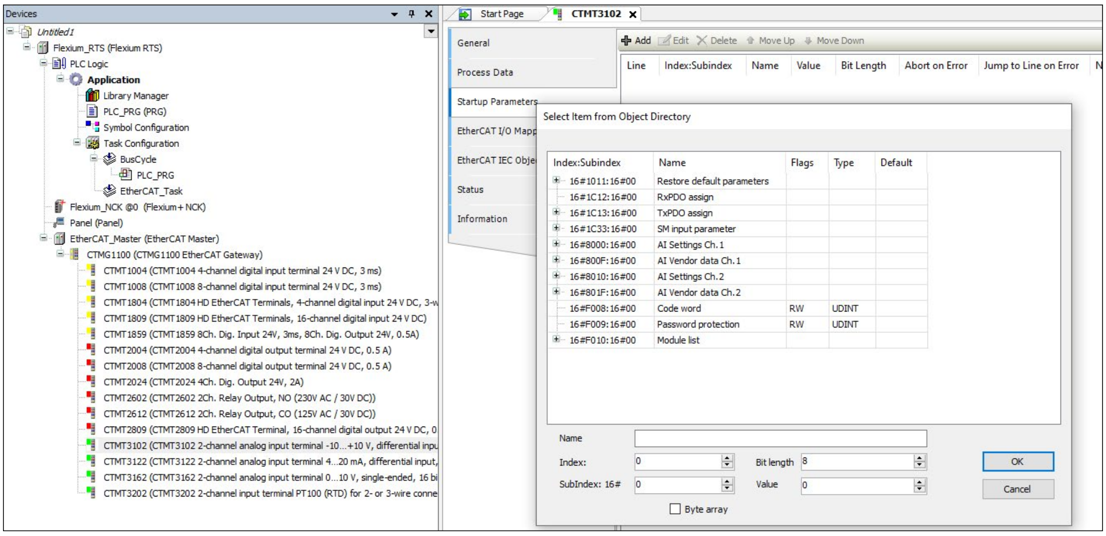


Fig.27 Configurable parameters

The description of the parameter meaning related to each NUM EtherCAT terminal is described in the following chapters

5.4 Restore object

This CoE object gives the opportunity to restore all the parameters to their delivery state.

5.4.1 Index 16#1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters	Restore default parameters	UINT8	RO	16#01 (1_{dec})
1011:01	SubIndex 001	If this object is set to “16#64616F6C” in the set value dialog, all backup objects are reset to their delivery state.	UINT32	RW	16#00000000 (0_{dec})

5.5 CTMT3102 CTMT3122 CTMT3162 configuration objects

5.5.1 Index 16#80n0 (for 0 ≤ n ≤ 1)

n = 0 for Channel 1, n = 1 for Channel 2

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	AI Settings	Maximum subindex	UINT8	RO	16#18 (24_{dec})
80n0:01	Enable user scale	User scale is active.	BOOLEAN	RW	16#00 (0_{dec})
80n0:02	Presentation	0: Signed presentation 1: Unsigned presentation 2: Absolute value with MSB as sign. Signed amount representation	BIT3	RW	16#00 (0_{dec})
80n0:05	Siemens bits	The S5 bits are displayed in the three low-order bits	BOOLEAN	RW	16#00 (0_{dec})
80n0:06	Enable filter	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	16#00 (0_{dec})
80n0:07	Enable limit 1	Limit 1 enabled	BOOLEAN	RW	16#00 (0_{dec})
80n0:08	Enable limit 2	Limit 2 enabled	BOOLEAN	RW	16#00 (0_{dec})
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	16#00 (0_{dec})
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	16#01 (1_{dec})
80n0:0E	Swap limit bits	Changing of the Limit Bits	BOOLEAN	RW	16#00 (0_{dec})
80n0:11	User scale offset	User scaling offset	INT16	RW	16#0000 (0_{dec})
80n0:12	User scale gain	User scaling gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65536_{dec} (16#00010000) and is limited to ±16#7FFFF	INT32	RW	16#00010000 (65536_{dec})
80n0:13	Limit 1	First limit value for setting the status bits	INT16	RW	16#0000 (0_{dec})
80n0:14	Limit 2	Second limit value for setting the status bits	INT16	RW	16#0000 (0_{dec})
80n0:15	Filter settings	This object determines the digital filter settings, if it is active via Enable filter (index 16#80n0:06. The possible settings are sequentially numbered. 0: 50 Hz FIR 1: 60 Hz FIR 2: IIR 1 3: IIR 2 4: IIR 3 5: IIR 4 6: IIR 5 7: IIR 6 8: IIR 7 9: IIR 8	UINT16	RW	16#0000 (0_{dec})
80n0:17	User calibration offset	User offset compensation	INT16	RW	16#0000 (0_{dec})
80n0:18	User calibration gain	User calibration gain	INT16	RW	16#4000 (16384_{dec})

5.5.2 Presentation, index 16#80n0:02

The measured value output is set in factory to two's complement representation (signed integer). Index 16#80n0:02 offers the possibility to change the method of representation of the measured value.

Signed integer representation
The negative output value is represented in two's complement (negated + 1).
Maximum representation range for 16 bits = -32768_{dec} to $+32767_{dec}$

Input signal			Value	
CTMT3102	CTMT3122	CTMT3162	Decimal	Hexadecimal
10 V	20 mA	10 V	32767	16#7FFF
5 V	12 mA	5 V	16383	16#3FFF
0 V	4 mA	0 V	0	16#0000
- 5 V	-	-	-16383	16#C001
- 10 V	-	-	-32768	16#8000

5.5.3 Siemens bits, index 16#80n0:05

If this bit is set, status displays are superimposed on the lowest three bits. In the error case "overrange" or "underrange", bit 0 is set.

5.5.4 Limit 1, index 16#80n0:13 and Limit 2, index 16#80n0:14

If the value exceeds or falls below these values, which can be entered in the indices 16#80n0:13 and 16#80n0:14, then the bits in the indices 16#60n0:03 and 16#60n0:05 are set accordingly (see example below). The indices 16#80n0:07 or 16#80n0:08 serve to activate the limit value monitoring.

Output limit n (2-bit):	
0:	not active
1:	Value is smaller than the limit value
2:	Value is larger than the limit value
3:	Value is equal to the limit value

Limit evaluation
The limit evaluation assumes a signed representation. The conversion to the desired representation (index 16#80n0:02) only takes place after the limit evaluation.

Example for CTMT3162:

Channel 1; Limit 1 and Limit 2 enabled, Limit 1 = 2.8 V, Limit 2 = 7.4 V, representation: signed integer
Entry in index (Limit 1): 16#8000:13
$(2.8\ V / 10\ V) \times 2^{16} / 2 - 1 = \mathbf{9174}_{dec}$

Entry in index (Limit 2): 16#8000:14
$(7.4\ V / 10\ V) \times 2^{16} / 2 - 1 = \mathbf{24247}_{dec}$

Input channel 1	Index 16#6000:03	Index 16#6000:05
1.8 V	16#01$_{hex}$, (Limit 1, limit value undershot)	16#01$_{hex}$, (Limit 2, limit value undershot)
2.8 V	16#03$_{hex}$, (Limit 1, limit value reached)	16#01$_{hex}$, (Limit 2, limit value undershot)
4.2 V	16#02$_{hex}$, (Limit 1, limit value exceeded)	16#01$_{hex}$, (Limit 2, limit value undershot)
8.5 V	16#02$_{hex}$, (Limit 1, limit value exceeded)	16#02$_{hex}$, (Limit 2, limit value exceeded)

5.5.5 Swap Limit index 16#80n0:0E

The limit function can be inverted by *SwapLimitBits* in index 16#80n0:0E.
Output Limit n (2-bit):

SwapLimitBits setting	Value
FALSE (default setting)	0: not active 1: value < limit value 2: value > limit value 3: Value is equal to the limit value
TRUE	0: not active 1: value > limit value 2: value < limit value 3: Value is equal to the limit value

5.5.6 Channel status BYTE

The status byte is located in the input process image, and is transmitted from terminal to the controller.

Bit	7	6	5	4	3	2	1	0
Name	-	ERROR	Limit 2		Limit 1		Overrange	Underrange

5.5.7 Channel status WORD

If activated by means of Flexium Tools, selected EtherCAT Device, Process Data tab.
The status word is located in the input process image, and is transmitted from terminal to the controller.

Bit	15	14	13	12	11	10	9	8
Name	TxPDO Toggle	TxPDO State	Sync error	-	-	-	-	-

Bit	7	6	5	4	3	2	1	0
Name	-	ERROR	Limit 2		Limit 1		Overrange	Underrange

5.5.8 Operating modes

The CTMT31x2 accordingly supports three different operating modes: Freerun (filter on, timer interrupt), Synchron (filter off, SyncManager interrupt) and DC (DC Sync interrupt) (Fig.28).

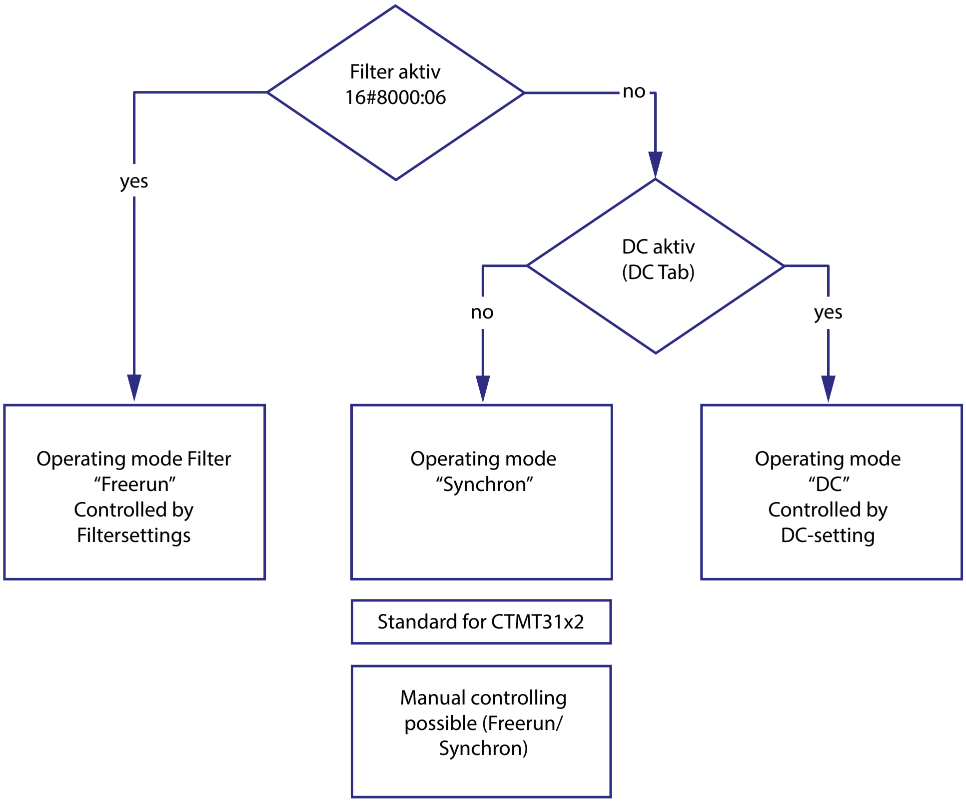


Fig.28 Relationship of operating modes

The terminal switches between the Freerun (filter on) and Synchron modes by activating/deactivating the filter via the index. The terminal remains in OP mode during this process. The changeover may result in longer sampling times and step changes in the process data until the filters have assumed a steady state.

DC mode can only be used when the filters are switched off. Likewise, it is not possible to switch the filters on in DC mode. The DC mode is parameterized via the DC section iof the NUM EtherCAT terminal (Fig.29)

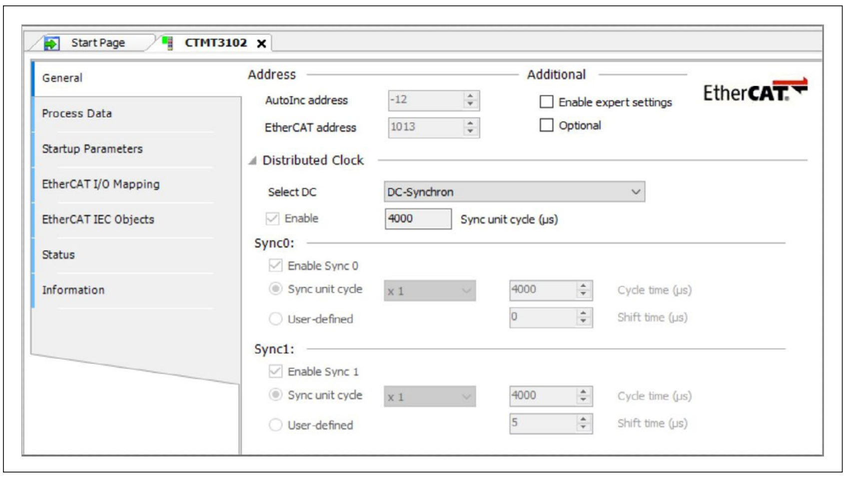


Fig.29 DC mode

DC operation

In DC mode the process data are requested via DC interrupt. This results in the temporal jitter between two frames being equalized, so that the sampling time is uniform across the system.

The CTMT31x2 should be operated in DC input based mode.
The DC mode requires minimum cycle times of

- 100 µs (CTMT31x2 in 1 channel mode)
- 125 µs (CTMT31x2 in 2 channel mode)

5.5.9 Filter operation (FIR and IIR), index 16#80n0:06, 16#80n0:15

The CTMT31x2 terminals incorporate a digital filter which, depending on its settings, can adopt the characteristics of a Finite Impulse Response filter (an FIR filter), or an Infinite Impulse Response filter (an IIR filter). The filter is deactivated by default. Please observe the following note regarding activation with index 16#x8000:06

Activation of the filter with index 16#8000:06 and setting of the filter characteristics via index 16#8000:15

The filter frequencies are set for all channels of the CTMT31x2 terminals centrally via index 16#8000:15 (channel 1). The corresponding indices 16#80n0:15 of the other channels have no parameterization function.

FIR filter

Parameterized via the index 16#8000:15.
The filter performs a notch filter function and determines the conversion time of the terminal. The higher the filter frequency, the faster the conversion time. A 50 Hz and a 60 Hz filter are available.

Notch filter means that the filter has zeros (notches) in the frequency response at the filter frequency and multiples thereof, i.e. it attenuates the amplitude at these frequencies.
The FIR filter operates as a non-recursive filter (Fig.30).

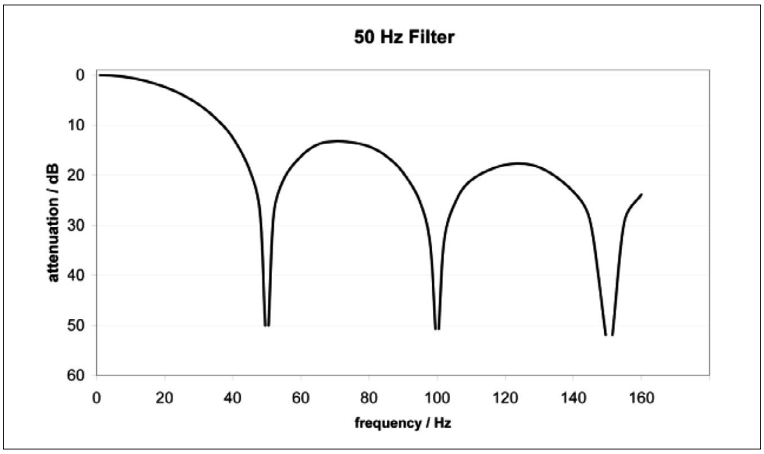


Fig.30 Attenuation curve notch. filter at 50 Hz

Filter data for FIR filter (1 to 2-channel terminals)			
Filter	Attenuation	Limit frequency (-3 dB)	Conversion time
50 Hz FIR	> 50 dB	22 Hz	625 µs
60 Hz FIR	> 45 dB	26 Hz	521 µs

IIR filter

The filter with IIR characteristic is a time-discrete, linear, time-invariant low-pass filter of 1st order (-20dB/decade), which can be adjusted in 8 levels, i.e. cut-off frequencies. (level 1 = weak recursive filter, up to level 8 = strong recursive filter).

The IIR can be understood to be a moving average value calculation after a low-pass filter.
Through the synchronization mode FreeRun the IIR filter operates with an internal cycle time of 180 µs (1 or 2 channels).

IIR filter	CTMT31x2, sampling time 180 µs
	Limit frequency (-3 dB)
IIR 1	1 kHz
IIR 2	500 Hz
IIR 3	285 Hz
IIR 4	142 Hz
IIR 5	66 Hz
IIR 6	33 Hz
IIR 7	17 Hz
IIR 8	8.2 Hz

5.5.10 Data stream and measurement ranges

Data stream

The flow chart (Fig.31) illustrates the data stream in the CTMT31x2 (processing of the raw data).

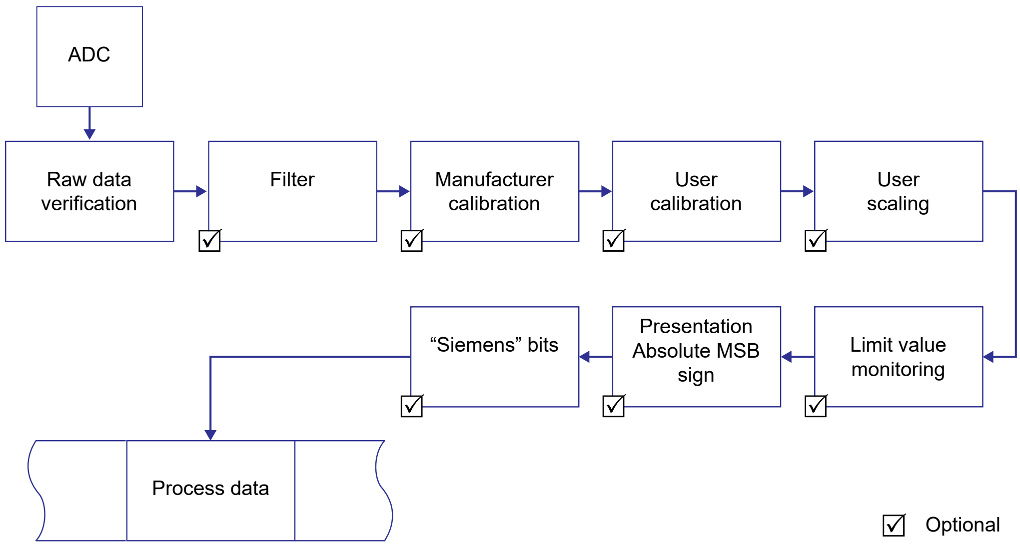


Fig.31 Data stream representation of the CTMT31x2

Calculation of process data

The concept "calibration", which has historical roots, is used here even if it has nothing to do with the deviation statements of a calibration certificate. Actually, this is a description of the vendor or customer calibration data/adjustment data used by the device during operation in order to maintain the assured measuring accuracy.

The terminal constantly records measured values and saves the raw values from its A/D converter in the ADC raw value object 16#80nE:01. After each recording of the analog signal, the correction calculation takes place with the vendor and user calibration data as well as the user scaling, if these are activated.

Calculation	Designation
$X_F = f\,(X_{ADC})$	Output value after the filter
$Y_H = (X_{ADC} - B_H) \times A_H \times 2^{-14}$	Measured value after vendor calibration
$Y_A = (Y_H - B_A) \times A_A \times 2^{-14}$	Measured value after vendor and user calibration
$Y_S = Y_A \times A_S \times 2^{-16} + B_S$	Measured value following user scaling

Name	Designation	Index
X_{ADC}	Output value of the A/D converter	16#80nE:01
X_F	Output value after the filter	-
B_H	Vendor calibration offset (not changeable)	16#80nF:01
A_H	Vendor calibration gain (not changeable)	16#80nF:02
B_A	User calibration offset (can be activated via index 16#80n0:0A	16#80n0:17
A_A	User calibration gain (can be activated via index 16#80n0:0A	16#80n0:18
B_S	User scaling offset (can be activated via index 16#80n0:01	16#80n0:11
A_S	User scaling gain (can be activated via index 16#80n0:01	16#80n0:12
Y_S	Process data for controller	-

Measurement result

The accuracy of the result may be reduced if the measured value is smaller than 32767 / 4 due to one or more multiplications.

Measurement ranges

The diagrams at the bottom show the output values of the measurement ranges and the behavior if the limit ranges are exceeded.

CTMT3102

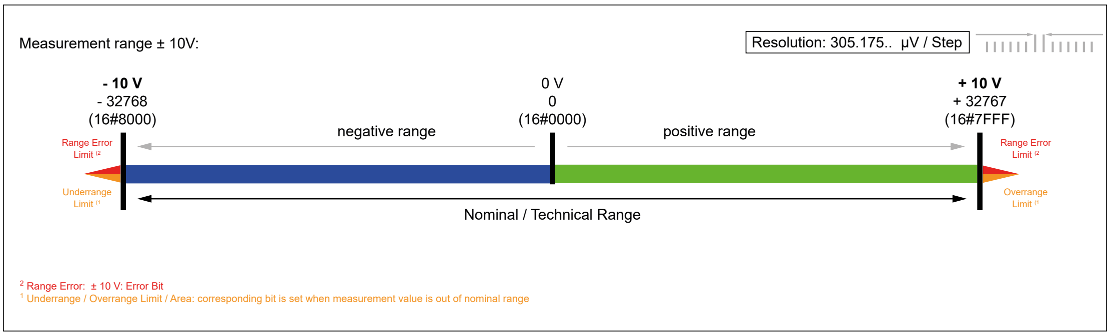


Fig.32 CTMT3102 Measurement range ± 10 V

CTMT3122

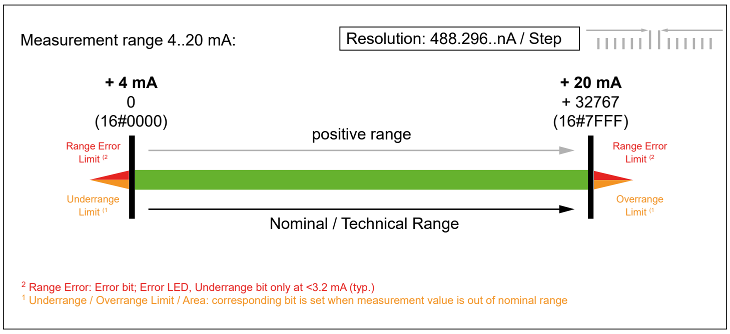


Fig.33 CTMT3122 Measurement range 4...20 mA

CTMT3162

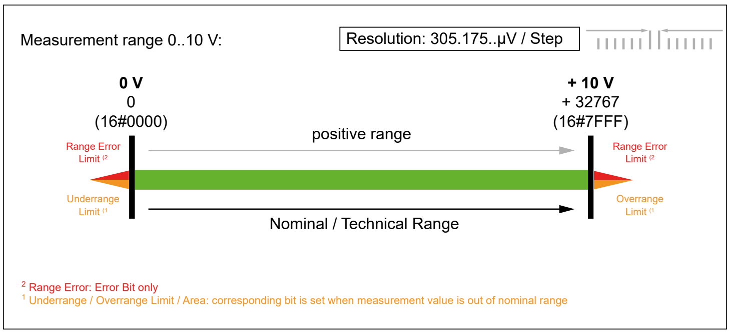


Fig.34 CTMT3162 Measurement range 0...10 V

5.5.11 Vendor calibration, index 16#80n0:0B

The vendor calibration is enabled via index 16#80n0:0B. Parameterization takes place via the indices

- 16#80nF:01 Vendor calibration: Offset
- 16#80nF:02 Vendor calibration: Gain

5.5.12 User calibration, index 16#80n0:0A

The user calibration is enabled via index 16#80n0:0A. Parameterization takes place via the indices

- 16#80n0:17 User calibration: Offset
- 16#80n0:18 User calibration: Gain

5.5.13 User scaling, index 16#80n0:01

The user scaling is enabled via index 16#80n0:01. Parameterization takes place via the indices

- 16#80n0:11 User scaling: Offset
- 16#80n0:12 User scaling: Gain

Manufacturer calibration
The vendor reserves the authority for the basic calibration of the terminals. Therefore, the vendor calibration cannot be changed.

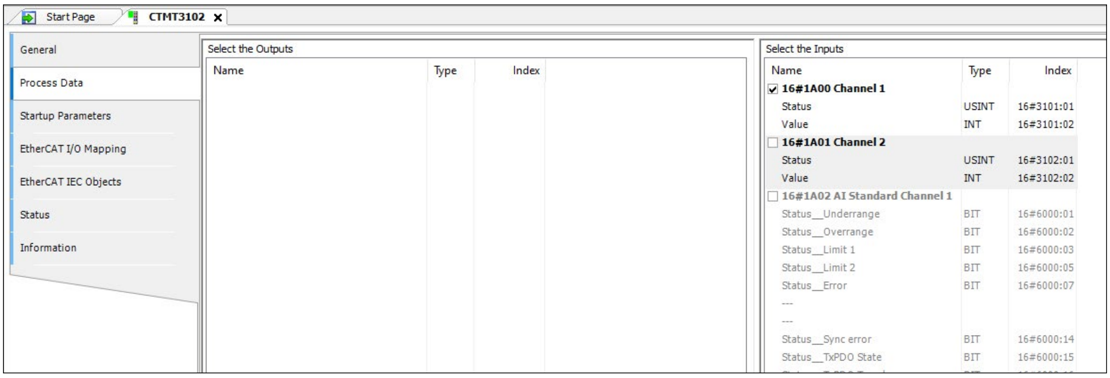
5.5.14 Fast mode

The Fast mode in NUM EtherCAT Terminals has developed historically and is an operating mode with which CTMT Terminals, primarily the CTMT31xx and CTMT41xx groups (analog input/output terminals), can be operated with a considerably faster conversion time. Hence, an analog input value can be converted more quickly/more often or output via the controller accordingly. This is achieved at the expense of other features, therefore consideration is required.

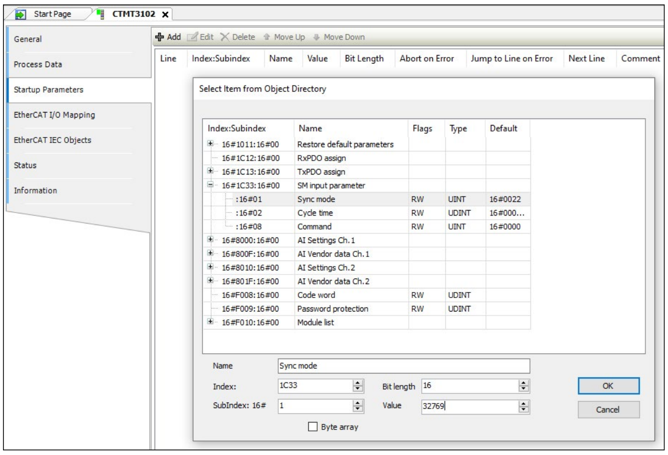
If a CTMT Terminal supports this mode, this is indicated in the relevant documentation.
You can switch the two-channel analog input and output terminals into Fast Mode by:

- **switching off the second channel**. When operating with a single channel (Fast Mode) the terminal's conversion time is about one third less than it is when operating two channels. You can find the precise figures for the conversion times in single-channel and two-channel operation in the technical data for the each particular terminal.
- **CoE access can be deactivated** in these terminals (if this is possible according to the documentation). All existing channels can convert faster as a result of this. In CTMT31x2 terminals the Fast mode is automatic enabled but disabled for CoE access.

FastMode by means of channel deactivation
You can switch the second input channel on and off on the Process Data tab



FastMode by means of CoE deactivation
To disable CoE support for input terminals, a 16#8001 (32769_{dec}) in CoE 16#1C33:01 must be entered in the StartUp list in the Startup Parameters tab for the terminal.



Filter deactivation for input terminals
If FastMode is enabled, filter mode (16#80n0:06) must be disabled!

The CoE access can be reactivated by writing the original value or, for example, x00 in the PREOP phase after CoE 16#1C33:01.

5.6 CTMT3202 configuration objects

5.6.1 Index 16#80n0 (for 0 ≤ n ≤ 1)

n = 0 for Channel 1, n = 1 for Channel 2

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	16#1B (27$_{dec}$)
80n0:01	Enable user scale	User scale is active.	BOOLEAN	RW	16#00 (0$_{dec}$)
80n0:02	Presentation	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100 C°)	BIT3	RW	16#00 (0$_{dec}$)
80n0:05	Siemens bits	The S5 bits are superimposed on the three low-order bits (value 16#60n0:11) Bit 0 = 1 (“overrange” or “underrange”) Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	16#00 (0$_{dec}$)
80n0:06	Enable filter	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	16#00 (0$_{dec}$)
80n0:07	Enable limit 1	The status bits are set in relation to Limit 1	BOOLEAN	RW	16#00 (0$_{dec}$)
80n0:08	Enable limit 2	The status bits are set in relation to Limit 2	BOOLEAN	RW	16#00 (0$_{dec}$)
80n0:09	Enable automatic calibration	A calibration is cyclically started. (optional)	BOOLEAN	RW	16#00 (0$_{dec}$)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	16#00 (0$_{dec}$)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	16#01 (1$_{dec}$)
80n0:11	User scale offset	User scaling offset	INT16	RW	16#0000 (0$_{dec}$)
80n0:12	User scale gain	This is the user scaling gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65536 (16#00010000).	INT32	RW	16#00010000 (65536$_{dec}$)
80n0:13	Limit 1	First limit value for setting the status bits (resolution 0.1 °C)	INT16	RW	16#0000 (0$_{dec}$)
80n0:14	Limit 2	Second limit value for setting the status bits (resolution 0.1 °C)	INT16	RW	16#0000 (0$_{dec}$)
80n0:15	Filter settings	This object determines the digital filter settings, if it is active via Enable filter (index 16#80n0:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	INT16	RW	16#0000 (0$_{dec}$)
80n0:16	Calibration intervall	Intervall of the cyclic calibration	INT16	RW	16#0000 (0$_{dec}$)
80n0:17	User calibration offset	User offset calibration	INT16	RW	16#0000 (0$_{dec}$)

80n0:18	User calibration gain	User gain compensation	INT16	RW	16#FFFF (65535_{dec})
80n0:19	RTD element	RTD element 0: Pt100 (-200...850°C) 1: Ni100 (-60 ... 250°C) 2: Pt1000 (-200 ... 850°C) 3: Pt500 (-200 ... 850°C) 4: Pt200 (-200 ... 850°C) 5: Ni1000 (-60 ... 250°C) 6: Ni1000 TK5000, 100°C: 1500 Ohm (-30...160°C) 7: Ni120 (-60 ... 320°C) 8: Output in Ohm Resolution 1/16 Ohm (0 to 4096 Ohm)*** 9: Output in Ohm Resolution 1/64 Ohm (0 to 1024 Ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please note “General” chapter 3.17	INT16	RW	16#0000 (0_{dec})
80n0:1A	Connection technology	Connection technology 0: 2-wire 1: 3-wire 2: 4-wire - not admitted by CTMT3202 3: not connected	UINT16	RW	16#0000 (0_{dec})
80n0:1B	Wire calibration 1/32 Ohm	Calibration of the supply lines	INT16	RW	16#0000 (0_{dec})

5.6.2 Presentation, index 16#80n0:02

In the delivery state, the measured value is output in increments of 1/10° C in two's complement format (signed integer).
The complete measuring range is output for each resistance sensor. Index 16#80n0:02 offers the possibility to change the method of representation of the measured value.

Measured value	Output (hexadecimal)	Output (signed integer, decimal)
-250.0 °C	16#F63C	-2500
-200.0 °C	16#F830	-2000
-100.0 °C	16#FC18	-1000
-0.1 °C	16#FFFF	-1
-0.0 °C	16#0000	0
-0.1 °C	16#0001	1
100.0 °C	16#03E8	1000
200.0 °C	16#07D0	2000
500.0 °C	16#1388	5000
850.0 °C	16#2134	8500

- **Signed Integer**
  The measured value is presented in two's complement format.
  Maximum presentation range for 16 bit = -32768 .. +32767

  Example:

  $1000\ 0000\ 0000\ 0000_{bin}$ = 8000_{hex} = $-\ 32768_{dec}$
  $1111\ 1111\ 1111\ 1110_{bin}$ = $FFFE_{hex}$ = $-\ 2_{dec}$
  $1111\ 1111\ 1111\ 1111_{bin}$ = $FFFF_{hex}$ = $-\ 1_{dec}$
  $0000\ 0000\ 0000\ 0001_{bin}$ = 0001_{hex} = $+1_{dec}$
  $0000\ 0000\ 0000\ 0010_{bin}$ = 0002_{hex} = $+2_{dec}$
  $0111\ 1111\ 1111\ 1111_{bin}$ = $7FFF_{hex}$ = $+32767_{dec}$

- **Absolute value with MSB as sign**
  The measured value is output in magnitude-sign format.
  Maximum presentation range for 16 bit = -32767 .. +32767

  Example:

  $1111\ 1111\ 1111\ 1111_{bin}$ = $FFFF_{hex}$ = $-\ 32767_{dec}$
  $1000\ 0000\ 0000\ 0010_{bin}$ = 8002_{hex} = $-\ 2_{dec}$
  $1000\ 0000\ 0000\ 0001_{bin}$ = 8001_{hex} = $-\ 1_{dec}$
  $0000\ 0000\ 0000\ 0001_{bin}$ = 0001_{hex} = $+1_{dec}$
  $0000\ 0000\ 0000\ 0010_{bin}$ = 0002_{hex} = $+2_{dec}$
  $0111\ 1111\ 1111\ 1111_{bin}$ = $7FFF_{hex}$ = $+32767_{dec}$

- **High resolution (1/100 C°)**
  The measured value is output in 1/100 °C steps.
  As a result, the maximum measuring range is limited to 32767_{dec} * (1/100) °C = 327.67 °C, but can be extended by the user scaling 16#80n0:12 .

5.6.3 Siemens bits, index 16#80n0:05

If this bit is set, status displays are superimposed on the lowest three bits. In the error case “overrange” or “underrange”, bit 0 is set.

5.6.4 Undershoot and overshoot of the measuring range (under range, over range), index 16#60n0:01 16#60n0:02

Pt100: T > 850°C (R > 400 Ω): Index 16#60n0:02 and index 16#60n0:07 (over range and error bit) are set. The linearization of the characteristic curve is continued with the coefficients of the upper range limit up to the limit stop of the A/D converter (approx. 500 Ω for Pt100).

Pt100: T < - 200°C (R < 18 Ω): Index 16#60n0:01 and index 16#60n0:07 (under range and error bit) are set.

The smallest negative number is displayed (16#8001 corresponds to -32767$_{dec}$).
For over range or under range the red error LED is switched on.

5.6.5 Limit 1, index 16#80n0:13 and Limit 2, index 16#80n0:14

A temperature range can be set that is compared with the values in the indices 16#80n0:13 and 16#80n0:14.
The bits are set in the process data if the limit values are undershot or exceeded.
The limit evaluation takes place after taking into account the set characteristic curve and negative values. The indices 16#80n0:07 or 16#80n0:08 serve to activate the limit value monitoring.

Output limit n (2-bit):	
0:	not active
1:	Value is smaller than the limit value
2:	Value is larger than the limit value
3:	Value is equal to the limit value

5.6.6 Channel status WORD

The status word is located in the input process image, and is transmitted from terminal to the controller.

Bit	15	14	13	12	11	10	9	8
Name	TxPDO Toggle	TxPDO State	-	-	-	-	-	-

Bit	7	6	5	4	3	2	1	0
Name	-	ERROR	Limit 2		Limit 1		Overrange	Underrange

5.6.7 Notch filter, index 16#80n0:06, 16#80n0:15

The CTMT3202 NUM EtherCAT terminals are equipped with a digital filter. The filter performs a notch filter function and determines the conversion time of the terminal. It is parameterized via the index 16#8000:15. The higher the filter frequency, the faster the conversion time.

Notch filter means that the filter has zeros (notches) in the frequency response at the specified filter frequency and multiples thereof, i.e. it masks out these frequencies. In order to filter out 50 Hz, therefore, the 50 or the 10 Hz filter can be used. Since all frequencies lower than the notch frequency usually have to be measured, however, the “50 Hz” setting is to be used in this case.

Index 16#80n0:06
The filter function is always active even if the bit is not set, since this is obligatory for the measurement process!

The filter frequencies are set for all channels of the CTMT3202 terminals centrally via index 16#8000:15 (channel 1). The corresponding indice 16#8010:15 of the other channel have no parameterization function.

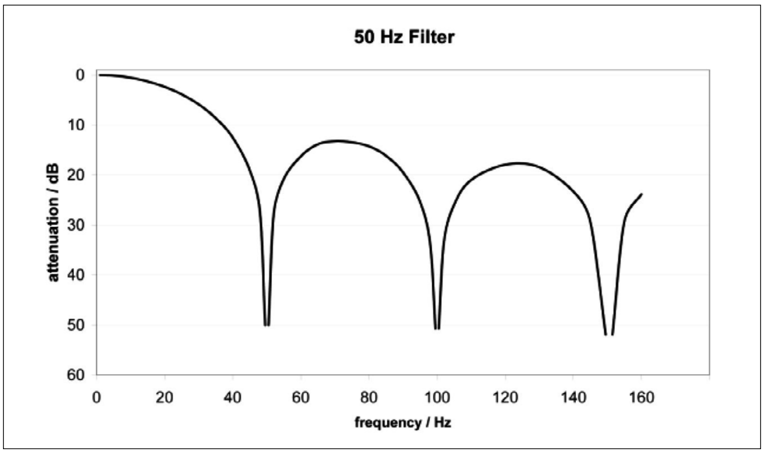


Fig.35 Attenuation curve notch. filter at 50 Hz

Details of the conversion time

- the conversion time depends on number of active channels, number of measurements (2/4-wire), filter time, const. computing time;
- the conversion time for the 2-wire measurement is about twice as long as for the 4-wire measurement;
- the process data TxPDO Toggle changes its state if a new measured value is present.

5.6.8 Data stream

Data stream

The flow chart (Fig.36) illustrates the data stream in the CTMT3202 (processing of the raw data).

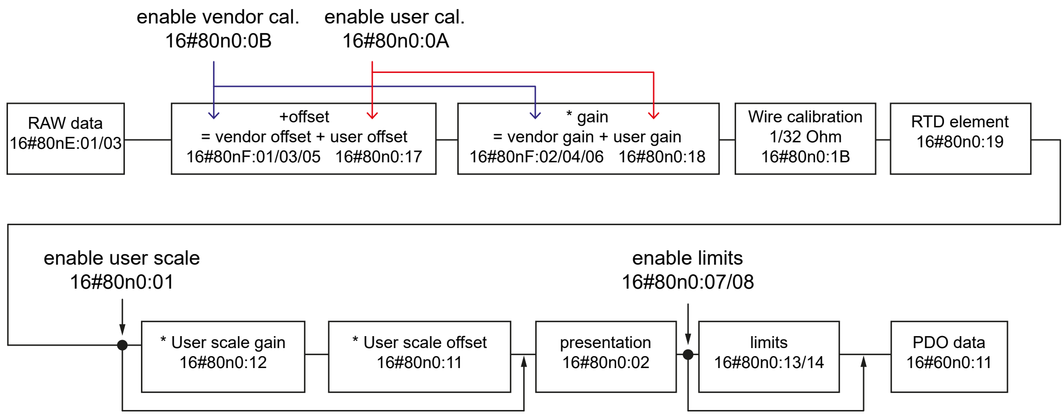


Fig.36 Data stream representation of the CTMT3202

Calculation of process data

The terminal records measured values continuously and places the raw values of its A/D converter into the ADC raw value object 16#80nE:01 or 16#80nE:02.

The calculation of the correction with the vendor calibration values takes place after each acquisition of the analog signal. User scaling then follows (optionally):

Calculation	Designation
$Y_H = (X_{ADC} - B_K) \times A_K$	Measured value following manufacturer calibration (corresponds to Y_A if index 16#80n0:0A is inactive)
$Y_A = Y_H \times A_w \times 2^{-16} + B_w$	Measured value following user scaling

Name	Designation	Index
X_{ADC}	Output value of the A/D converter	16#80nE:01, 16#80nE:02
B_K	Manufacturer calibration offset (only changeable if the object Producer codeword is set	16#80nF:01, 16#80nF:03
A_K	Manufacturer calibration gain (only changeable if the object Producer codeword is set	16#80nF:02, 16#80nF:04
B_W	User scaling offset (can be activated via index 16#80n0:0A)	16#80n0:17
A_W	User scaling gain (can be activated via index 16#80n0:0A)	16#80n0:18
Y_A	Process data for controller	-

Interference from equipment

When operating the CTMT3202 analog NUM EtherCAT Terminals, high frequency superimposed signals from interfering devices (e.g. proportional valves, stepper motors or DC motor output stages) can be picked up by the terminal. In order to guarantee interference-free operation, we recommend the use of separate power supply units for the terminals and the interference-causing devices.

The integrated filter of the terminal (see index 16#80n0:06) should be switched on as an additional measure.

5.6.9 Vendor calibration, 16#80n0:0B

The manufacturer compensation is enabled via index 16#80n0:0B. Parameterization takes place via the indices:

- 16#80nF:01 Calibration offset
- 16#80nF:02 Calibration gain
- 16#80nF:03 Calibration offset, input RL
- 16#80nF:04 Calibration gain, input RL

5.6.10 User calibration, index 16#80n0:0A

The user calibration is enabled via index 16#80n0:0A. Parameterization takes place via the indices

- 16#80n0:17 User calibration: Offset
- 16#80n0:18 User calibration: Gain

5.6.11 User scaling, index 16#80n0:01

The user scaling is enabled via index 16#80n0:01. Parameterization takes place via the indices

- 16#80n0:11 User scaling: Offset
- 16#80n0:12 User scaling: Gain

Manufacturer calibration
The vendor reserves the authority for the basic calibration of the terminals. Therefore, the vendor calibration cannot be changed.

5.6.12 Connection tecnology and wire compensation, index 16#80n0:1A and 16#80n0:1B

The electrical connection of a resistance sensor to the CTMT3202 can take place using the 2-wire or 3-wire method, 4-wire method is not foreseen for such terminal. Since the measuring method is a resistance measurement, the sensor supply cables with their internal resistance can falsify the measurement. The following are available for this:

- 3-wire sensors: this simplified connection reduces wiring costs and compensates cable resistances to a considerable degree.
- 2-wire sensors: very simple connection, recommended only for short supply cables. The supply line resistances can be eliminated from the calculation in Two-wire mode if they are made known to the CTMT3202 in the CoE object 16#80n0:1B (unit [1/32 Ω]). The determination of the supply line resistance is possible on the application side either by measurement or by comparison.

Refer to chapter 4.5.20.1 for teminal connection example.

5.7 CTMT4102 CTMT4122 CTMT4132 configuration objects

5.7.1 Analog Output Ch.1, index 16#8010

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:0	AO settings Ch.1	Max. Subindex	UINT8	RO	16#16 (22_{dec})
8010:01	Enable user scale	User scale is active	BOOLEAN	RW	16#00 (0_{dec})
8010:02	Presentation	0: Signed presentation 1: Unsigned presentation Maximum presentation range for 16 bit : 0 .. $+65535_{dec}$ 2: Absolute value with MSB as sign The measured value is output in magnitude-sign format. Maximum representation range for 16 bits = -32768_{dec} ... $+32767_{dec}$ 3: Absolute value Negative numbers are also output as positive numbers	BIT3	RW	16#00 (0_{dec})
8010:05	Watchdog	0: Default watchdog value The default value (16#8010:13) is active. 1: Watchdog ramp The ramp (16#8010:14) for moving to the default value is active. 2: Last output value In the event of a watchdog drop the last process data is issued.	BIT2	RW	16#00 (0_{dec})
8010:07	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	16#00 (0_{dec})
8010:08	Enable vendor calibration	Enable vendor calibration	BOOLEAN	RW	16#01 (1_{dec})
8010:11	Offset	User scaling offset	INT16	RW	16#0000 (0_{dec})
8010:12	Gain	User scaling gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65536 (16#00010000)	INT32	RW	16#00010000 (65536_{dec})
8010:13	Default output	Default output value	INT16	RW	16#0000 (0_{dec})
8010:14	Default output ramp	Ramp for ramping down to the default value. Value in digits/ms.	UINT16	RW	16#FFFF (65535_{dec})
8010:15	User calibration offset	User calibration offset	INT16	RW	16#0000 (0_{dec})
8010:16	User calibration gain	User calibration gain	UINT16	RW	16#FFFF (65535_{dec})

5.7.2 Analog Output Ch.2, index 16#8020

Index (hex)	Name	Meaning	Data type	Flags	Default
8020:0	AO settings Ch.2	Max. Subindex	UINT8	RO	16#16 (22_{dec})
8020:01	Enable user scale	User scale is active.	BOOLEAN	RW	16#00 (0_{dec})
8020:02	Presentation	0: Signed presentation The measured value is presented in two's complement format. Maximum representation range for 16 bits = -32768_{dec} ... $+32767_{dec}$ 1: Unsigned presentation Maximum presentation range for 16 bit : 0 .. $+65535_{dec}$ 2: Absolute value with MSB as sign The measured value is output in magnitude-sign format. Maximum representation range for 16 bits = -32767_{dec} .. $+32767_{dec}$ 3: Absolute value Negative numbers are also output as positive numbers	BIT3	RW	16#00 (0_{dec})
8020:05	Watchdog	0: Default watchdog value The default value (16#8020:13) is active. 1: Watchdog ramp The ramp (16#8020:14) for moving to the default value is active. 2: Last output value In the event of a watchdog drop the last process data is issued.	BIT2	RW	16#00 (0_{dec})
8020:07	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	16#00 (0_{dec})
8020:08	Enable vendor calibration	Enable vendor calibration	BOOLEAN	RW	16#01 (1_{dec})
8020:11	Offset	User scaling offset	INT16	RW	16#0000 (0_{dec})
8020:12	Gain	User scaling gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65536 (16#00010000).	INT32	RW	16#00010000 (65536_{dec})
8020:13	Default output	Default output value	INT16	RW	16#0000 (0_{dec})
8020:14	Default output ramp	Ramp for ramping down to the default value. Value in digits/ms.	INT16	RW	16#FFFF (65535_{dec})
8020:15	User calibration offset	User calibration offset	INT16	RW	16#0000 (0_{dec})
8020:16	User calibration gain	User calibration gain	INT16	RW	16#FFFF (65535_{dec})

5.7.3 SM ouput parameter, index 16#1C32

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	16#20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 2 Event • 2: DC-Mode - Synchron with SYNC0 Event • 3: DC-Mode - Synchron with SYNC1 Event	UINT16	RW	16#0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	16#00000000 (0_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	16#00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: free run is supported • Bit 1 = 1: Synchronous with SM 2 event is supported • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 10: Output shift with SYNC1 event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 16#1C32:08	UINT16	RO	16#C007 (49159_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	16#00000000 (0_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	16#00000000 (0_{dec})
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 16#1C32:03, 16#1C32:05, 16#1C32:06, 16#1C32:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	16#0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	16#00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	16#0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	16#0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	16#0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	16#00 (0_{dec})

5.7.4 Presentation, index16#8010:02 (channel 1), index 16#8020:02 (channel 2)

In the delivery state of the measured value is shown in two’s complement format (signed integer). Index 16#8010:02 or 16#8020:02 offers the possibility to change the method of representation of the output value.

Output signal	Value	
CTMT4102	Decimal	Hexadecimal
0 V	0	16#0000
5 V	16383	16#3FFF
10 V	32767	16#7FFF

Output signal	Value	
CTMT4122	Decimal	Hexadecimal
4 mA	0	16#0000
12 mA	16383	16#3FFF
20 mA	32767	16#7FFF

Output signal	Value	
CTMT4132	Decimal	Hexadecimal
-10 V	-32768	16#8000
-5 V	-16383	16#C001
0 V	0	16#0000
5 V	16383	16#3FFF
10 V	32767	16#7FFF

Note

Signed Integer:

The output value is presented in two's complement format.
Maximum presentation range for 16 bit = -32768 .. +32767

Example:

$1000\ 0000\ 0000\ 0000_{bin}$ = $16\#8000_{hex}$ = -32768_{dec}
$1111\ 1111\ 1111\ 1110_{bin}$ = $16\#FFFE_{hex}$ = -2_{dec}
$1111\ 1111\ 1111\ 1111_{bin}$ = $16\#FFFF_{hex}$ = -1_{dec}
$0000\ 0000\ 0000\ 0001_{bin}$ = $16\#0001_{hex}$ = $+1_{dec}$
$0000\ 0000\ 0000\ 0010_{bin}$ = $16\#0002_{hex}$ = $+2_{dec}$
$0111\ 1111\ 1111\ 1111_{bin}$ = $16\#7FFF_{hex}$ = $+32767_{dec}$

Unsigned Integer:
The output value is shown with 16 bit resolution.
Maximum presentation range for 16 bit :
0 .. $+65535_{dec}$

Absolute value with MSB as sign:
The output value is displayed in magnitude-sign format.
Maximum presentation range for 16 bit = -32767 .. +32767

Example:

$1111\ 1111\ 1111\ 1111_{bin}$ = $16\#FFFF_{hex}$ = -32767_{dec}
$1000\ 0000\ 0000\ 0010_{bin}$ = $16\#8002_{hex}$ = -2_{dec}
$1000\ 0000\ 0000\ 0001_{bin}$ = $16\#8001_{hex}$ = -1_{dec}
$0000\ 0000\ 0000\ 0001_{bin}$ = $16\#0001_{hex}$ = $+1_{dec}$
$0000\ 0000\ 0000\ 0010_{bin}$ = $16\#0002_{hex}$ = $+2_{dec}$
$0111\ 1111\ 1111\ 1111_{bin}$ = $16\#7FFF_{hex}$ = $+32767_{dec}$

Absolute value:
Negative output values are shown positive (absolute value)

5.7.5 Watchdog, index16#8010:05 (channel 1), index 16#8020:05 (channel 2)

The analog output value can, e.g. in the case of a failure of communication with the controller, be set to a user-specific value.
The "Default watchdog value" must be set in the Startup Parameter tab; the value entered previously in index 16#8010:13 or 16#8020:13 is output.

If the user-specific value is to be approached only after a certain time in the event of a fault, the "Watchdog ramp" function (index 16#8010:14 or 16#8020:14) can be set. The value is input in digits/ms.

The setting "Last output value" outputs the last valid output value after the occurrence of an error.

5.7.6 Activation of user scaling, index 16#8010:01 (channel 1), index 16#8020:01 (channel 2)

The user scaling is activated via index 16#8010:01 or 16#8020:01.

Parameterization takes place via the indices
- 16#8010:11 or 16#8020:11
  User scaling offset

- 16#8010:12 or 16#8020:12
  User scaling gain

5.7.7 Manufacturer calibration, index 16#8010:08 (channel 1), index 16#8020:08 (channel 2)

Manufacturer calibration is activated via index 16#8010:08 16#8020:08. The obligatory default value in this object is “TRUE”

Producer Codeword
The vendor reserves the authority for the basic calibration of the terminals. The calibration is therefore reserved at present via the producer codeword.

Parameterization takes place via the indices
- 16#801F:01 or 16#802F:01
  Calibration offset

- 16#801F:02 or 16#802F:02
  Calibration gain

5.7.8 User calibration index, 16#8010:07 (channel 1), index 16#8020:07 (channel 2)

The user calibration is activated via index 16#8010:07 or 16#8020:07.

Parameterization takes place via the indices
- 16#8010:15 or 16#8020:15
  User calibration offset

- 16#8010:16 or 16#8020:16
  User calibration gain

5.7.9 Examples of calculation and calibration of the output value

The terminal places the raw values of its D/A converter into the DAC raw value object 16#4041:01 (channel 1) or 16#4081:01 (channel 2) (RAM). The output value is adjusted with the manufacturer's calibration values. User scaling can, optionally, follow:

$Y_H = (X_{DAC} - B_K) \times A_K$	Output value after manufacturer's calibration (corresponds to Yout when feature object 16#8010:01 or 16#8020:01 is inactive)
$Y_A = Y_H \times A_W \times 2^{-16} + B_W$	Output value following user scaling

Example: Limitation of the output range of -5 V to +5 V in the case of CTMT4132, calculation of the GAIN factor of the user scaling, index 16#8010:12 or 16#8020:12

$Y_A = Y_H \times A_W \times 2^{-16} + B_W$	Calculation of the GAIN factor for an upper limit value of +5 V (corresponds to a lower limit value of -5 V by shortening the sign)	
$\leftrightarrow (Y_A - B_W) / (Y_H \times 2^{-16}) = A_W$	$Y_A = 16383_{dec}$	corresponds to the desired upper limit value of +5 V
$(16383 - 0) / (32767 \times 2^{-16})$	$Y_H = 32767_{dec}$	corresponds to the upper limit value of +10 V
$=$ $\mathbf{A_W = 32767}$	$B_W = 0_{dec}$	corresponds to the offset of the user scaling
	$A_W = 32767_{dec}$	corresponds to the gain value of the user scaling

Example: Shifting of the output range of -3 V to +10 V in the case of CTMT4132, calculation of the OFFSET value of the user scaling, index 16#8010:11 or 16#8020:11

$Y_A = Y_H \times A_W \times 2^{-16} + B_W$	Calculation of the OFFSET value for the shifting of the lower limit value to -3 V	
$\leftrightarrow Y_A - Y_H \times A_W \times 2^{-16} = B_W$	$Y_A = -9831_{dec}$	corresponds to the desired lower limit value of -3 V
$16383 - 0) / (32767 \times 2^{-16})$	$Y_H = -32769_{dec}$	corresponds to the lower limit value of -10 V
$=$ $\mathbf{A_W = 32767}$	$A_W = 65536_{dec}$	corresponds to the gain factor of the user scaling (factor 1)
	$B_W = 22938_{dec}$	corresponds to the offset value of the user scaling of +7V

OFFSET value

The shifting of the output value by the OFFSET takes place linearly to the lower limit value (-10 V / -10 mA) or upper limit value (+ 10 V / +10 mA).

Name	Designation	Index
X_{DAC}	Output value of the D/A converter	-
Y_A	Process data for controller	-
B_K	Manufacturer calibration offset (only changeable if the object Producer codeword is set)	16#801F:01, 16#802F:01
A_K	Manufacturer calibration gain (only changeable if the object Producer codeword is set)	16#801F:02, 16#802F:02
B_W	User scaling offset (can be activated via index 16#8010:01 or 16#8020:01 of the feature objects 16#8010 or 16#8020)	16#8010:11, 16#8020:11
A_W	User scaling gain (can be activated via index 16#8010:01 or 16#8020:01 of the feature objects 16#8010 or 16#8020)	16#8010:12, 16#8020:12

5.7.10 SM ouput parameter, index 16#1C32:01 and index 16#1C32:02

These parameters could be defined into the CTMT device “General” tab on FlexiumTool.

Page deliberately empty

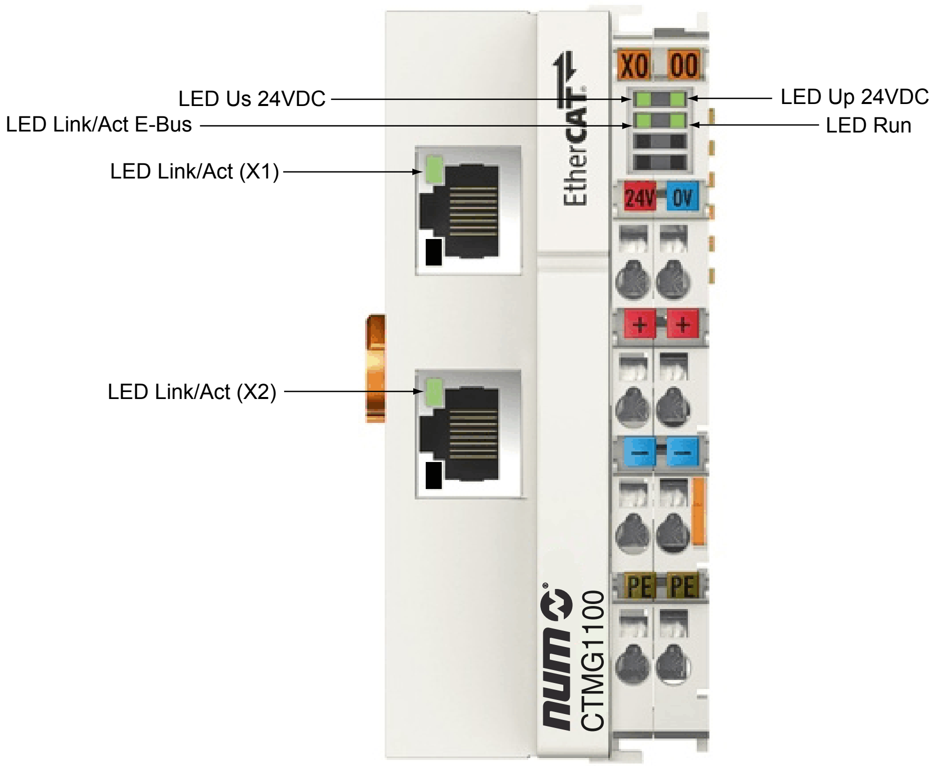
Summary

Page deliberately empty

6 Diagnostic LEDs

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

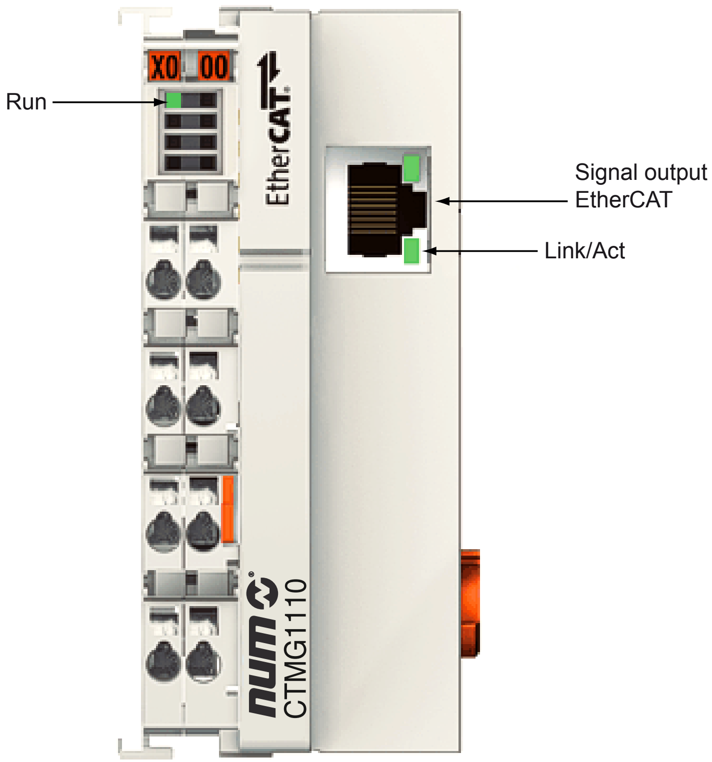
LED	Color	Display	Status	Meaning
Run	Green	OFF	Init	State of the EtherCAT State Machine: *INIT = Initialization*
		Blinking	Pre-Operational	State of the EtherCAT State Machine: *PREOP = Pre-Operational*
		Single flash	Safe-Operational	State of the EtherCAT State Machine: *SAFEOP = Safe-Operational*
		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

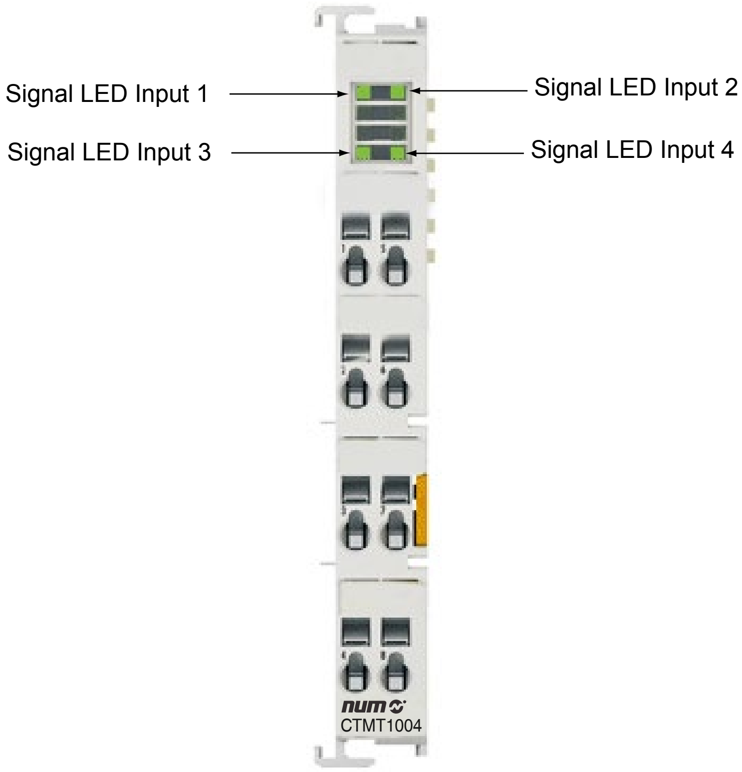
LED	Color	Display	Status	Meaning
LINK / ACT	Green	OFF	-	No connection with EtherCAT client
		ON	Linked	EtherCAT-client connected
		Blinking	Active	Communication with EtherCAT client

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

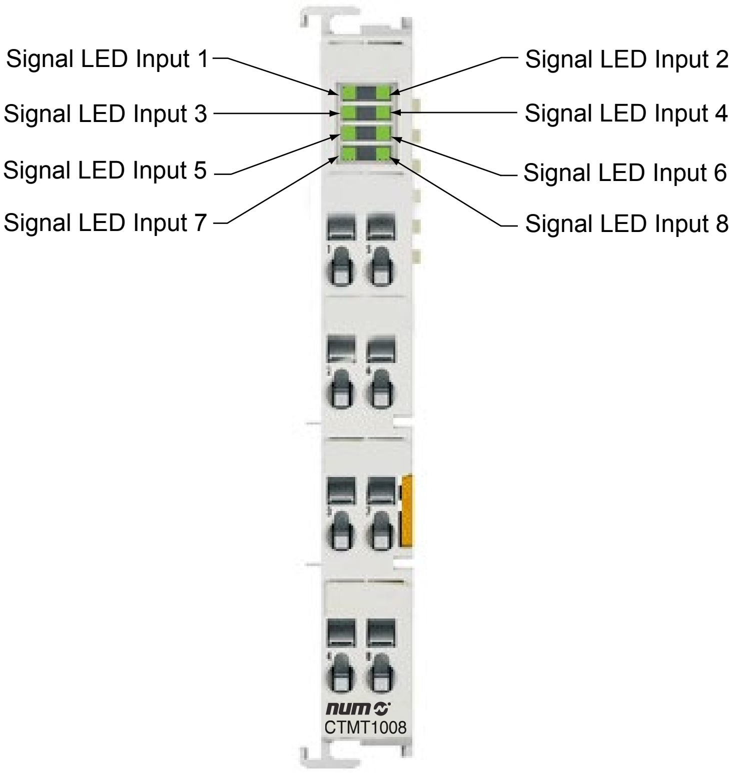


LEDs

LED	Color	Meaning	
INPUT 1 - 4	Green	OFF	Signal voltage “0” (-3 V ... 5 V)
		ON	Signal voltage “1” (11 V ... 30 V)

6.4 CTMT1008

Diagnostic LEDs

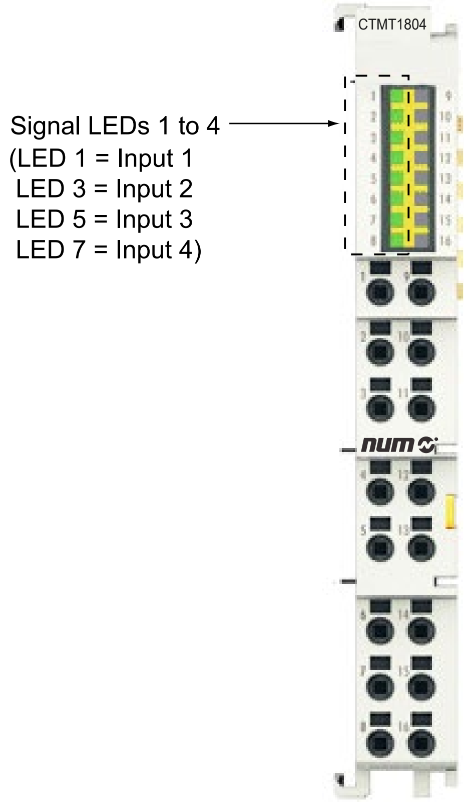


LEDs

LED	Color	Meaning	
INPUT 1 - 8	Green	OFF	Signal voltage “0” (-3 V ... 5 V)
		ON	Signal voltage “1” (11 V ... 30 V)

6.5 CTMT1804

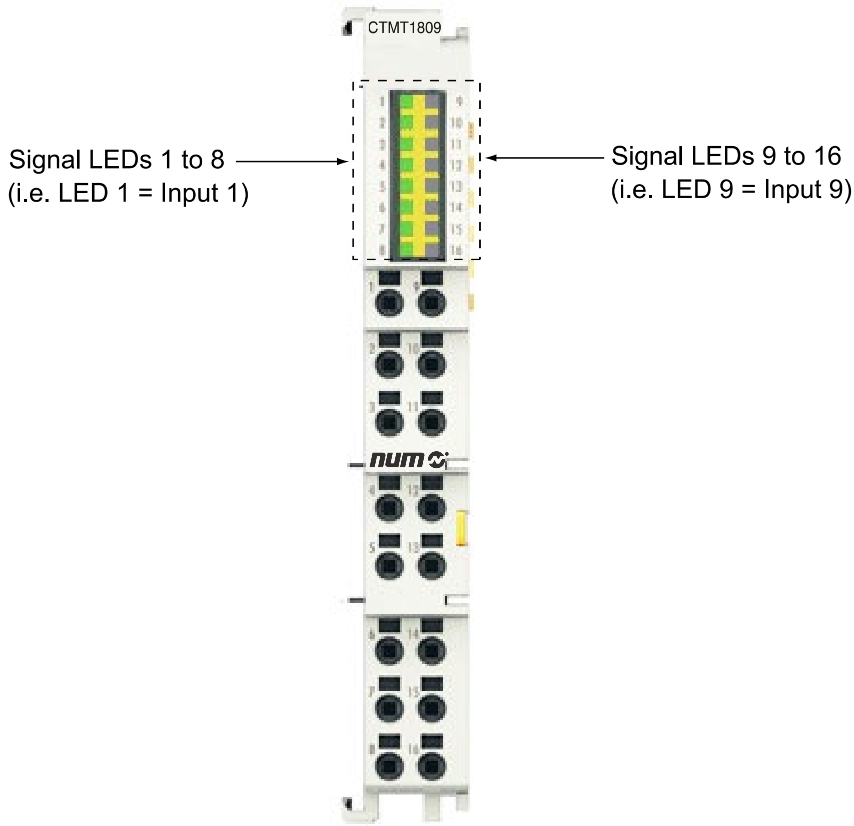
Diagnostic LEDs



LED	Color	Meaning	
INPUT 1 - 4	Green	OFF	Signal voltage "0" (-3V ... 5V)
		ON	Signal voltage “1” (11V ... 30V)

6.6 CTMT1809

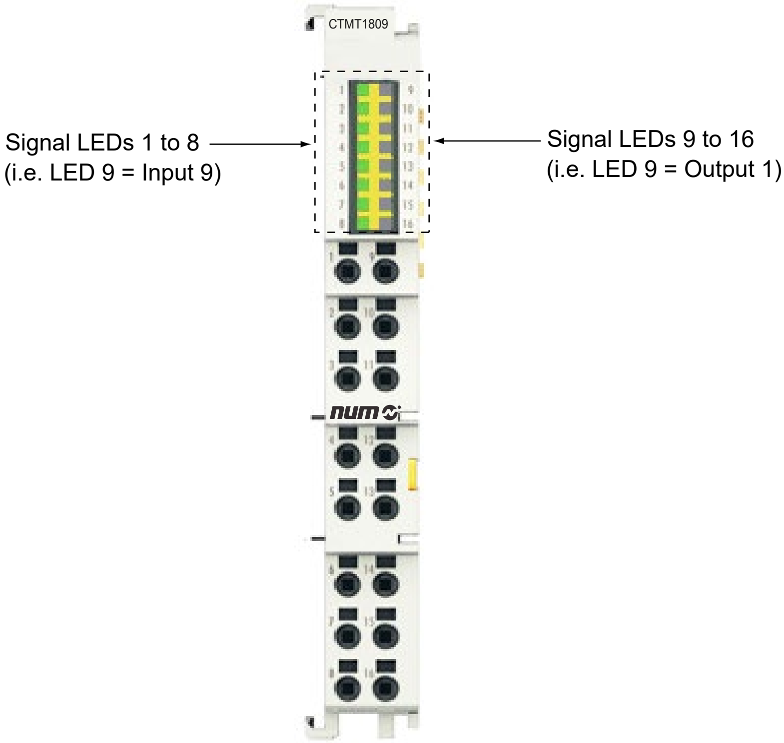
Diagnostic LEDs



LED	Color	Meaning	
INPUT 1 - 16	Green	OFF	Signal voltage "0" (-3V ... 5V)
		ON	Signal voltage “1” (11V ... 30V)

6.7 CTMT1859

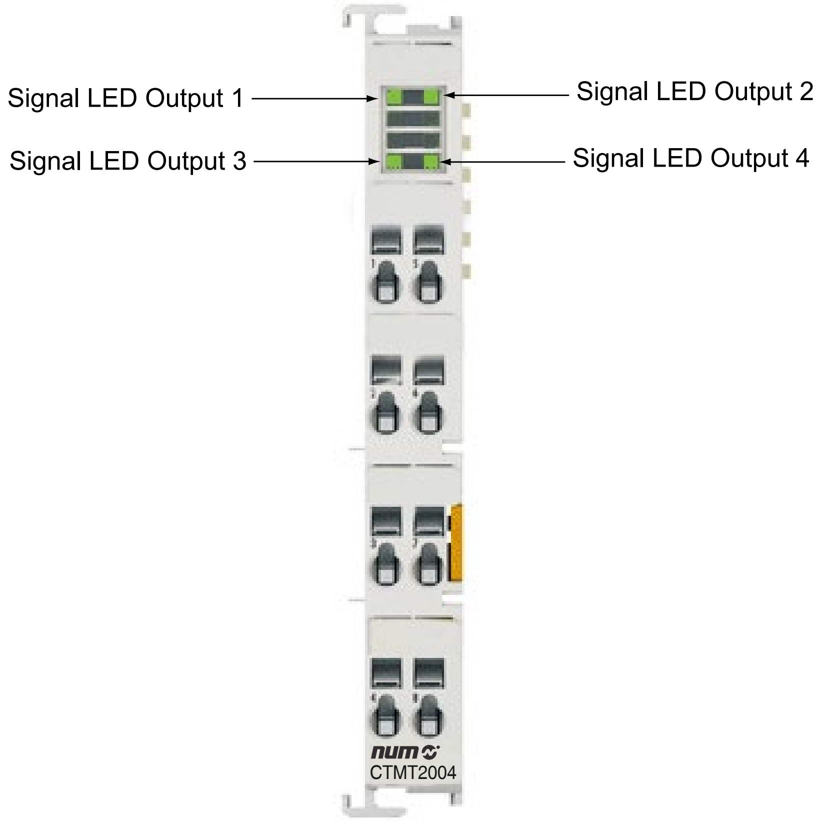
Diagnostic LEDs



LED	Color	Meaning	
INPUT 1 - 8	Green	OFF	signal “0” voltage (-3 V ... 5 V)
		ON	signal “1” voltage (11 V ... 30 V)
OUTPUT 1 - 8	Green	OFF	no output voltage
		ON	+24 VDC output voltage

6.8 CTMT2004

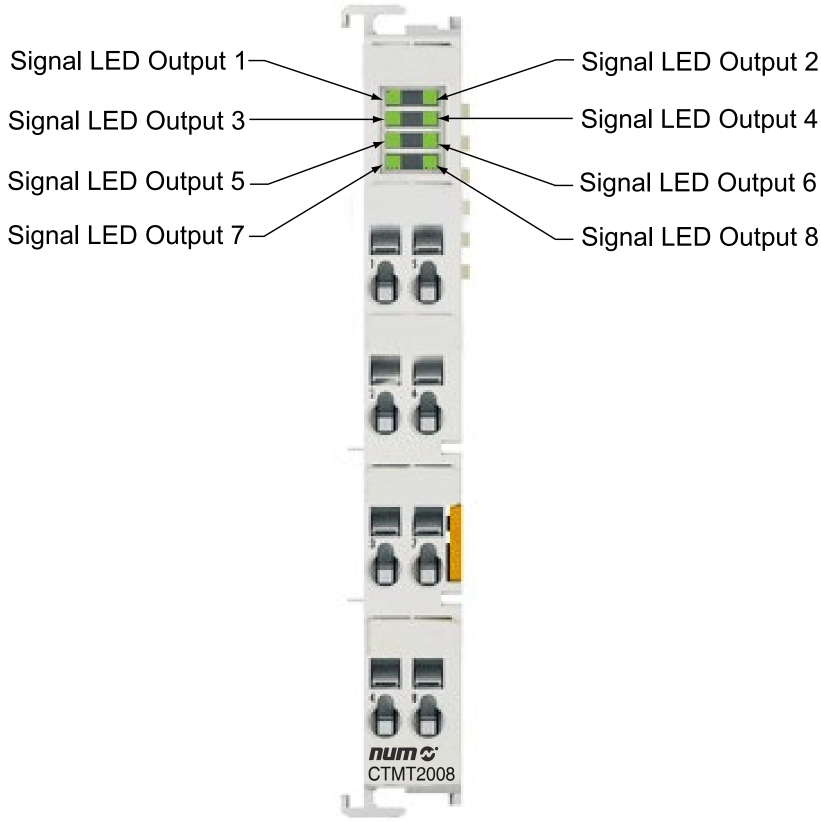
Diagnostic LEDs



LED	Color	Meaning	
OUTPUT 1 - 4	Green	OFF	No output signal
		ON	24 V_{DC} output signal at the respective output

6.9 CTMT2008

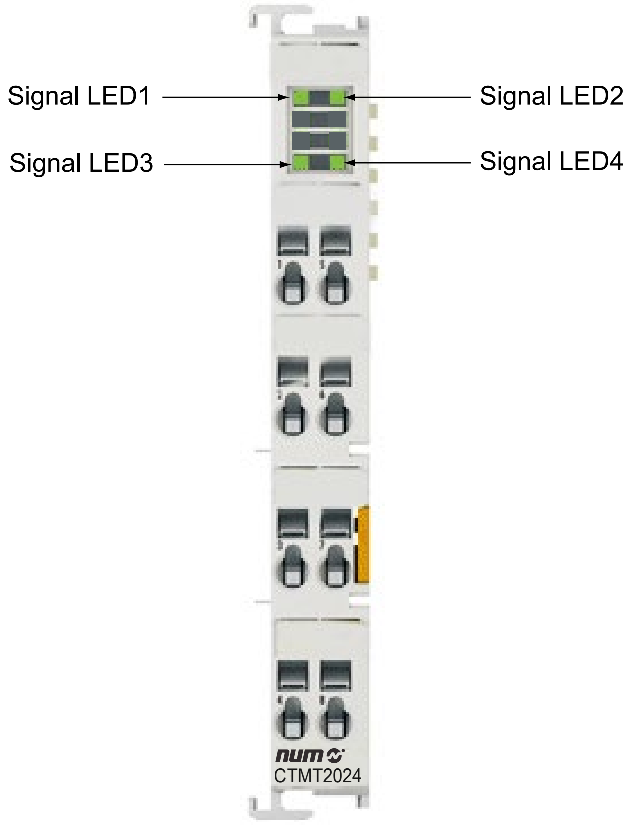
Diagnostic LEDs



LED	Color	Meaning	
OUTPUT 1 - 8	Green	OFF	No output signal
		ON	24 V_{DC} output signal at the respective output

6.10 CTMT2024

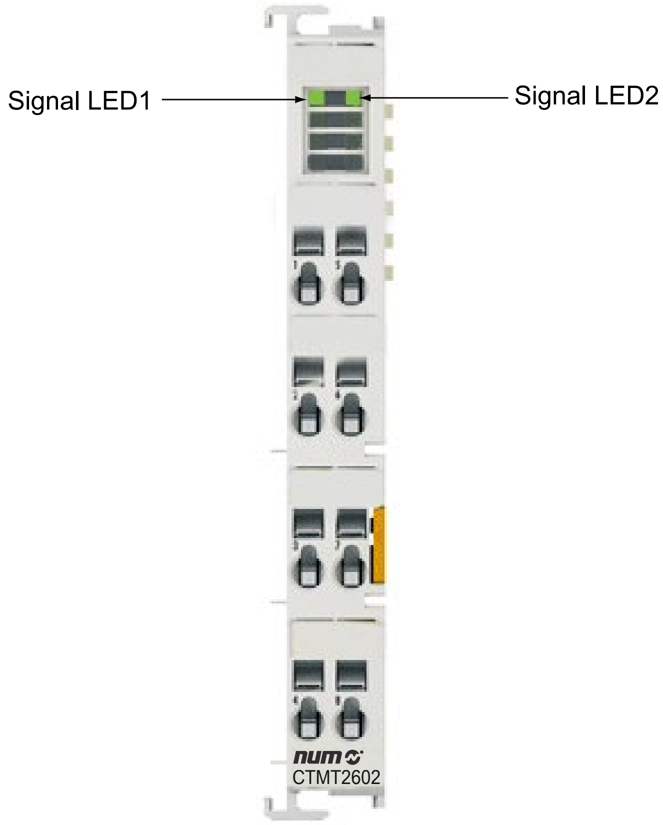
Diagnostic LEDs



LED	Color	Meaning	
OUTPUT 1 - 4	Green	OFF	No output signal is present.
		ON	A 24 VDC output signal is present

6.11 CTMT2602

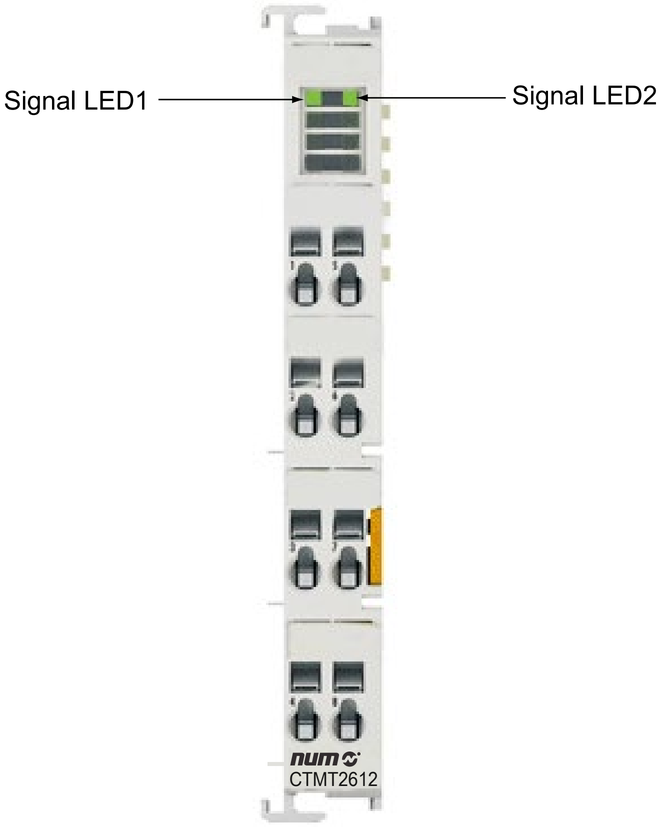
Diagnostic LEDs



LED	Color	Meaning	
Relay 1, Relay 2	Green	OFF	No voltage on output 1 and output 2 respectively
		ON	Output voltage (≤ 230 VAC or ≤ 30 VDC) on output 1 and output 2 respectively.

6.12 CTMT2612

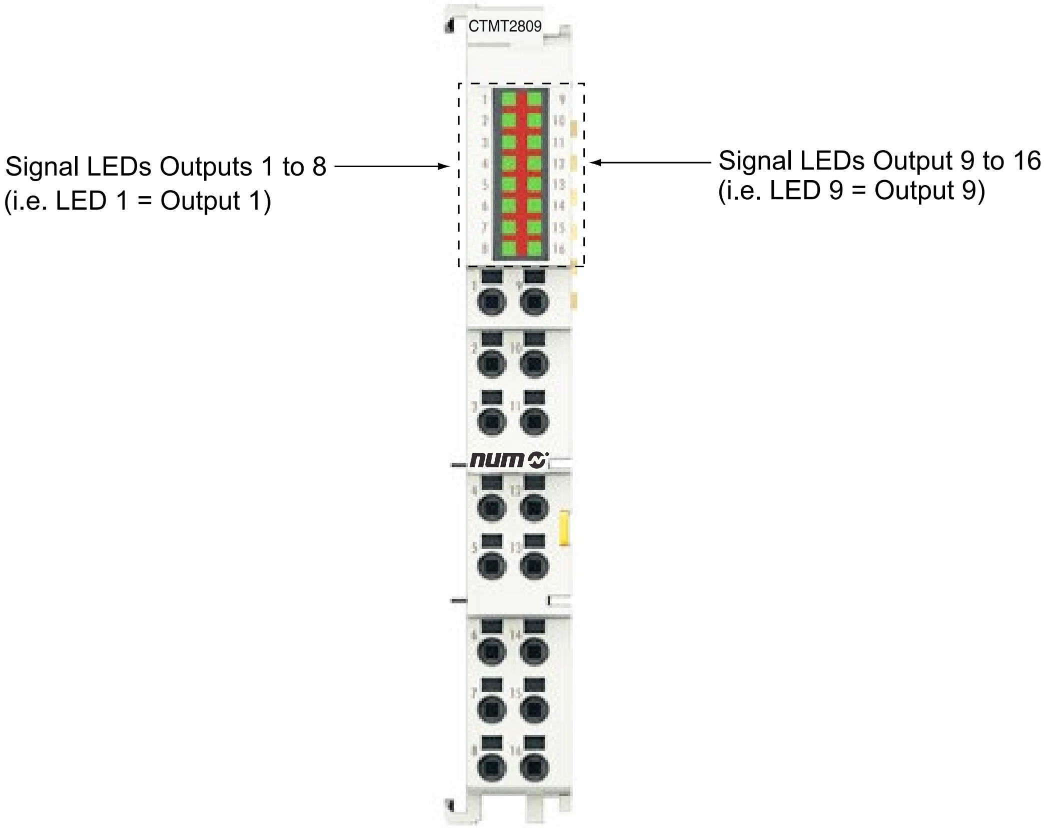
Diagnostic LEDs



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

6.13 CTMT2809

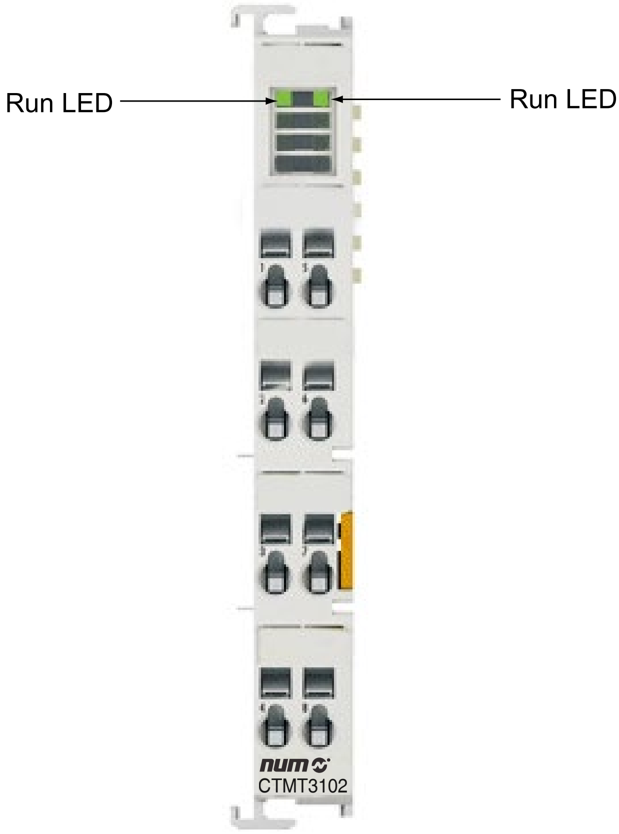
Diagnostic LEDs



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

6.14 CTMT3102

Diagnostic LEDs

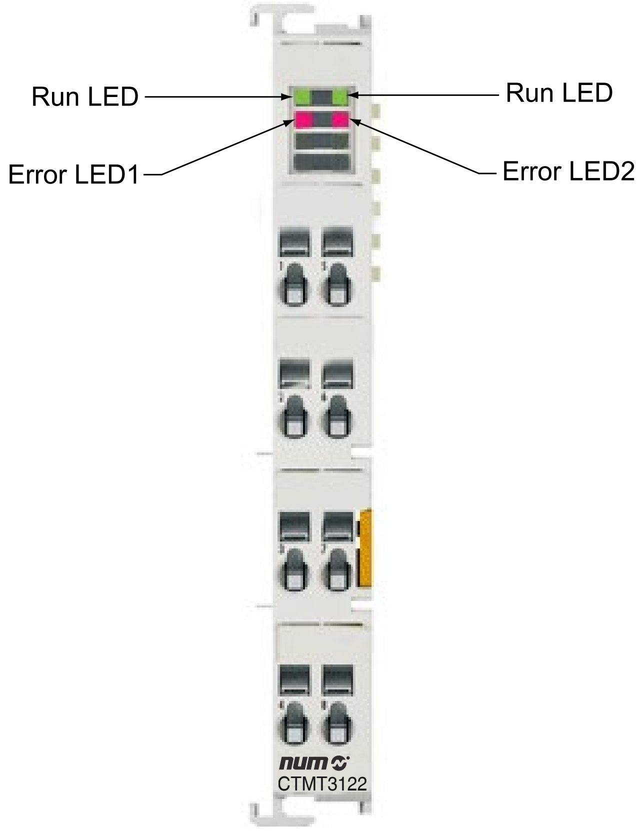


LED	Color	Meaning	
RUN*	Green	This LED indicates the terminal’s operating state (if more than one RUN LED is present, all of them have the same function):	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		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.

6.15 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.

6.16 CTMT3162

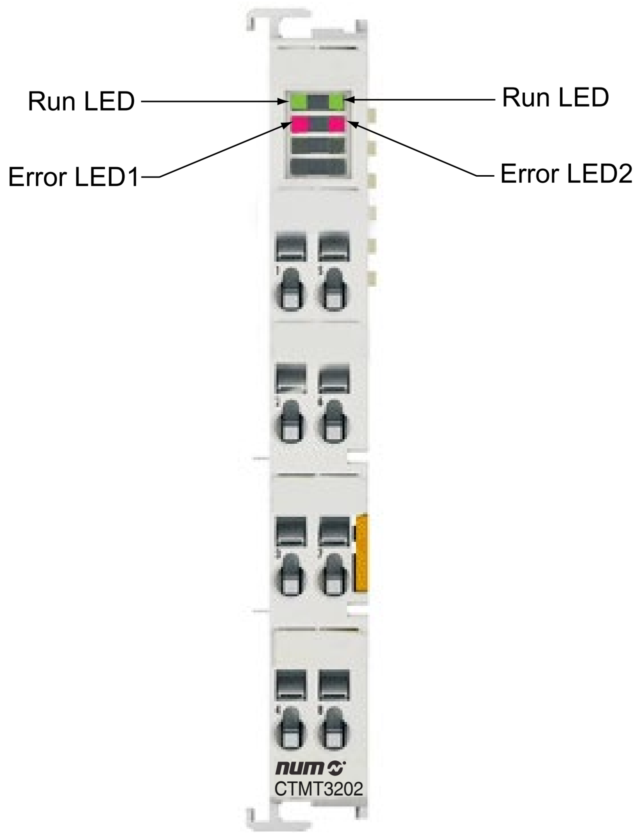
Diagnostic LEDs

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.

6.17 CTMT3202

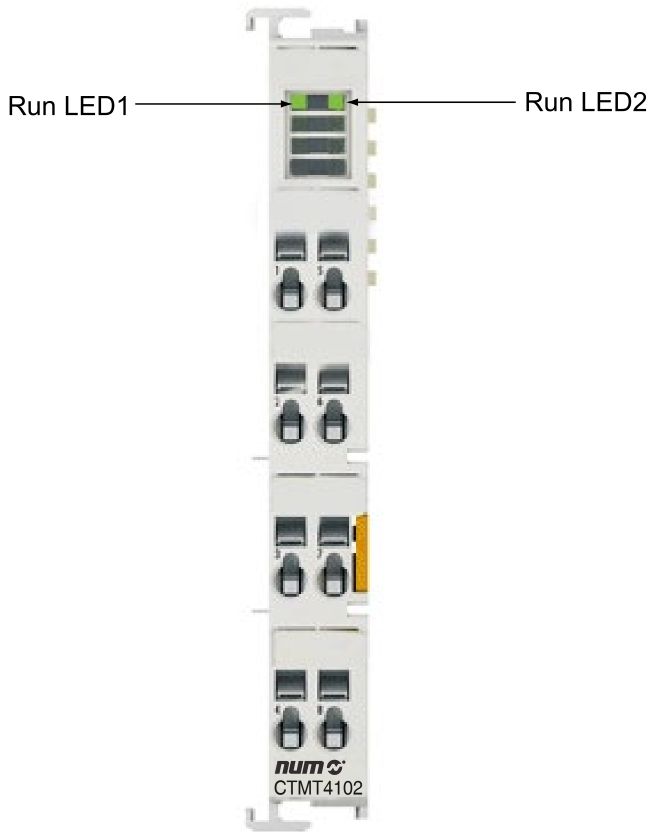
Diagnostic LEDs



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.

6.18 CTMT4102

Diagnostic LEDs

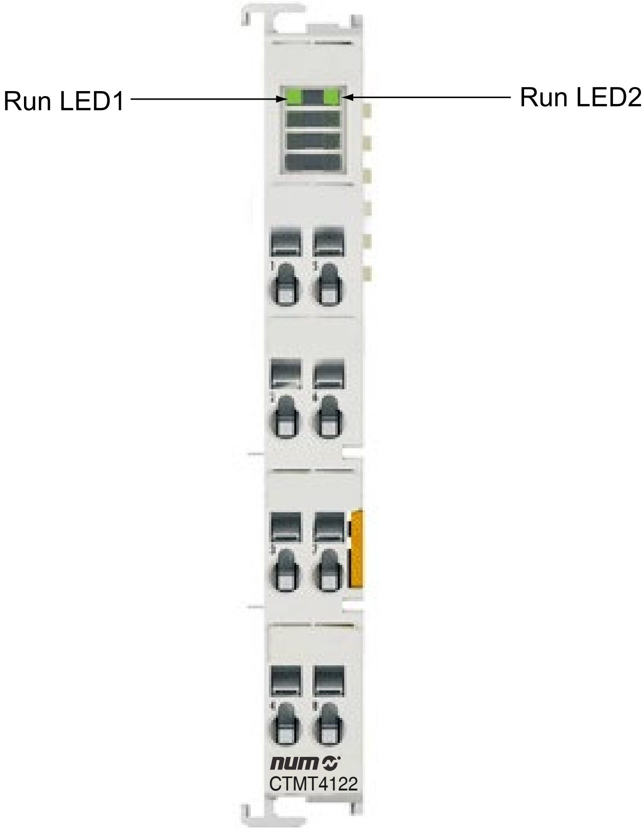


LED	Color	Meaning	
RUN*	Green	This LED indicates the terminal's operating state (if more than one RUN LED is present, all of them have the same function):	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		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.

6.19 CTMT4122

Diagnostic LEDs

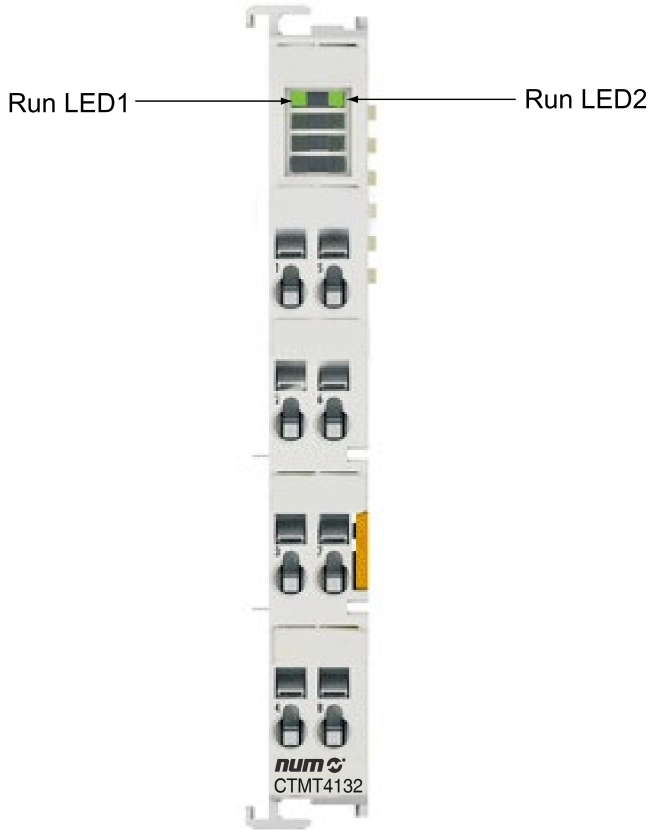


<table>
<tr><th>LED</th><th>Color</th><th colspan="2">Meaning</th></tr>
<tr><td rowspan="5">RUN</td><td rowspan="5">Green</td><td colspan="2">This LED indicates the terminal’s operating state:</td></tr>
<tr><td>OFF</td><td>State of the EtherCAT State Machine:
INIT = Initialization of the terminal or BOOTSTRAP = Function for firmware updates of the terminal.</td></tr>
<tr><td>Blinking</td><td>State of the EtherCAT State Machine:
PREOP = Setting for mailbox communication and variant standard settings.</td></tr>
<tr><td>Single flash</td><td>State of the EtherCAT State Machine:
SAFEOP = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.</td></tr>
<tr><td>ON</td><td>State of the EtherCAT State Machine:
OP = Normal operation mode, mailbox- and process data communication possible.</td></tr>
</table>

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

6.20 CTMT4132

Diagnostic LEDs

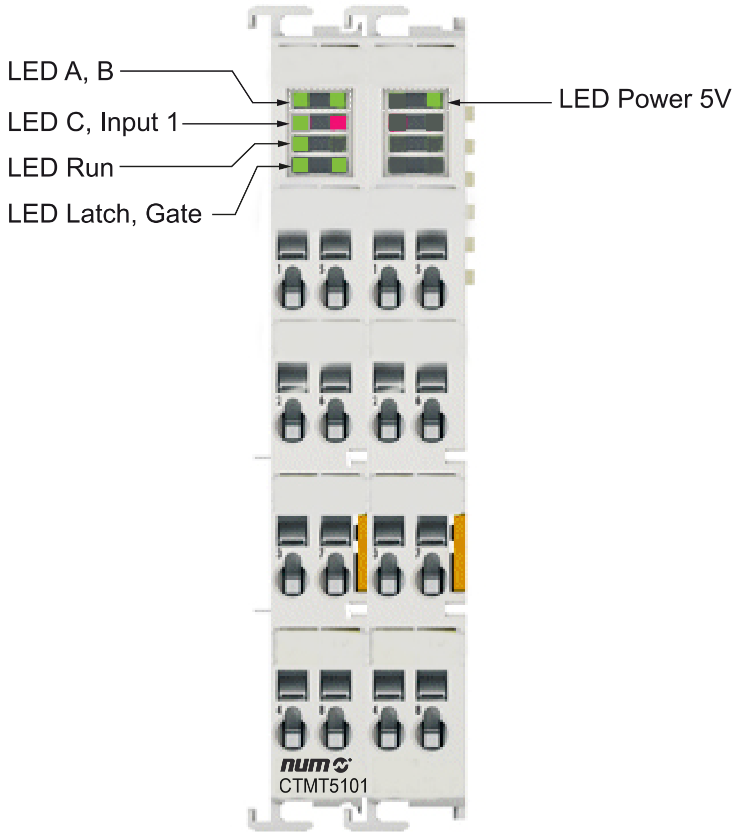


LED	Color	Meaning	
RUN	Green	This LED indicates the terminal's operating state:	
		OFF	State of the EtherCAT State Machine: **INIT** = Initialization of the terminal or **BOOTSTRAP** = Function for firmware updates of the terminal.
		Blinking	State of the EtherCAT State Machine: **PREOP** = Setting for 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.

6.21 CTMT5101

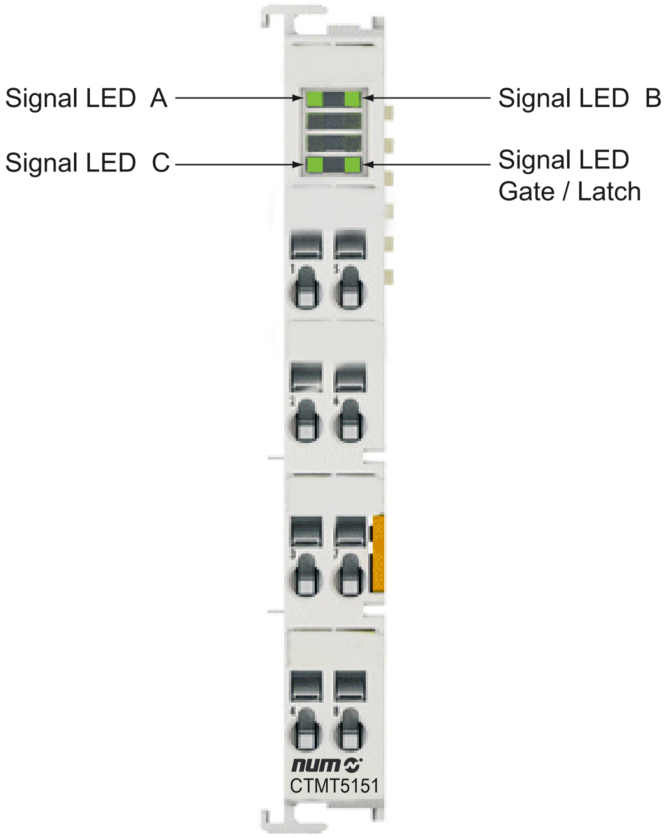
Diagnostic LEDs



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.

6.22 CTMT5151

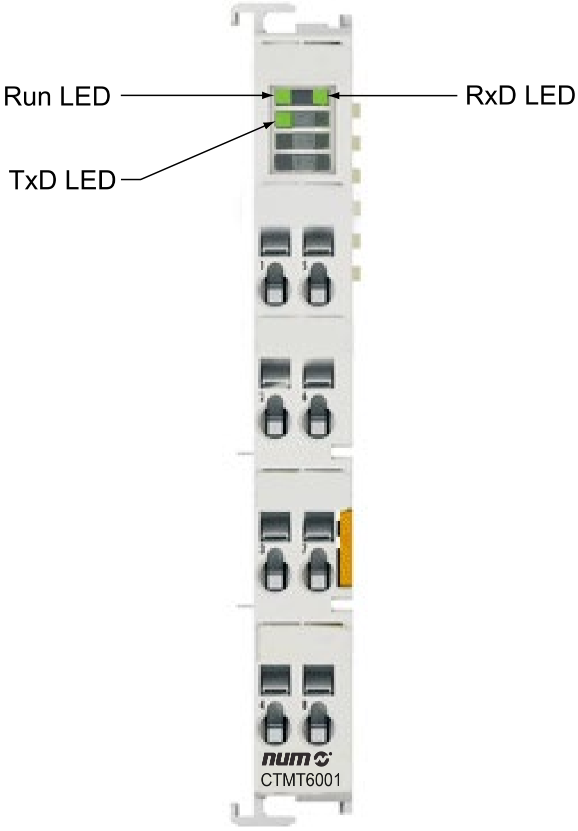
Diagnostic LEDs



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

6.23 CTMT6001

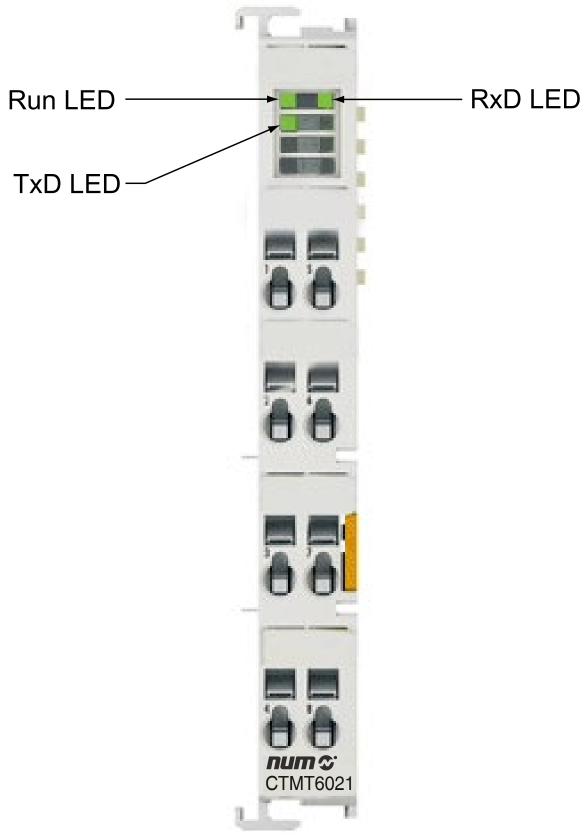
Diagnostic LEDs



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 (on: HI signal level on transmit line).	
RxD	Green	State of the receive signal line (on: HI signal level on receive line).	

6.24 CTMT6021

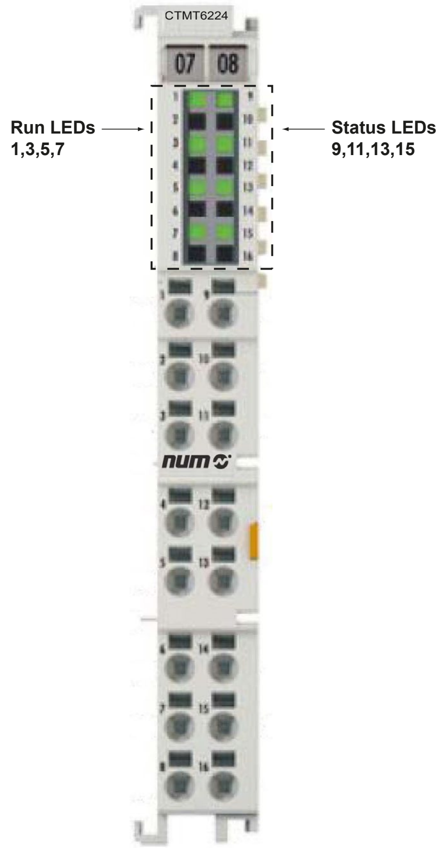
Diagnostic LEDs



<table>
<tr><th>LED</th><th>Color</th><th colspan="2">Meaning</th></tr>
<tr><td rowspan="5">RUN</td><td rowspan="5">Green</td><td colspan="2">This LED indicates the terminal’s operating state:</td></tr>
<tr><td>OFF</td><td>State of the EtherCAT State Machine:
INIT = Initialization of the terminal or BOOTSTRAP = Function for firmware updates of the terminal.</td></tr>
<tr><td>Blinking</td><td>State of the EtherCAT State Machine:
PREOP = Setting for mailbox communication and variant standard settings.</td></tr>
<tr><td>Single flash</td><td>State of the EtherCAT State Machine:
SAFEOP = Channel checking of the Sync Manager and the Distributed Clocks. Outputs stay in safe operation mode.</td></tr>
<tr><td>ON</td><td>State of the EtherCAT State Machine:
OP = Normal operation mode, mailbox- and process data communication possible.</td></tr>
<tr><td>TxD</td><td>Green</td><td colspan="2">State of the transmit signal line (on: HI signal level on transmit line).</td></tr>
<tr><td>RxD</td><td>Green</td><td colspan="2">State of the receive signal line (on: HI signal level on receive line).</td></tr>
</table>

6.25 CTMT6224

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.
State Ch. 1 - 4	Green	ON / OFF	Status of the signal line (if configured as STD in / out)
		Flashes briefly twice	IO-Link communication is being established
		Permanently flashing	IO-Link communication established and functioning

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

6.26 CTMT6731

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.
BF	red	OFF	DP master is in CLEAR/OPERATE mode, all DP slaves are in data exchange
		Flashing	DP master is in CLEAR/OPERATE mode, at least one DP slave is in data exchange
		ON	DP master is in STOP mode
CPU Err	red	ON	CTMT6731 processor error
		Single flash	The CTMT6731 processor starts

6.27 CTMT9100

Diagnostic LEDs

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

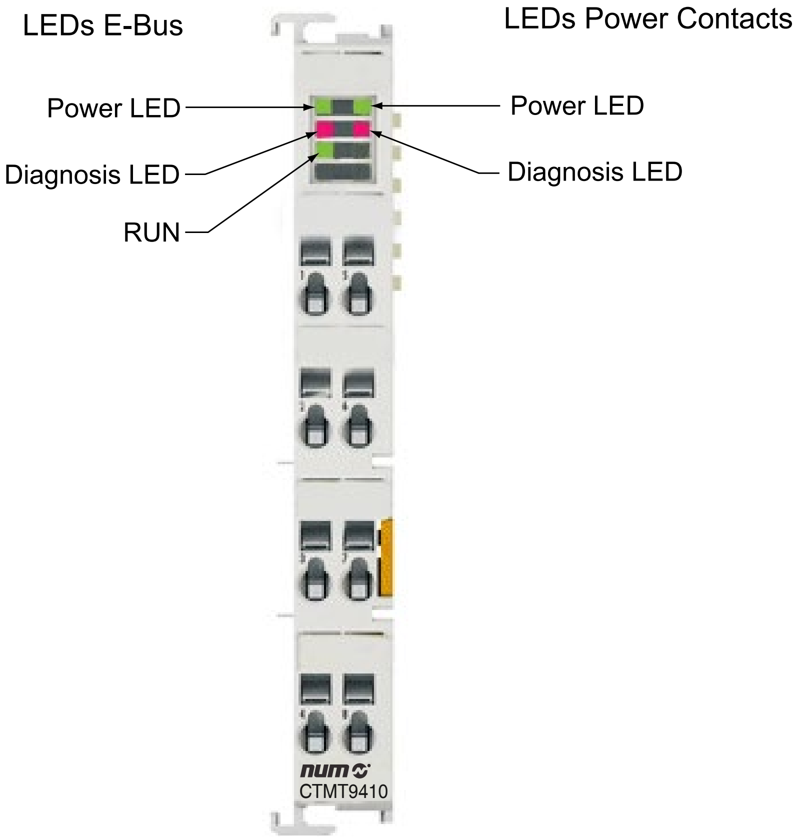
6.28 CTMT9110

Diagnostic LEDs

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

6.29 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: Supply input +24V for the E-Bus less then 17VDC
Diagnosis LED Up	Red	OFF	No error
		ON	Undervoltage: Supply input +24V for power contact less then 17VDC
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.

Page deliberately empty

Page deliberately empty

Published by NUM Spa

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

Printed March 2022

CNC HighEnd Applications