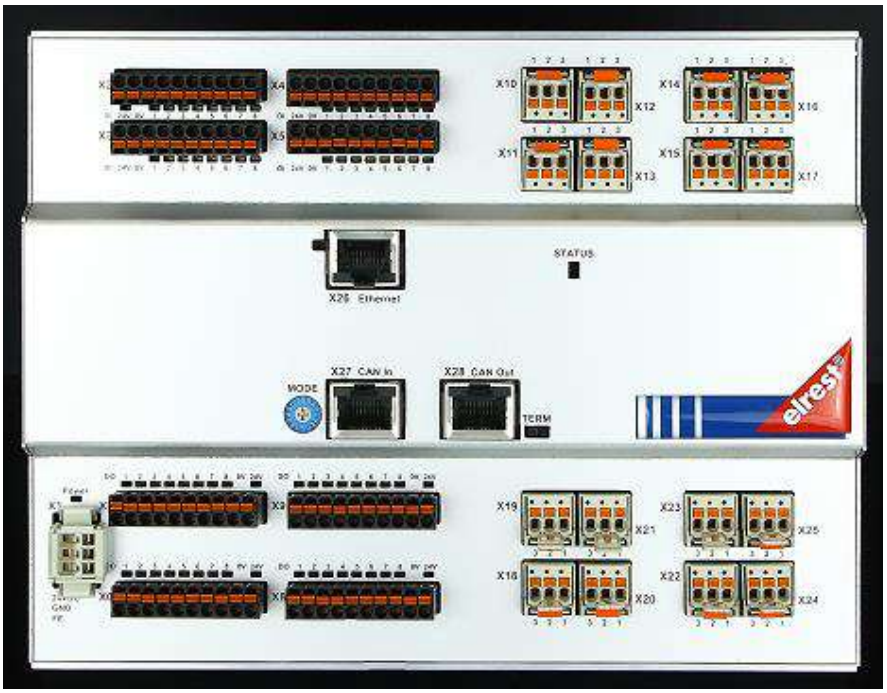
# Device description_V 1.6

## robusto control Series robusto slave RSC102

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# Imprint



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This document was carefully created, in order to ensure the correctness and completeness of the documentation.
Since, in spite of all the care taken, errors can never be completely avoided, we are always grateful for advice and suggestions.

# 1 General

## 1.1 Preface

This manual contains texts, illustrations and explanations for the correct installation and operation. This manual must be read and considered before installation and employment of the devices.

This documentation is mainly directed towards qualified personnel to control and automation technology. They must be well acquainted with the current standards and guidelines.

If you have any questions about the installation, application and operation, please contact the *elrest* customer hotline:

Phone: 07021/92025-33

Fax: 07021/92025-59

E-Mail: hotline@elrest.de

or contact your responsible agency.

This manual is published subject to any changes. Changes can be made without reference.

## 1.2 Liability

The documentation was carefully compiled.

All examples and illustrations in this manual serve only as assistance for understanding the text. Changes without references can be made. We do not assume any liability for the correctness of the represented operations. No claims for the modification of products that have already been supplied may be made on the base of the texts, explanations and illustrations in this documentation. elrest Automationssysteme GmbH takes on no responsibility for an application of products, which refers to the represented examples (e.g. in eStudio demo).

elrest Automationssysteme GmbH assumes under no circumstances the liability or responsibility for damage, which resulted from an inappropriate installation, respectively an application of the devices or the accessories.

The staff must ensure that the installation and the application of the products according all of the safety requirements, laws, regulations and standards

In each case the national regulations and the valid safety regulations have to be considered.

Interferences and changes in the devices automatically render the warranty void.

## 1.3 Security regulations and safty precautions

This manual was provided for trained and competent personnel. The qualification is defined by the European guidelines for machines, low-voltages and EMV. The connection and the assembly of the devices can be carried out only via an electrical specialist, if the voltages are higher than the Safety Extra Low Voltage (SELV).

In each case the national regulations and the valid safety regulations have to be considered. Interferences and changes in the devices automatically render the warranty void.

Due to the large number of different applications for these devices, you must adapt yourself for your particular application.

If circuit components should fail, appropriate safety devices must ensure that the attached periphery is stopped.

Do not try to repair the devices themselves or exchange electrical parts. Please turn exclusively to the elrest service department. You can contact us on the elrest-hotline.

Consider the local, national standards and regulations during the installation and the employment of the devices.

The relevant regulations (VDE etc.) while handling electrical system are to be considered:

- To activate
- Prevent unintentional restart
- The unit must be deenergized
- Ground and short-circuiting
- No ground-loops.
- Cover or shield nearby live electric parts.

## 1.4 Copyright

The information, contained in this document, may be changed without advance notice and represents no obligation on the part of elrest.

## 1.5 Symbols

In this manual different symbols are used for the emphasis of certain information. Hereby the service personnel receive necessary references to the safety and preventive measures. With each occurrence of the symbols the associated reference has to be read.

Indicates a directly threatening danger situation which may result in damage to persons or property.

Indicates a possibly arising danger, which may result in damage to persons or property.


Indicates notes, thereby the handling gets easier.

DANGER

Personal injury caused by electric current!

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

DANGER

Personal injury caused by electric current!

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Warning of damage to persons

Indicate a possible danger with moderate risk that can result in death or (severe) bodily injury if it is not avoided.

CAUTION

Warning of damage to persons

Indicates a low-risk, potentially hazardous situation which, if not avoided, could result in slight to moderate injury.

CAUTION

Warning of damage to material

Indicates a possible danger which can result in material damage, when it cannot be avoided.

ESD

Damage to Property Caused by Electrostatic Discharge (ESD)!

Indicates a potentially hazardous situation which, if not avoided, may result in damage to property

NOTICE

Important Note!

Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

INFORMATION

Further information

Refers to further information, which is not a substantial component of this documentation (e.g. Internet

ST

```
(* comment to CoDeSys code lines *)
a := a+1;
```

## 1.6 Safety instructions

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:

DANGER

Don’t assembly the devices under voltage!

Always switch off the power supply before assembling the device, eradicating defaults or carrying out maintenance operations.

---

DANGER

Take note of the general regulations on prevention of accidents!

Take note of the relevant regulations on prevention of accidents, e.g. the regulations during installation and commissioning of BGV A 3 "electrical installations and equipment" for mounting, installation and eradicating defaults.

---

DANGER

Take note of connection in compliance with the standard!

To avoid risks of the staff and the disturbances on the device, install the data- and the supply line conforming to standards. Take note of the correct assignment of connections.Observe the relevant EMC directives for your application.

---

ATTENTION

Replace defective or damaged device!

Replace defective or damaged device/module (e.g., in the event of deformed contacts), since the long-term functionality of fieldbus station involved can no longer be ensured.

---

ATTENTION

Shield the devices from creeping and isolating materials!

The components are not resistant against materials which have creeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If it cannot be excluded that this substances are in the environment of the device, incorporate the device in a cage which is resistant against the above-named substances. Always use proper tools and materials for the maintenance.

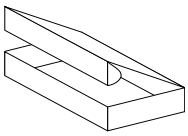
## 1.7 Before you start…

Before switching- on the supply voltage, please check definitely:

- The wiring
- Possible interference
- Free circulation around the heatsink

## 1.8 Storage, transport and packaging

The delivery has to be checked for completeness after the receipt. Possibly determined transport damages shall be notified to the shipping company and the manufacturer immediately. In the case of a possible temporary storage it is recommended to use the original packaging. The storage must be clean and dry. According the §BGB §446 and §448, the transfer of perils of the purchased product will pass to the buyer from invoicing. elrest does not assume any liability for the transport risk.If the carrier's liability of the transport enterprise does not cover the commodity value, it is incumbent on the buyer to conclude an additional transport insurance.



The devices are delivered in a suitable packing. To avoid damages please remove the packing before using the device. If the packing includes further accessories or descriptions, consider and keep them absolutely.

## 1.9 Warranty

A warranty claim presupposes a professional assembly and start-up, based on a valid assembly-, commissioning instruction and the operating instructions. The necessary assembly, start-up and maintenance work may be accomplished only by adept and authorized persons. See our EULA regulations too.

| **Manufacturer** | **Trademark** | **Country of origins** |
|---|---|---|
| elrest<br>Automationssysteme GmbH<br>D-73230 Kirchheim unter Teck<br><br>Leibnizstraße 10<br>Phone:+49 (0) 7021/92025-0<br>Fax: +49 (0) 7021/92025-29 | | Germany |

## 1.10 Application area

The CANopen Slave reads and sets analog and digital inputs. The relevant information is transferred via the CANopen protocol. The Slave can be set in any network.

### *1.10.1 Intended use*

The devices are intended for the use in the ranges of the regulation, control and automatic control engineering.

Within all ranges, particularly when using inductive loads (e.g. engines and relay etc.), it must be guaranteed that arising voltage peaks don't exceed the maximum input voltages of the entrances and exits. If necessary, external protecting circuit parts must be installed.

The devices are exclusively intended for the installation in machines and plants. Start-up is forbidden until the conformity of the final product with the guideline 2006/42/EG „machine guideline "is determined.

With certain devices external measures (e.g. a special power supply) can be necessary, in order to achieve the requiered interference immunity against surge). In this case, it will be pointed out at the respective device.

It will be applied accordingly to the appropriate device, if external measures are necessary for the minimization of the radiated interference.
Further the environment can affect the radiated interference.

Fulfils a device the "higher" engineer standards (e.g. EN 61000-6-3:2007 generic standard emission: Living quarters, business and industrial areas and small enterprises), it will be applied accordingly to the appropriate device (see to chapter „data sheets ").

Warning!

This is a Class A product. In a domestic environment it may cause radio interference, in which case the user may be required to take adequate measures.
Designates a possibly arising danger, which can lead to a damage to property or person

### *1.10.2 Structure of the robusto control RSC102*

Uniform structure of the robusto device:

- Robust aluminium heat sink housing
- Rail mounting
- Status LED for optical contol of the operating status
- Plugs can be installed
- RJ45 sockets for interface connection

### *1.10.3 Configuration*

A CANopen communication level is available.

The selected configuration of the hardware must be accord the setting of the peripheral components. Malfunctions may otherwise occur, if no safty prompts are programmed in the application.

A slave module can only be (dis-)connected to the system only in power-off state of all system components.

# 2 Implementing

## 2.1 Mechanical installation

Safety notes at the workplace:

Before installating and starting up, the manual must be read and followed carefully. The relevant EN and VDE regulations are valid.

Before starting up, adapt the device to the room temperature. By condensation you are allowed to switch on the device only after it is completely dry.

To prevent the device from overheating:

- avoid direct sun contact to the device,

- do not cover the vents

- ensure sufficient air circulation.

All devices must be dimensioned on the same mains voltage.

### *2.1.1 Required space*

During installation, please ensure sufficient access to the device for the operator and maintenance work. Care must be taken for sufficient air ventilation.

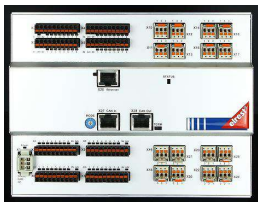
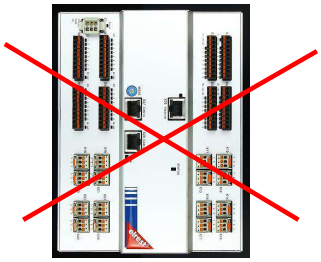
### *2.1.2 Installation / Assembly*

The valid local, and in particular, electrical safety regulations must be kept.

Safety notes at the workplace:

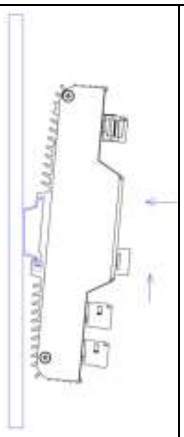
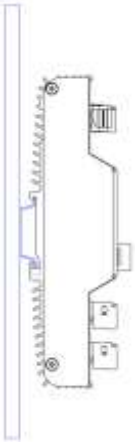
- The devices are intended for installation in switching cabinets;
  (in general switching cabinets made of steel)
- The protection rating IP20 has to be warranted;
- Unless otherwise indicated, the devises may only be installed perpendicular.
- The installation point has to be in a solid position with low vibration.

### 2.1.2.1 Assembly/Disassebly of the RSC102

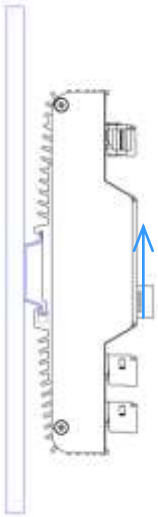
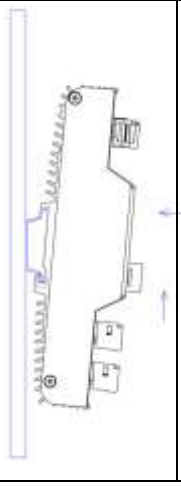
| | | | |
|---|---|---|---|
| | The RSC102 is mounted on a 35 mm top hat rail acc. DIN EN 60715<br>Bring the system into a safe, de-energized state before starting installation, disassembly or wiring of the device!<br>THE TOP HAT RAIL MUST BE CONNECTED TO THE FUNCTIONAL EARTH (FE) | | |
| | **The device must be installed vertically** |  |  |

The device will be connected via X1 (power supply).
By connecting and disconnecting cables, which require a great effort, the device must be hold in the top hat rail, so that no tear out of it is possible.

**Montage** :

| | |
|---|---|
|  | Keep the RSC102 over the top hat rail, so that the top hat rail applies in a right angle to the rear side of the device.<br><br>Put the device into the top hat rail and push against the spring force of the splay, till the upper part of the profile snaps over the upper part of the top hat rail. |
|  | Release the device; it must fit free and robust on the top hat rail.<br>Check the best fit by easy attempts at movement of the device. |

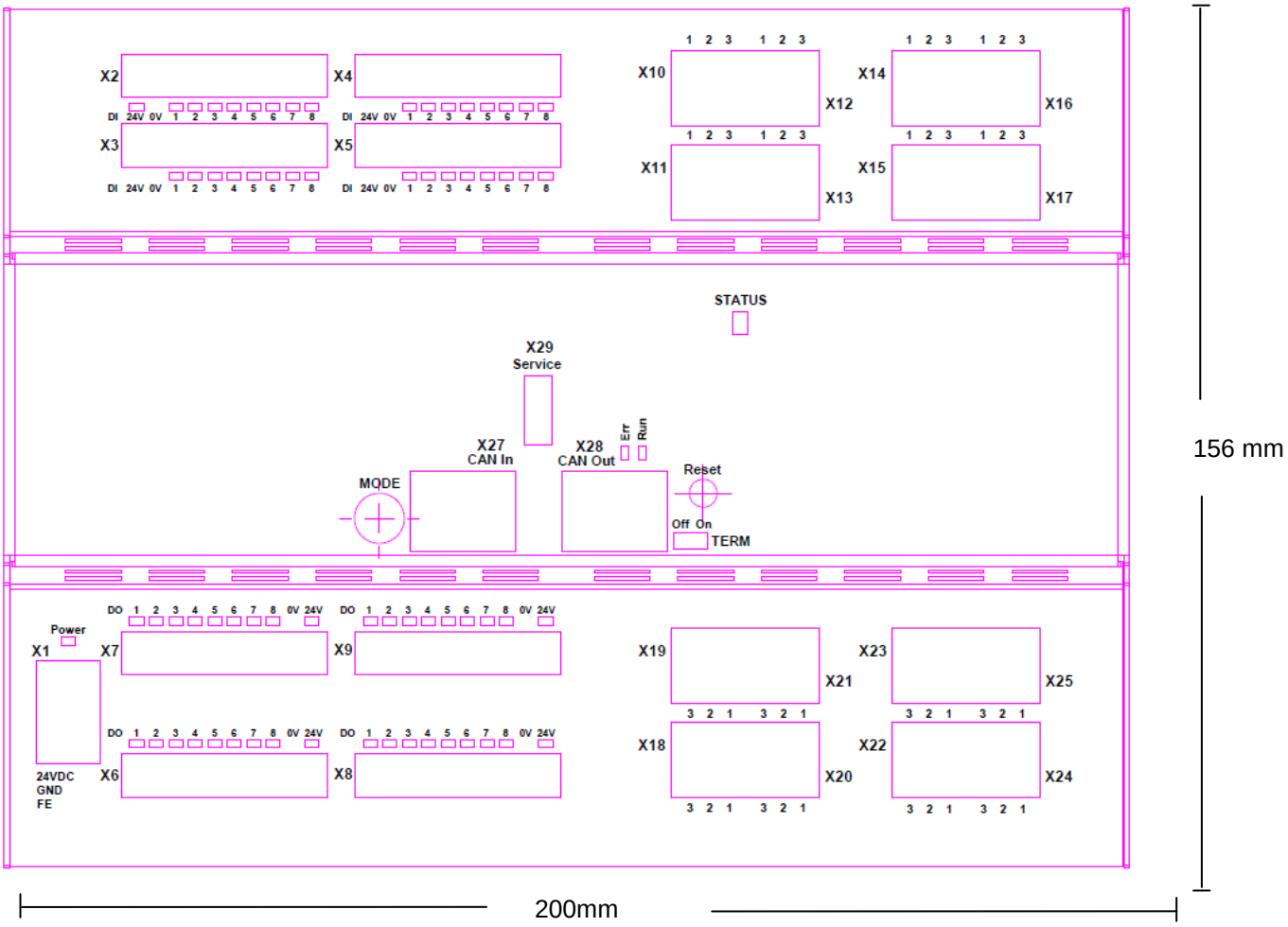
**Demontage:**

| | |
|---|---|
|  | All connecting plugs must be removed before the disassembly.<br>For the disassembly push up the device, till the device can be tipped forward for the release |
|  | Push the device against the spring force of the splay till it can released from the upper part of the top hat rail.<br>In this moment the device is no longer kept from the top hat rail, it must keep hold of you to avoid falling down.<br>Lower the device and remove it from the top hat rail. |

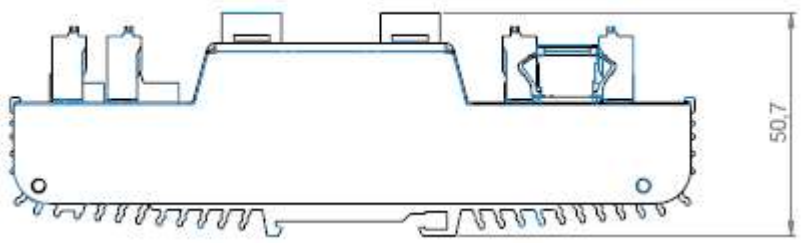
### *2.1.3 Cooling*

Passive heat sink: Cooling is achieved via the robusto heat in the backside of the device.

## 2.1.4 Dimension drawing front view




## 2.1.5 Dimension drawing side view



## 2.2 Elektrical Installation

### *2.2.1 Supply voltage*

Proceed with start-up generally as follows:

- Attach the devices to the power supply.
- Attach the supply voltage for the device to X1.
- Turn the power supply on.

The supply voltage connection of the control component from the device has polarity protection.

If several connection points are available for the identical potential, than no potential difference between them is allowed. Otherwise, the resulted compensation currents can lead to irreversible damages of the device. Therefore, provide a suitable equipotential bonding!

For the 24 V – supplier ensure a reliable electrical isolation of the low voltage. Only use power supply units manufactured to the standards IEC 364 - 4 - 41 / HD 384.04.41 (VDE 0100 Part 410).

Only use power supply units in accordance with SELV and PELV specifications!

The supply voltage may be intermediate within the specified voltage range! Otherwise this may cause malfunction on the device. See the technical specifications for the supply voltage requirements.

High frequency radiation, from mobile phones for example, can cause unintentional operating situations.

#### 2.2.1.1 Connectors for power supply

For the connectors X1, X2 - X9 und X10 - X25 only use the specified manufacturer types, not analog connectors can damage the pin connectors.
For the interfaces USB, CAN and EtherCAT can be used commercially connectors with good quality.

The connectors may not be separated while under load!
Faulty or incorrect connection may cause malfunction on the device

### *2.2.2 EMC-compliant design*

The basis for an interference-free operation is an EMC-compliant hardware construction of the system, as well as the use of interference-free cables**.** The guidlines for interference-free installation of your system are accordingly to the installation of the RSCxxx devices.

For all signal connections are allowed only protected lines.

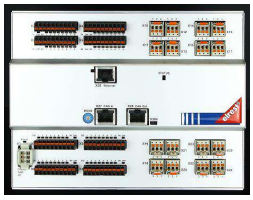
- All plug connectors must be screwed or locked;
- Signal lines and high-voltage cables are not allowed to lead both in the same cable duct;
- For malfunctions and damages caused by the use of unsuitable cable, no liability can be accepted;
- Unused signals (e.g. unused interfaces, battery connections, etc.) have to be adequate covered to avoid electrostatic influences (ETUC/ESD);
- Cables only plug in/off when the device is turned off.
- During the operation, all unit- connected cables must be connected to a remote peer.

### *2.2.3 Connections to other devices*

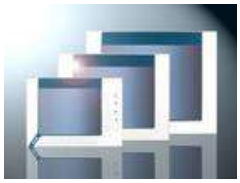
Establish the connection as follows:

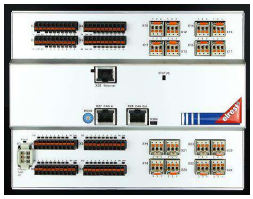
| **Article number:** | | **25211.0000/25211.0002** |
|---|---|---|
| MASTER<br>CM 1xx or 2xx or further Slave | Patch cable<br>RJ-45 to RJ-45 | |





| **Article number:** | **240020100** | **25211.0000/25211.0002** |
|---|---|---|
| Visio control<br>PMC4xx | Cable D-Sub-9 to<br>RJ-45 | |





The individual accessory components can be gleanded from the chapter „accesorries“.

### *2.2.4 EGB / ESD- guidelines*

#### 2.2.4.1 What means EGB/ ESD

Nearly all modern modules are equipped with highly integrated chips or components in MOS technology. These electronic components are very sensitive to overvoltage and therefore to electrostatic discharge.

The international abbreviation for ESD means Electrostatic Sensitive Device.

This symbol is on cabinets, subtracks, or packing boxes and indicates the use of electrostatically sensitive devices and thereby sensitivity by touching the devices:

EGB /ESD sensitive components may be damaged by energies and voltages that are below the limit of human perception. This kind of voltages occurs when somebody, which is not electrostatically discharged, touches a module/chip/component. In most of the cases, the components exposed to such overvoltages can not immediately be detected as defective. Only after long operating of the device may an error occur.

An installation that conforms to EMC requirements as well as the use of interferencefree cables represents a basic requirement in ensuring trouble-free operation.

The directives for interference-free installation of your device also apply for the installation of the HMI device.

#### 2.2.4.2 Protective measures against static charge

The most plastics are hard chargeable and therefore must be kept away from ESDs!
Ensure that operators, work area, and packaging have proper grounding when working with ESDs!

#### 2.2.4.3 Handling of ESD-Modules

Basically, the electronic boards should be touched only when it's absolutely necessary. Never touch the chip connectors and live conductors of a flat electronic module.

Touch the electronic components **only**, if you are permanently grounded via the ESD wristband, ESD shoes, or shoes with protecting strip in constant touch with an ESD floor.

Discharge your body before touching any electronic module. For example, by touching electrically conductive and grounded material (e.g. grounded bare metal cabinet parts, water pipes…).

Electrostatic sensitive components or modules must not get in contact with materials which are chargeable including all standard types of plastic, desk top, and clothes with synthetical material and so on. Components must only be placed on conductive surfaces.(table witg ESD- layer, ESD conductive cellular material, ESD packaging, ESD container)

Do not place the components near visual displays and monitors or television sets. (Keep a minimum distance of 10cm)

### *2.2.5 Guidelines*

The conformity of the above specified products with the provisions of the Directive 2006/42 /EG is supported by the respect of the following standards:

#### 2.2.5.1 Product standard

Household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers (IEC 60335-2-40:2002, modifiziert + A1:2005, modifiziert + A2:2005, modifiziert + Korrigendum 1:2006)

#### 2.2.5.2 Immunity

Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:2005)

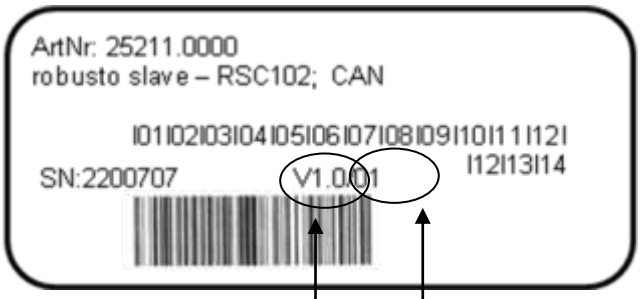
#### 2.2.5.3 Interference immunity

Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments

Suppression level according to EN EN 55011 Class A

## *2.2.6 Label*

Each device has on the back side an individual series label, which identifies the device.




The serial label includes the following information:

article number
article description
additional text

serial number index . month of delivery
year of delivery

The index Vx.x/yy splits in

x.x hardware status

yy software status

Note for devices with the index = „ PROTOTYPE”.

Prototypes are used only for test purposes.

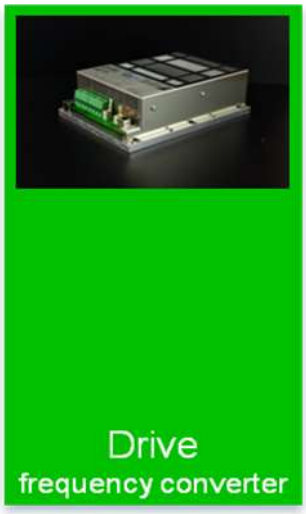
# 3 System overview

## 3.1 Products

elrest-products


combo
robusto


visio terminal
visio control




motion


software

## 3.2 Communication interfaces

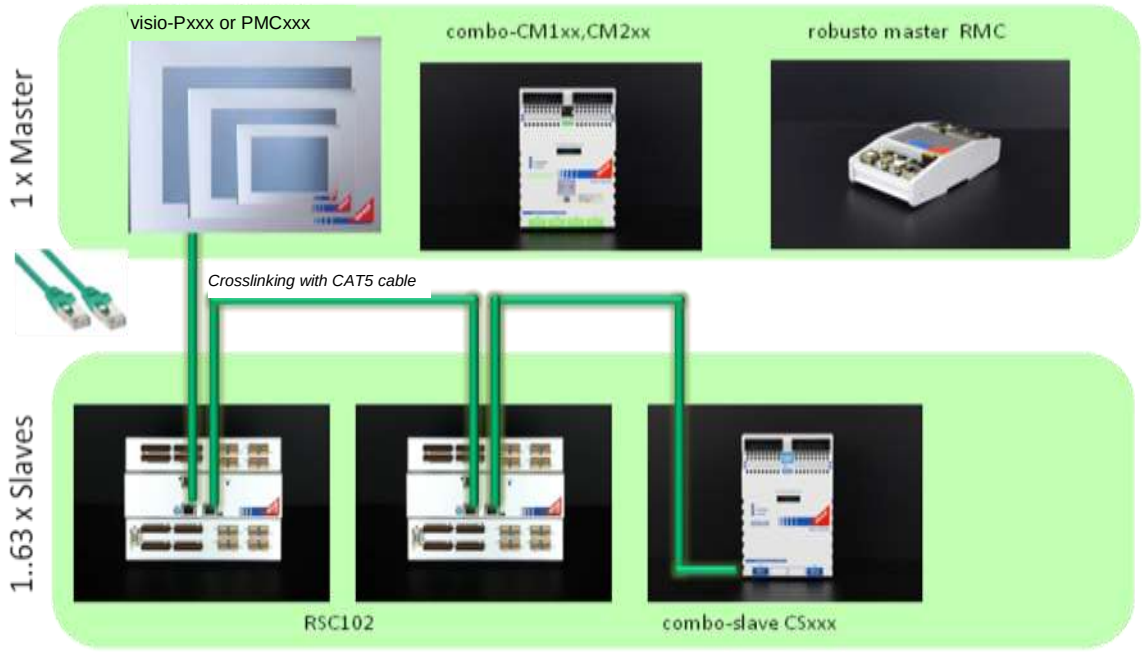
CANopen is a widespread layer7 protocol for the automation. Serial interface for monitoring absolute position values of an encoder.

An open fieldbus interface to any CAN protocols, e.g. Truck-Norm J1939-base

**Availability**

The CAN interface is designed as a CANopen interface.

### *3.2.1 Crosslinking with CANopen*




A CAN- network can consist maximum of 127 participants, without a repeater 64 paricipants.
The CAN physics allows a length of maximum 1000m @ 50 kBaud

# 4 Device description

## 4.1 Technical data

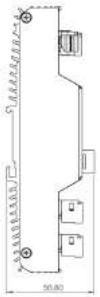
### *4.1.1 RSC102*

**robusto control**

*Data sheet robusto slave RSC102*

elrest
Wir steuern Ihren Erfolg

symbolic illustration



robusto control

- **32 digital In- and 32 digital Outputs**
- **16 analog In- or 16 analog Outputs**

| | |
|---|---|
| **Specification** | |
| Processor | 32 Bit Cortex-M4 CPU 168 MHz |
| **Interface** | |
| Field bus interface | 1 x CAN acc. ISO 11898 with galvanically isolation<br>(2 x RJ45 In/Out) |
| **Functions** | |
| CANopen | CANopen Slave implementation |
| **Bestell-Nr.:** | |
| 25211.0000 | robusto slave - RSC102; 32DI, 32DO, 16AIO (CANopen) |
| **Environment/ mechanical values** | |
| Supply voltage | 24 VDC (-15% / +20%) SELV with reverse battery protection |
| Housing | robusto heat sink with device lid |
| Protection class | IP20, acc. EN 60529 |
| Mounting | snap-in mounting on top-hat rail DIN50022 |
| Outside dimensions in mm (w x h x d) | approx. 200 x 156 x 50 |
| Weight app. | 430 g |
| Operating temperature | 0 °C…55 °C |
| Storage temperature | -20°C... 70°C |
| Relative humidity for operation | 10%...85% non-condensing |
| Relative humidity for storage | 5%...85% non-condensing |
| Cooling | Passive heat sink |
| **Diagnostic** | |
| LED's | LEDs for operating- and status reports; LED Power;<br>LED status I/O |
| **Digitale Inputs** | |
| Number | 32 |
| Input voltage | 24 VDC with galvanically isolation, EN61131-2 Typ 3 |
| Frequency max. | 100 Hz |
| Over voltage | 33 V |
| Dissipation loss | 0,2 watt per input |
| Connection | 4 x socket 10-pole; contact spacing 3,5 mm,<br>conductor crosssection up to 0,2 … 1,0 mm², 8 A<br>WAGO: 714-140 |

| **Digital Outputs** | | | | |
|---|---|---|---|---|
| Number | | 32 | | |
| Output voltage | | 24 VDC with galvanically isolation | | |
| Output current | | 0,5 A | | |
| Total current (per DIN) | | max. 4 A | | |
| Switching frequency Ohm/inductive | | 100 Hz | | |
| Short circuit - / therm. protection | | Current limiting 0,7 A per channel/ 150°C fuse, 5 A | | |
| Reverse polarity | | yes | | |
| Connection | | 4 x socket 10-pole; contact spacing 3,5 mm,<br>conductor crosssection up to 0,2 … 1,0 mm², 8 A<br>WAGO: 714-140 | | |
| **Analog In- and Outputs** | | | | |
| Number | | 16 | | |
| Analog input types of sensors : | | KTY81-1 | | |
| | | PT100, PT1000, PT500 (2- oder 3-wire) | | |
| | | TC (B,E,J,K,L,N,R,S,T) | | |
| | | Voltage : – 10...+ 10 VDC | | |
| | | Current : 0...+ 20 mA | | |
| | | Resistance: 0…500 Ohm | | |
| Analog output types of sensors : | | Voltage : – 10...+ 10 VDC | | |
| | | Current : 0...+ 20 mA | | |
| Accuracy | | ± 80 µA over input current 0..20 mA | | |
| | | ± 40 mV over input voltage -10..10 V | | |
| Conversion time | | 100 ms of all analog channels | | |
| | | Range: | Type: | Resolution: |
| Current measuring range | Ain | 0(4)…20 mA | Ampere | 11µA/digit |
| | Aout | 0(4)…20 mA | Ampere | 27µA/digit |
| Voltage measuring range | Ain | -10…10 V | Volt | 6mV/digit |
| | Vout | -10…10 V | Volt | 6mV/digit |
| Temperature measuring range | | -55…150°C | *KTY81-1 | 0,21°C/digit (bei 1 mA) |
| | | -200...850°C | PT100 | 0,6°C/digit (bei 5 mA) |
| | | -200...850°C | *PT500 | 0,65°C/digit (bei 1 mA) |
| | | -200…200°C | PT1000 | 0,59°C/digit (bei 1 mA) |
| | | 0…1820°C | *TC Typ B | 1,65°C/digit |
| | | 0…630°C | *TC Typ E | 0,17°C/digit |
| | | 0…830°C | *TC Typ J | 0,22°C/digit |
| | | 0...1170°C | TC Typ K (Ni-CrNi) | 0,31°C/digit |
| | | 0…820°C | *TC Typ L (Fe-CuNi) | 0,22°C/digit |
| | | 0...1300°C | *TC Typ N | 0,35°C/digit |
| | | 0...1760°C | *TC Typ R | 1,05°C/digit |
| | | 0...1760°C | *TC Typ S (Pt-RhPt) | 1,2°C/digit |
| | | 0...400°C | *TC Typ T | 0,25°C/digit |
| | | 0…500 Ohm | Resistance | 0,5 Ohm /digit |

| | |
|---|---|
| AD converter analog input | 12-bit |
| D/A-converter analog output | 12-bit |
| Current | 0,1 A |
| Conversion time | 100 ms of all analog channels |
| Connection | 16 x multipoint socket connector eCOM with straight solder pins; with hilt plate; 3-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 …1,5 mm², 10 A<br>WAGO: 2091-1403 |
| * | in preperation |
| **Standards** | |
| Product standard | |
| EN61131-2 | Programmable controllers - Part 2: Equipment requirements and tests (IEC 61131-2:2007); German version EN 61131-2:2007 |
| Immunity and interference | |
| EN61000-6-2 | Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Emission standard for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005 |
| EN61000-6-4 | Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments (IEC 61000-6-4:2006 + A1:2010); German version EN 61000-6-4:2007 + A1:2011 |
| **Accessories** | |
| 25001.0001 | Connector set composed of:<br>8 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,0 mm², 8 A<br>Series 714-110  <br>16 x multipoint socket connector picoMAX® with straight solder pin; with hilt plate; 3-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 …1,5 mm²,10 A,<br>WAGO: 2091-1103, serial: 2091-1103/002-000  <br>1 x socket 3-pole , Wago 734-103/037-000<br>Supply connector: 1x socket 3-pole, contact spacing 3,5 mm, conductor crosssection up to 0,08 …1,5 mm²,10 A, Serie 734-103 |
| **Applications** | |
| | in many industries such as plastics, medical- and automation technology |



*Remark: The use of standard memory card (e.g. CF-cards is generally possible. Anyhow elrest GmbH does not take any responsibility thereby.

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E601304-1.5

## 4.1.2 RSC102_NTC

**robusto control**

*Data sheet robusto slave RSC102-NTC*

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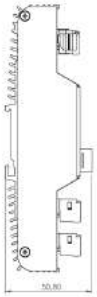
Wir steuern Ihren Erfolg

symbolic illustration



robusto control

- **32 digital In- and 32 digital Outputs**
- **16 analog In- or 16 analog Outputs**

| | |
|---|---|
| **Specification** | |
| Processor | 32 Bit Cortex-M4 CPU 168 MHz |
| **Interface** | |
| Field bus interface | 1 x CAN acc. ISO 11898 with galvanically isolation<br>(2 x RJ45 In/Out) |
| **Functions** | |
| CANopen | CANopen Slave implementation |
| **Bestell-Nr.:** | |
| 25211.0002 | robusto slave - RSC102-NTC |
| **Environment/ mechanical values** | |
| Supply voltage | 24 VDC (-15% / +20%) SELV with reverse battery protection |
| Housing | robusto heat sink with device lid |
| Protection class | IP20, acc. EN 60529 |
| Mounting | snap-in mounting on top-hat rail DIN50022 |
| Outside dimensions in mm (w x h x d) | approx. 200 x 156 x 50 |
| Weight app. | 430 g |
| Operating temperature | 0 °C…55 °C |
| Storage temperature | -20°C... 70°C |
| Relative humidity for operation | 10%...85% non-condensing |
| Relative humidity for storage | 5%...85% non-condensing |
| Cooling | Passive heat sink |
| **Diagnostic** | |
| LED's | LEDs for operating- and status reports; LED Power;<br>LED status I/O |
| **Digitale Inputs** | |
| Number | 32 |
| Input voltage | 24 VDC with galvanically isolation, EN61131-2 Typ 3 |
| Frequency max. | 100 Hz |
| Over voltage | 33 V |
| Dissipation loss | 0,2 watt per input |
| Connection | 4 x socket 10-pole; contact spacing 3,5 mm,<br>conductor crosssection up to 0,2 … 1,0 mm², 8 A<br>WAGO: 714-140 |

| | | | | |
|---|---|---|---|---|
| **Digital Outputs** | | | | |
| Number | | 32 | | |
| Output voltage | | 24 VDC with galvanically isolation | | |
| Output current | | 0,5 A | | |
| Total current (per DIN) | | max. 4 A | | |
| Switching frequency Ohm/inductive | | 100 Hz +/- 20% | | |
| Short circuit - / therm. protection | | Current limiting 0,7 A per channel/ 150°C fuse, 5 A | | |
| Reverse polarity | | yes | | |
| Connection | | 4 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,0 mm², 8 A WAGO: 714-140 | | |
| **Analog In- and Outputs** | | | | |
| Number | | 16 | | |
| Analog input types of sensors : | | KTY81-1, KTY81-2, KT110/130 | | |
| | | PT100, PT1000, PT500 (2- oder 3-wire) | | |
| | | Voltage : – 10...+ 10 VDC | | |
| | | Current : 0...+ 1 mA | | |
| | | Widerstand: 0…200 kOhm | | |
| Analog output types of sensors : | | Voltage : – 10...+ 10 VDC | | |
| | | Current : 0...+ 1 mA | | |
| Accuracy | | ± 80 µA über Eingangsstrom 0..1 mA | | |
| | | ± 40 mV über Eingangsspannung -10..10 V | | |
| Conversion time | | 100 ms aller Analogkanäle | | |
| | | Range: | Type: | Resolution: |
| Current measuring range | Ain | 0…1 mA | Ampere | 11µA/digit |
| | Aout | 0…1 mA | Ampere | 27µA/digit |
| Voltage measuring range | Ain | -10…10 V | Volt | 6mV/digit |
| | Vout | -10…10 V | Volt | 6mV/digit |
| Temperature measuring range | | -55…150°C | *KTY81-1 | 0,21°C/digit (at 1 mA) |
| | | -55…150°C | *KTY81-2 | 0,42°C/digit (at 1 mA) with given ampification factor |
| | | -55…150°C | *KT110/130 | 0,42°C/digit (at 1 mA) |
| | | -40…60°C | NTC 10kOhm | 0,1°C/ von -30…60<br>0,25°C/ von -40…-30 |
| | | -60…690°C | *NI1000 | 0,85°C/digit (at 1 mA) |
| | | -60…690°C | *NI1000TK5000 | 0,85°C/digit (at 1 mA) |
| | | -200…850°C | PT100 | 3°C/digit (at 1 mA) |
| | | -200…850°C | *PT500 | 0,65°C/digit (at 1 mA) |
| | | -200…850°C | PT1000 | 0,59°C/digit (at 1 mA) |
| | | 0…500 Ohm | Resistance | 0,5 Ohm /digit |
| AD converter analog input | | 12-bit | | |
| D/A-converter analog output | | 12-bit | | |
| Current | | 0,016 A | | |
| Anschluss | | 16 x Federleiste eCOM mit geraden Lötstiften; mit Griffplatte; 3-polig; | | |
| Connection | | 16 x multipoint socket connector eCOM with straight solder pins; with hilt plate; 3-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 …1,5 mm², 10 A WAGO: 2091-1403 | | |
| | * | in preperation | | |

| | |
|---|---|
| **Standards** | |
| Product standard | |
| EN61131-2 | Programmable controllers - Part 2: Equipment requirements and tests (IEC 61131-2:2007); German version EN 61131-2:2007 |
| Immunity and interference | |
| EN61000-6-2 | Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Emission standard for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005 |
| EN61000-6-4 | Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments (IEC 61000-6-4:2006 + A1:2010); German version EN 61000-6-4:2007 + A1:2011 |
| **Accessories** | |
| 25001.0001 | Connector set composed of:<br>8 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,0 mm², 8 A Series 714-110<br>16 x multipoint socket connector with straight solder pin; with hilt plate; 3-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 …1,5 mm², 10 A<br>WAGO: 2091-1103, serial: 2091-1103/002-000<br>1 x socket 3-pole , Wago 734-103/037-000<br>Supply connector: 1x socket 3-pole, contact spacing 3,5 mm, conductor crosssection up to 0,08 …1,5 mm²,10 A, Serie 734-103 |
| **Applications** | |
| | in many industries such as plastics, medical- and automation technology |



*Remark: The use of standard memory card (e.g. CF-cards is generally possible. Anyhow elrest GmbH does not take any responsibility thereby.

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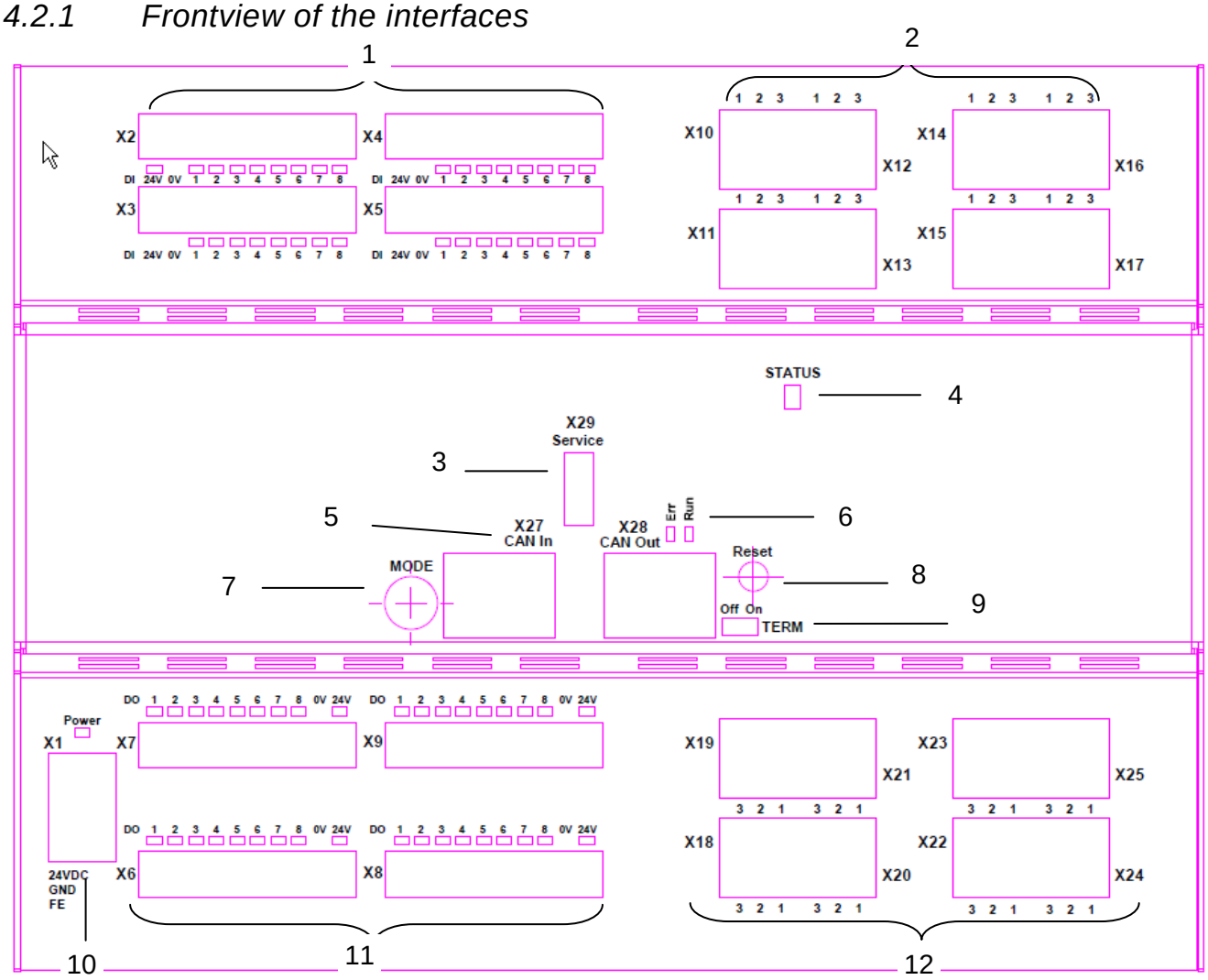
E601322-1.5

## 4.2 Interfaces

### 4.2.1 *Frontview of the interfaces*




| Nr. | | Designation |
|---|---|---|
| 1 | X2- X5 | Digital inputs |
| 2 | X10-X17 | Analog in- or outputs |
| 3 | X29- | Service interface |
| 4 | STATUS | Status LED |
| 5 | X27 | CAN IN |
| 6 | X28 | CAN OUT with LEDs |
| 7 | MODE | Hex- switch |
| 8 | Reset switch | After >8 sec. Hardware-Reset |
| 9 | TERM | CAN terminal resistor 120 Ohm (switched on and off) |
| 10 | X1 | Power supply with power control light |
| 11 | X6- X9 | Digital outputs |
| 12 | X18-X25 | Analog in- or outputs |

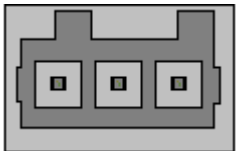
### *4.2.2 Terminal assignment*

#### 4.2.2.1 X1: power supply

Via this connector the device will be supplied with the operating voltage. The connection is protected against polarity

**X1**

1 2 3




| PIN | Configuration |
|---|---|
| 1 | PS-24V |
| 2 | PS-GND-IN |
| 3 | FE |

The pins are additionally marked with its signal-name on the label of the lid.

The control-LEDs „24 V “light up, if the voltage systems are functioning properly.

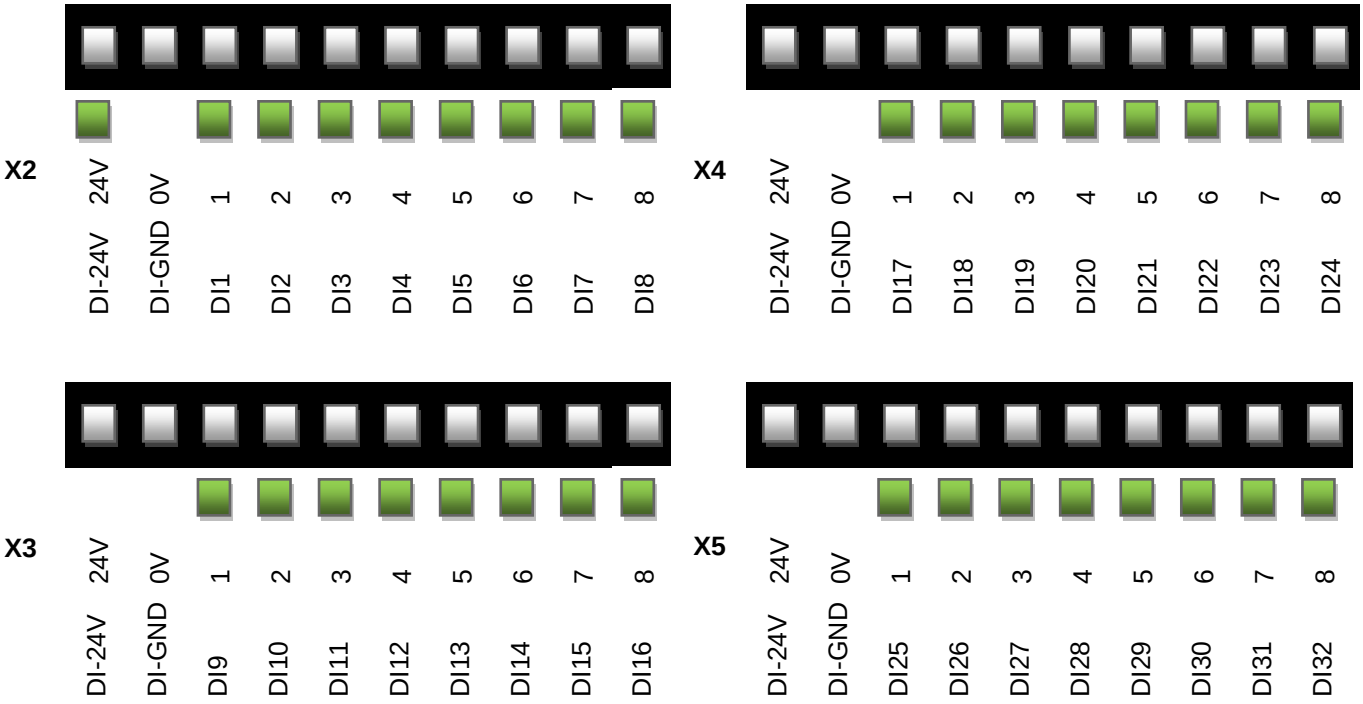
The RSC102 has to be included via its functional earth (FE) in the earthing concept.

- Connecting the top hat rail to FE
- Connecting the Power supply X1 / Pin3 to FE
- The cable screens of the communication ports, X27 /CAN IN, X28 /CAN OUT, are connected with their respective mating plug to FE.

### 4.2.2.2 X2 – X5 digital inputs

32 green LEDs for the inputs

32 green LEDs for the inputs
4 x 10-pole
WAGO-714-110



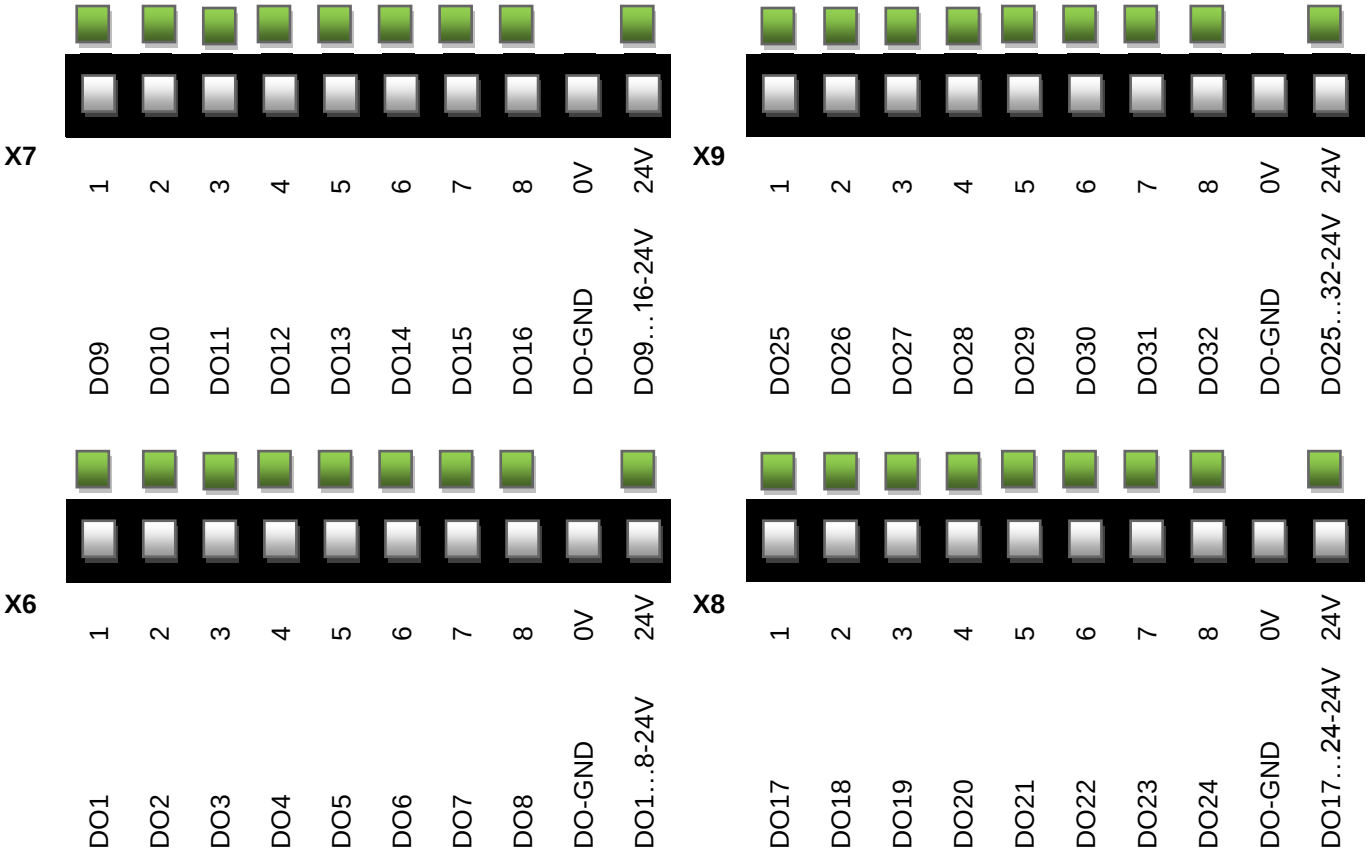

INFORMATION

The digital inputs are not galvanically isolated from each other.

The power supply via a plug it's sufficient for the digital inputs.

### 4.2.2.3 X6 – X9 digital outputs

32 green LEDs fort he outputs
4 x 10-pole
WAGO-714-110



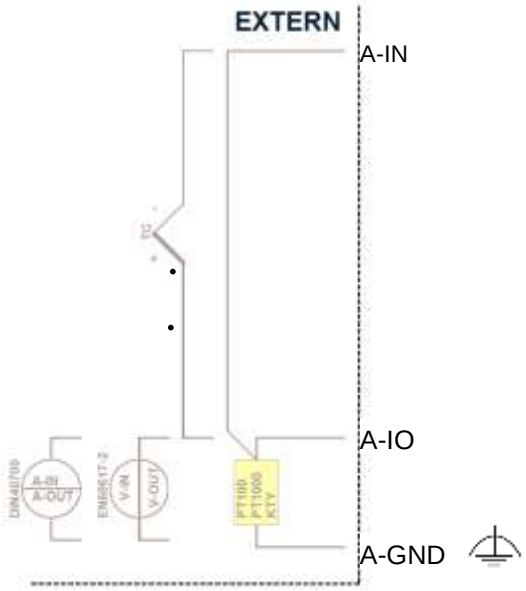

INFORMATION

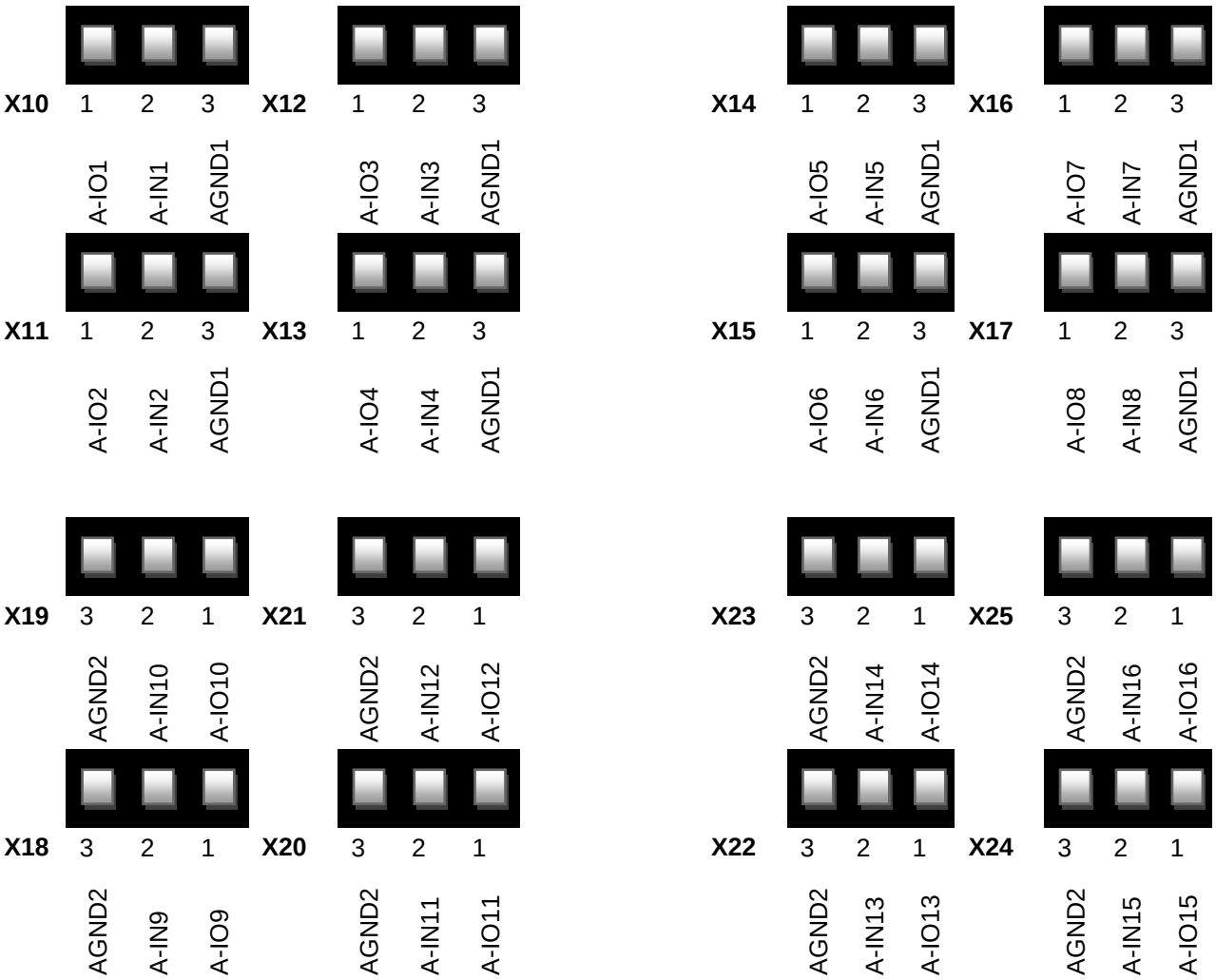
The digital inputs are not galvanically isolated from each other.

The outputs must be powered of each connector.

### 4.2.2.4 X10 – X25 analog in- or outputs

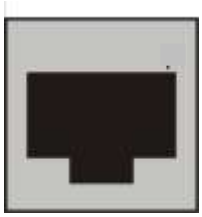
16 analog in- or outputs
A 3-pole connector is required for each channel
Wago 2091-1103/002-000



### 4.2.2.5 X27 CAN IN

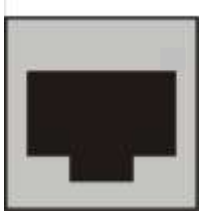
This interface is leaded out via an 8-pole RJ45 connector.
It's galvanically isolated from the supply voltage of the device.



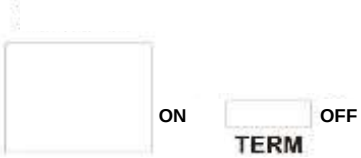
| PIN | Configuration |
|---|---|
| 1 | CAN-L |
| 2 | CAN-H |
| 3 | GND (Signal Ground for CAN) |
| 4 | NC |
| 5 | NC |
| 6 | NC |
| 7 | NC |
| 8 | NC |

### 4.2.2.6 X28 CAN OUT

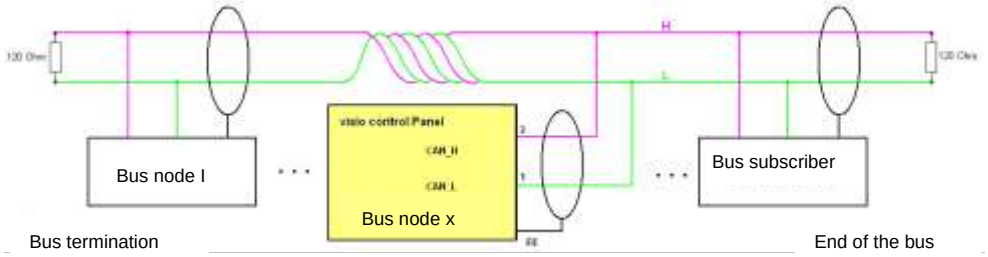
This interface is leaded out via an 8-pole RJ45 connector.
It's galvanically isolated from the supply voltage of the device.



| PIN | Configuration |
|---|---|
| 1 | CAN-L |
| 2 | CAN-H |
| 3 | GND (Signal Ground für CAN) |
| 4 | NC |
| 5 | NC |
| 6 | NC |
| 7 | NC |
| 8 | NC |




The CAN interface is supplied internally with voltage and is galvanically seperatly. The RJ45 metal insert is on theFE potential (screen connection).
The device contains aswitchable load resistance (switch „TERM“ = ON / OFF)



Tip for the connector socket on the cable:

Connect only the necessary pins for your application.
Check, if an external terminal resistor is necessary, because of the complete bus structure. Usually are the termination resistors at the beginning and the end of the bus cable. The resistance value is characterised 120 Ohm.

#### 4.2.2.7 CAN LED

Access CIA Draft Recommendation 303 Part3: Indicator specifikation

### *4.2.3 Power- LED*

1 x green:for the power supply of 24 V

### *4.2.4 Status - LED*

The status LED indicates various states by using the hex switch and in the run- modus. The description is given at the respective points of the document.

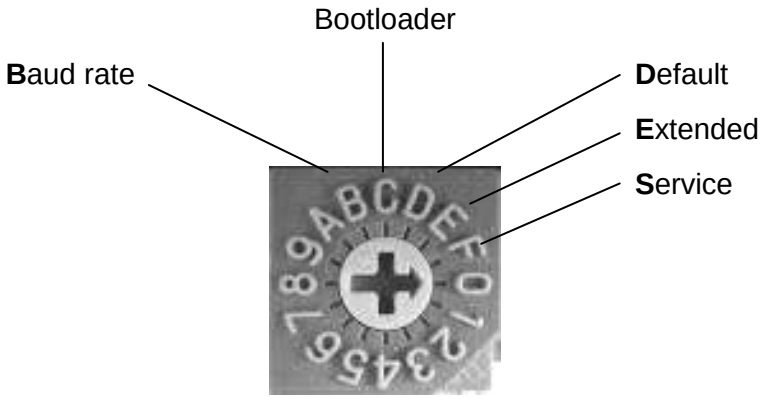
OFF: the device is off
Fast flashing: the control is in the service-mode ,Run-/CAN –Modus

### *4.2.5 HEX - switch (Modi)*

The hex- rotary switch is used for the settings of different operation modes and device parameters.
The switch position will be taken after a reset of the device.

The different switch positions have the following predefined functionality.

#### 4.2.5.1 Modi



Mode 0...9: Run-Mode:
CANopen Stack runs
The unit position of the NodeID corresponds to the switch setting.

Mode A: Stop

Mode B: Advanced service-mode(CAN baud rate):
CANopen Stack is stopped
Run-LED flashes (ca. 1,2 Hz)

By changing the switch settings 0…5 and remaining for 3 s, the baud rate of the CAN interfaces will be set, after the expiration (3s) the device performs a reset.

| **switch setting** | **baud rate** |
|---|---|
| 0 | 1 MBd |
| 1 | 500 kBd |
| 2 | 250 kBd |
| 3 | 125 kBd |
| 4 | 100 kBd |
| 5 | 50 kBd |

Mode C Bootloader
The device changes in the bootloader modus. The firmware can changed via the serial interface.

Mode D Default
After 3 s all settings will be reset to factory defaults.

- baud rate is set to 125 kBd
- nodeID is zeroised

Mode E: Expanded service-mode (CAN NodeID):
CANopen Stack is stopped
Run-LED flashes (approx.. 1,25 Hz)

By changing the switch settings 0…9 and remaining for 3 s, the tens digit of the CAN NodeID will be set.
After 3 sec the device is performed a reset.

Mode F: Service-mode:
CANopen Stack is stopped
Run-LED flashes (approx. 1,2 Hz)

#### 4.2.5.2 Delivery status

The device is supplied in switch setting „F“. This correspond the service-mode.
The CANopen stac is stoppped and the device is no active CAN bus device.

### *4.2.6 Reset- button*

Hardware: Funktionality: t > 8 s; hardware- reset

Software: If the reset-button will be pressed longer than 2 seconds during the restart, the firmware will be deleted and the device will be remained in theBootLoader mode.

### *4.2.7 Download - plug*

Behind the housing is a plug with a cover.

#### 4.2.7.1 Download - Adapter

With the download – adapter can be executed via CODESYS IDE a firmware-update.

# 5 Software

## 5.1 Software dokumentations

### *5.1.1 General*

On our website can download further information:

The customer link will take you directly to the download area:

- Enter user name and password 
- Public 

- If not yet provided, please contact our support:
- In der nachstehenden Tabelle finden sie weitere Informationen und Hilfe zur Installation.
- In the following table you find further information and help for the installation:

### *5.1.2 EDS file:*

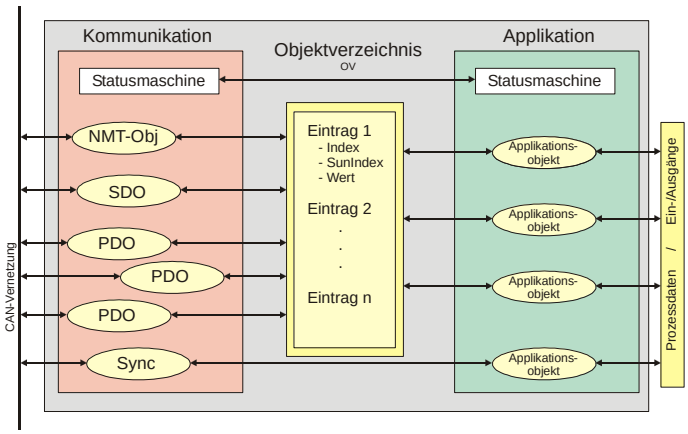
| File: | Remark: | Download |
|---|---|---|
| RSC102.eds | EDS file for the configuration of the device | customer-login |

# 6 CANopen

## 6.1 CANopen introduction

The CANopen application layer and communication profile specification was defined as a standardized application profile for industrial applications, initially based on CAN application layers (CAL). As CAL is only restricted on the definition communications services, CANopen goes byond and offers a uniform description of the device functionality. With the passage of version four, all CAL services, which are necessary for CANopen, were integrated into the CANopen documents. The CANopen specification is updated by the CAN-in-Automation (CiA) and is since end of 2002 accepted as european standard EN 50325-4:2002 Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces -- Part 4: CANopen.

Device model
The CANopen profile family is based on an communication profile, which specified the communication mechanisms and their description.
The most important types of device used in industrial automation technology, e.g. digital and analog I/Os (CiA 401), drives (CiA 402), controller (CiA 404), programmable controls (CiA 405) or encoder (CiA 406) are described in device profiles.




Service data objects (SDO) serve to fast data communication of the input and output data.

In the object dictionary (OV/OD) are structured the CANopen device parameters and the process data.

Via service data objects (SDO) can be accessed to any data of this object dictionary.

Further, some special objects (e.g. types of messages) are available for the network management (NMT), error messages, synchronization e.g.

Basic structure of the object dictionary:

| Index (hex) | Object |
|---|---|
| 0000 | not used |
| 0001-001F | Static Data Types |
| 0020-003F | Complex Data Types |
| 0040-005F | Manufacturer Specific Complex Data Types |
| 0060-007F | Device Profile Specific Static Data Types |
| 0080-009F | Device Profile Specific Complex Data Types |
| 00A0-0FFF | Reserved for further use |
| 1000-1FFF | Communication Profile Area |
| 2000-5FFF | Manufacturer Specific Profile Area |
| 6000-9FFF | Standardised Device Profile Area |
| A000-BFFF | Standardised Interface Profile Area |
| C000-FFFF | Reserved for further use |

**Communication modes**

CANopen defines serveral communication modes for the process data objects (input and output data):

Event driven:

Telegrams are sent as soon as their contents have changed. Not the whole process image will be transfered all the time, only the alterations of it.

Ccyclic - synchronous:

A SYNC telegram causes the modules to accept the output data that was previously received, and to send new input data.

Requested (polled):

A CAN- data request telegram causes the modules to send the input data.
The desired mode of communication will be set with the parameter transmission type.

Device profile:

The robusto slave devices support all E/A communication modes and correspond to the device profile for input/output modules (DS401 Version 2).

Transfer rates

Seven transfer rates from 10 kBaud to 1 MBaud for different bus length are available. Short system reaction times and comparable low data rates achieves CANopen via an effective utilisation of the bus bandwidth.

Topology

CAN is based on a linear bus topology. CANopen logically limits the number of devices per net to 128, physically; the present driver generation permits 64 nodes in one net segment. With low data rates a maximum possible network can be increased by the use of repeaters, they also enable a construction of the tree structures.

Bus access procedures

CAN operate on the basis of the Carrier-Sense-Multiple Access with Collision Avoidance (CSMA/CA) method. i.e. with regard to bus access each user is equal to the other and can access the bus as soon as the bus is free (Multi-Master-Bus Access).The exchange of information is not member related but message related. This means, that every message contains a unique identifier, which also defines the priority of the message. To exclude collisions on the bus by creating messages of various users, during the start of a data transmission a bit-wise bus arbitration will be carried out. The bus arbitration assigns the bus spread to the messages in order of priority; at the end of the arbitration phase only one bus subscriber occupies the bus. Collisions will be excluded and the range will be fully used.

Configuration and parameterisation

For the parameterization of the robusto slave devices with configuration tools third-party, eds files (electronic data sheet) are available on the elrest homepage (http://www.elrest.de). You'll also find these eds- files on the current eStudio installation CD.

Certification

The elrest CANopen devices have a powerful implementation in conformity with the CiA, the CAN in automation association.

### *6.1.1 Configuration and parametrisation*

The robusto Slave devices have several of configuration- and setting possibilities. The configuration The configuration effort is however very small, as for almost all parameters are several default values are exist. This defaults are ensure the efforts of the most applications.

Adress (CAN NodeID)

Before commissioning of the robusto slave devices, the Node ID (CAN NodeID) must be set.
This setting is accomplished with the help of the rotary switch. The CAN NodeID is adjustable in the area of 1 to 127. The once digit of the NodeID can be determined directly from the setting of the rotary switch, the tens digit is explained in the following paragraphs. Please notice, that the switch is properly engaged. The change of the address will be valid, as soon as the slave device has switched on. Each Node ID must be assigned only once.

CAN-baud rate

Before commissioning of the robusto slave devices, the CAN baud rate must be set. On instsllation, the CAN baud rate will be set with the help oft he rotary switch. All the nodes in a CANopen network must be set of the same baud rate.

PDO parameter

PDO-Indentifier

The default identifier distribution provides for up to 4 received process data objects (RxPDOs) and 4 transmit process data objects (TxPDOs). E.g., there are 32 digital and 12 analog In-/Outputs available

PDO- communication modes

On which principle it communicates, can be set individual for each process date object:
- default,
- polled
- synchronized

PDO-Mapping

By commissioning of the robusto slave devices, the data of the In- and Outputs will be mapped the process data objects. (Default-Mapping). When required, this mapping can be changed (see objects 0x1600 bzw. 0x1A00).

Heartbeat/Guarding

If the devices should transmit the status informations autonomously, if the devices should response to the failure of the request telegrams or the master –heartbeats the respective, parameters have to be set (Guarding: Objekt 0x100C ; Heartbeat: Objekt 0x1016).

SDO

The list of all parameters which can be achieved via CAN, are found in the object dictionary.
The objects of the object dictionary are accessed via SDO.

Configuration file

In the configuration files (electronic data sheet, eds), the parameters and the settings for the CANopen devices are listed. These eds-files can be read by the configuration tools. The structure (and syntax) of the eds-files are defined in CiA DSP 306.

Configuration with external controllers

CANopen interfaces are for a large number of programmable logic controllers (PLCs), embedded controls and industrial-PCs.

The range of the configuration tools for the CANopen interfaces is wide. It extends from the graphical configuration tools right down to the easy interfaces to CAN-Layer 2, on which the user must be indicate CANopen and handle each CAN object.

In this description are all needed CAN objects described in details. So it’s possible to address the robust slave device directly from an easy CAN interface.

The eds- files are available for the configuration with a genaral CANopen configuration tool. Usually it’s sufficient to replicate the default mapping of the input /output modules

For more details of the configuration, it must be referenced to the manuals of the respective software and automation suppliers.

### *6.1.2 Network management*

Easy Boot-Up

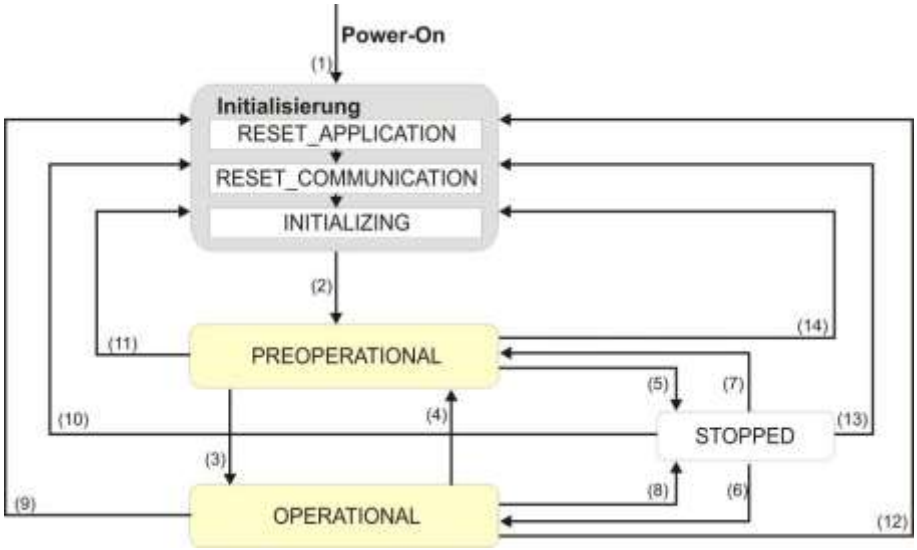
CANopen allows a very easy boot-up of the distributed network. After the initialization, the modules are automatically in the state pre-operational.Already in this state can be accessed via service-data objects

(SDOs) with default-identifier on the object directory, therefore, the modules can be configured.

For all entries in the object dictionary are default settings available, so in the most circumstances can be renounced of a configuration.

Only one CAN message is needed to start the modules: Start_Remote_Node: Identifier 0, two data bytes: 0x01, 0x00. They change the nodes into the state "OPERATIONAL"

State diagramm of a CANopen device:




| | |
|---|---|
| (1) | Power-On |
| (2) | Finished initialization |
| (3),(6) | Start-Remote-Node Indication |
| (4),(7) | Enter Preoperational Indication |
| (5),(8) | Stop Remote Node Indication |
| (9),(10),(11) | Reset Communication Indication |
| (12),(13),(14) | Reset Application Indication |
| (3),(6) | Start-Remote-Node Indication |

PREOPERATIONAL

After the initialization, the robusto Slave device changes without a command from outside, this means automatically, into the state PREOPERATIONAL. In this state it can be configured, because the service data objects (SDO) are already active. However, the process data objects are still off.

OPERATIONAL

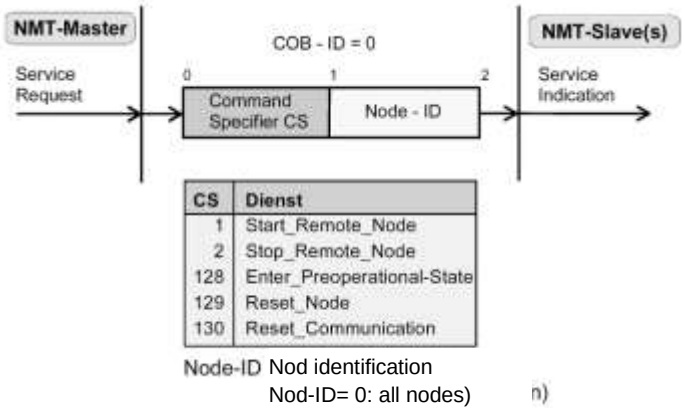
In the status operational are the process data objects active.
From the status operational can be restored a node in the status REOPERATIONAL. E.g. for additional configurations.

Status transitions

Generally, in the CANopen specification is for NMT services to the nodes control the message identifier 0h reserved. Addressing of the individual nodes is performed via one Byte object within the user data area of the CAN telegrams.

The following NMT commands are available for the controlling of the node state:

- Stop_Remote_Node
- Start_Remote_Node
- Enter_Preoperational
- Reset_Node
- Reset_Communication




Protocol of the NMT services:

The following illustration gives an overview of all CANopen status transitions and the concerning command specifier (Command Specifier in the NMT master telegram)

| Status transition | Command Specifier cs | Explanation |
|---|---|---|
| (1) | - | The initialization state is reached automatically at power-on. |
| (2) | - | After initialization the state PREOPERATIONAL is reached automatically the boot-up message is sent. |
| (3), (6) | cs = 1 = 0x01 | *Start_Remote_Node*<br>Starts the module, releases outputs and starts the PDO transmission. |
| (4), (7) | cs = 128 = 0x80 | *Enter_Preoperational*<br>Stops PDO transmission, SDO still active. |
| (5), (8) | cs = 2 = 0x02 | *Stop_Remote_Node*<br>Outputs are switching in error state and SDO and PDO are switched off. |
| (9), (10), (11) | cs = 129 = 0x81 | *Reset_Node*<br>Executes reset.<br>All objects are set back to Power-On defaults.. |
| (12), (13), (14) | cs = 130 = 0x82 | *Reset_Communication*<br>Executes reset of the communication functions.<br>Objects 0x1000 - 0x1FFF are set back to Power-On defaults. |

Boot-Up-message

After the initialization sends the robusto Slave device the boot-up message.
The boot-up message is a CAN-message with a data byte (0) on the identifier of the guarding or heartbeat message: CAN-ID = 0x700 + Node-ID. Therfore can be observed reliable a subsequently activated device or a temporary loss of a device during the operation (e.g. voltage drop) without a node guarding.
The transmitter can be defined via the identifier of the messenge (see default identifier distribution). Additionally, this allows by the help of a CAN monitor, to recognize which nodes are in the network during starting without a write access on the bus (e.g. scanning network via reading parameters 0x1000)

Finally, via the boot-up message it will be communicated the end of the initialization phase. The device signalize that it can be configured or started.

Nodes monitoring

For the default monitoring of the CANopen network are heartbeat and guarding-mechanism available. These are most importantly in CANopen, because the devices sign not regularly in the event driven mode. When guarding, the participants will be polled cyclically via request telegrams (Remote Frame) of their status. When heartbeat, the nodes will be send their status themselves. (Node Guarding)

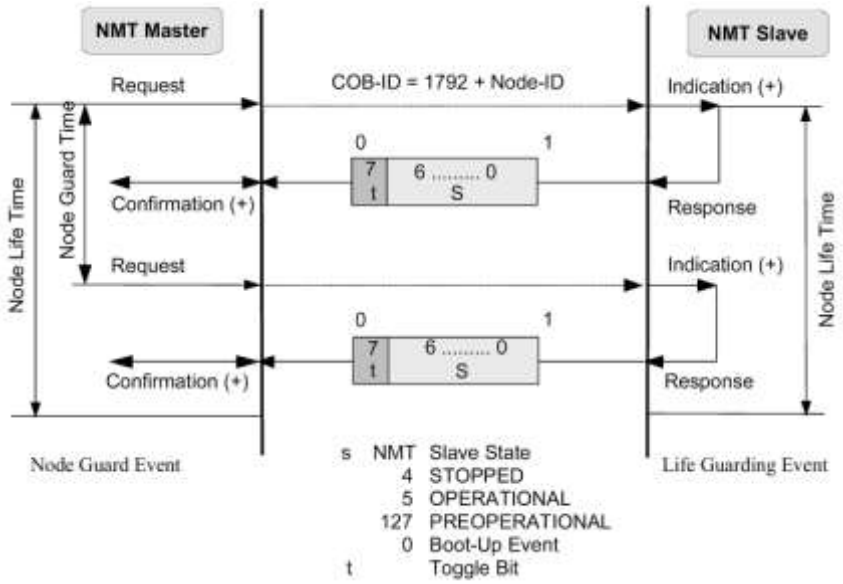
The following diagram shows the protocol of the cyclic node guarding.

The NMT Master polls each NMT Slave in specified time intervals (Node-Guard-Time) with a node specific remote-transmission-request-telegram. The NMT-Slave answers the request by sending its communication status.
The NMT Master send to the application a node-guarding-event,
- If a node hasn’t response a status request within its specific node-life-time
- or the sended status by a node is different then the available node of the NMT Master.

Otherwise a NMT-Slave sends a life-guarding-event to the application
- if the node status is not requested from the NMT Master longer as its life-time.
- node-guard- and node-life-time can be different for each NMT-Slave

For polling of the NMT- Slaves via the NMT-Master and the status message of the NMT- Slaves are 127 low-priority node-specific CAN-identifier rserved.

CANopen node-guarding protocol:




The Toggle-Bit (t) which is transmitted in the first guarding has the value 0.
Then the bit toggles in each guarding- telegram and signs thus, if a telegram was lost. In the other seven bit, the node displays it's network status (s):

The node life –time is calculated from the parameters guard-time (object 0x100C) and life-time-factor (object 0x100D):

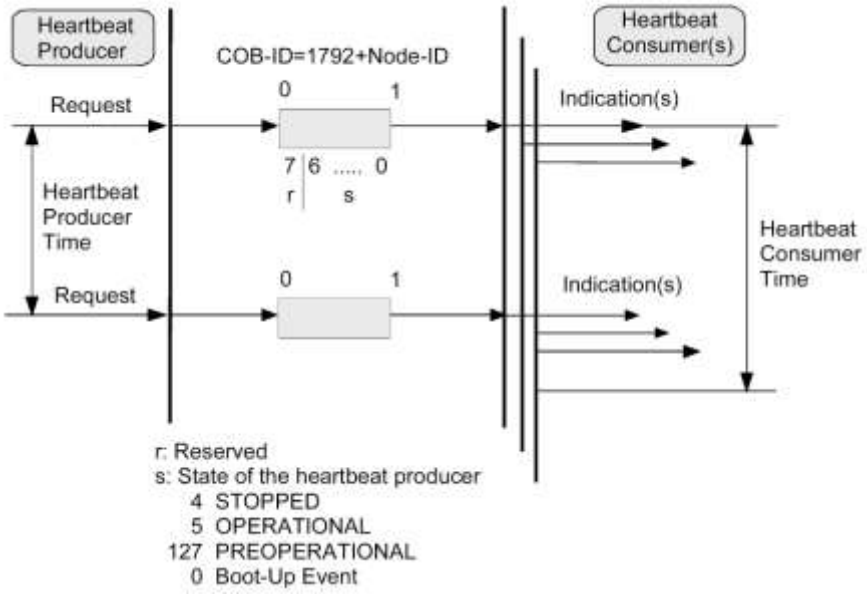
Life-Time = Guard-Time x Life-Time-Factor

If one of the both parameters is "0" (default-setting), there is no monitoring of the Master (no life guarding).

Heartbeat:
The heartbeat method sends the nodes of their respective status message automatically. So remote frames can be ignored, and less bus load will be generated as guarding.

The Master sends its heartbeat-telegram also cyclic, so the slaves can recognize the loss of the master (no life guarding).

CANopen heartbeat protocol:




The simultaneous implementation of both node monitoring methods is not allowed. If the heartbeat-producer-time is configured not zero, the heartbeat-protocol will be used.

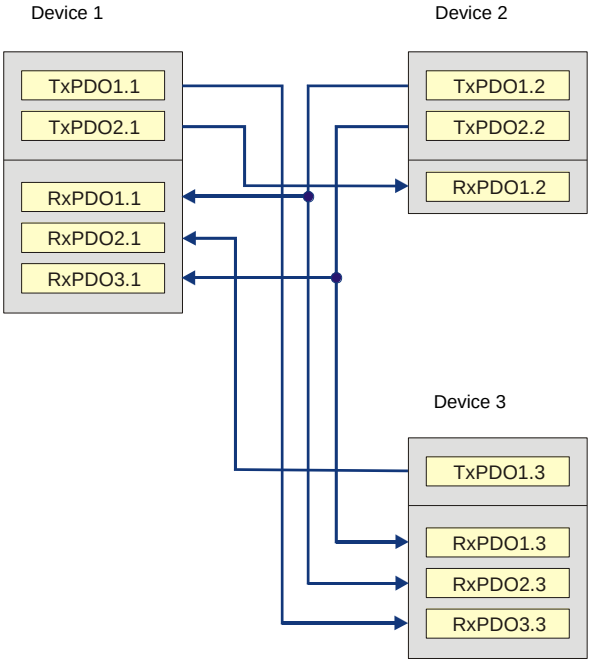
### *6.1.3 Prozess data objects (PDO)*

Introduction:

In many fieldbus systems the whole process image is transferred - mostly more or less cyclically. CANopen is not reduced to this communication principle, for CAN offers other possibilities due to the multi master bus access control.

Process data objects are triggering the very mechanism for the transmission of process data (application objects). A PDO is send from a producer and can received from one or more consumers. The process data sended from the PDO-producer could include max 8 byte. Transfer of PDOs is made without confirmation. A clearly assigned CAN message identifier for the PDO is necessary. The meaning of the transmitted data will be defined by the used CAN message identifier and the PDO-mapping. The PDO identification is done via the message identifier and the data contents consists only of user data, so the PDO tranmission will be made without an additional protocol overhead.

Transfer of PDOs occurs in form of broadcast messages according to the CAN protocol. Via PDOs could be done easily any communication structures between the network devices.
The following figure shows an example of a communication structure with PDOs.
There is
- device 1: producer of TxPDO1.1 and TxPDO2.1
- and device 2 together with device 3: Consumer von TxPDO1.2 and TxPDO2.2.




The administration of PDOs is done from the PDO Producer and also from the PDO-Consumer, in two data structures per PDO (PDO Communication Parameter or PDO Mapping Parameter).These structures are within the object dictionary and will be configured generally during the system initialization via SDO.

Communication parameters

The PDOs can be applicated with communication parameters different according to the requirements of the application.

The transmission type of a PDO defines how the transmission of a PDO will be triggered at the PDO-Producer.
Besides the event driven or a requested transmisson of PDOs will be required in the practically application of distributed systems, often a transfer after the expiration of a defined time interval. Also the possibility network synchronous capture and output will be required. CANopen supports these requirements by corresponding operation modes

Basically it will be differenced between the a*synchronous* and s*ynchronous* mode.

In *asynchronous transmission*:
The transmission of a PDO and the data transfer to the application process will be made immediately after the occurrence of assigned events, and the receive of a PDO via a consumer.

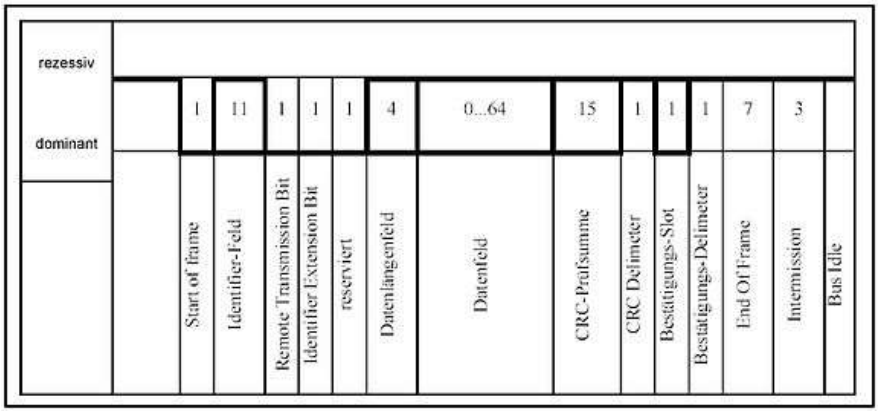
In *synchronous transmission:*
Until a Sync object has been received, the corresponding PDO will be transmitted.
If a synchronous PDO will be transmitted just once after the occurrence of a synchronization object, it's named *acyclic – synchronous* PDO. ( Receipt of a SYNC object and the data content of a PDO object )
A PDO, which will be transmitted after a number of synchronization objects, it's named *cyclic – synchronous* PDO.

The CANopen parameters are in the object dictionary of the device. Via these can be accessed tothe service data objects. The parameters for the RxPDOs are in Index 0x1400 (RxPDO1) and the following. Up to 512 RxPDOs can be available (in the range of Index 0x15FF). Accordingly the entries for the TxPDOs on index 0x1800 (TxPDO1) to 0x19FF (TxPDO512).

PDO-Identifier

The most important communication parameter of a PDO is the CAN identifier (also called Communication Object Identifier,COB-ID).
It identifies the data and specifies their priority at the bus access. For every CAN data telegram there may be only one sending node (producer), but due to CAN, where the messages are sent in t in a broadcasting procedure, a telegram may be received from that many nodes you want (consumer).
Thus one node may place its input information at the disposal of several bus participants at the same time - even without the passing on by a logical bus master.
The Identifier is in the sets of communication parameters. It is coded as 32-Bit value, however the least significant 11 Bits (Bit 0...10) contains the actual identifier.

CAN-Data telegram in Base Frame format




combo Slave-devices don’t support 29 Bit Identifiern (acc. CAN 2.0B).

PDO-communication modes: overview

CANopen offers different possibilities to transmit the process data.

Event-driven:

(and/od Event Timer)


Polling

with Remote Frames


Sync

(cyclical / acyclical)


| Transmission mode | cyclical | acyclical | synchronous | asynchronous | only RTR |
|---|---|---|---|---|---|
| 0 | | X | X | | |
| 1-240 | X | | X | | |
| 241-251 | | | - allocated - | | |
| 252 | | | X | | X |
| 253 | | | | X | X |
| 254, 255 | | | | X | |

Acyclic – synchronous

PDOs of the transmission mode 0 operate synchronously, but not cyclically.
A RxPDO is only evaluated after the receipt of the next SYNC telegram. For example axle groups can get successively new target position, which all will become valid for the next SYNC, without the continually need of sampling points.

A device, which TxPDO is configured of transmission mode 0, determines the input data by the receipt of the SYNC (synchronous process mapping) and transmits it, if the corresponding event occurs (modification of the inputs). The transmission mode 0 cominrd the reason of transmitting “event-driven” with the transmitting- / the processing- time "SYNC-receipt".

Cyclic – synchronous

At the transmission - mode 1-240 will be sent the PDO cyclically. Every “nth” SYNC (n=1...240).
For the transmission type may not only be combined in the network but also at one coupler, you may thus define e.g. a fast cycle for the digital inputs (n=1), while the data of the analog inputs are transmitted in a slower cycle (e.g. n=10). RxPDOs ot distinguished between the transmission mode 0...240:

A received PDO will be set to valid next time for the SYNC message. The cycle time (SYNC rate) may be monitored (Object 0x1006), The device response of SYNC failure according the definitionof the device profile and sets its outputs in error state.

RTR only

Process data objects which are only transmitted on requirements via a remote frame are the transmission types 252 and 253 valid.
252 is synchronously:
When SYNCs are received, process data will be determined, they just will be send on request.
253 is asynchronously:
The data will be determined continually and send on request.
It's not being advisable, because the retrival of the input data are not supported entirely of some CAN-controllers. Because particularly the CAN controllers respond automatically to remote frames (without requesting input-data before), so the actuality of the polled data is maybe doubtful.

Asynchronous

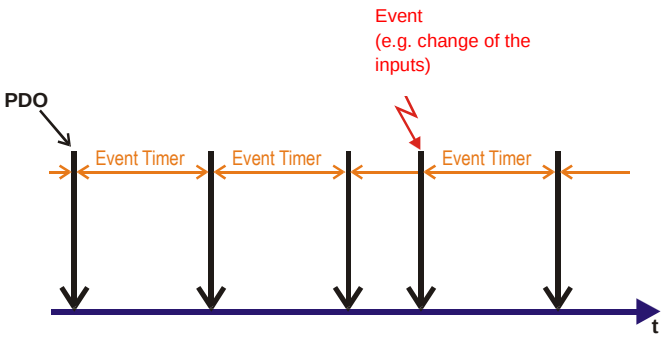
The transmission types 254 + 255 are asynchronous or also event triggered:
At the transmission type 254 the event is proprietary, at 255 it is defined in the device profile.
In the simplest case, the event is the change of the input. Each change of value will be transmitted.
The asynchronous transmission mode can be connected with the event timer and provides the input data, if actually no event has occurred.

Inhibit time

Via the parameter "inhibit time" a "send filter" may be activated that does not lengthen the reaction time of the relatively first input alteration, but that is active for the following changes. The inhibit time (send delay time) describes the min. time span that has to pass between the sending of two identical telegrams. If you use the inhibit time, you may evaluate the maximum bus load and therefore the latent time in a "worst case" scenario.

Event Timer

Via Sub-index 5 of the PDO communication parameters can be set the event timer for send PDO.
Expiration of this timer will be valued as an additionally event for the corresponding PDO, thus the PDO will be send.
If the application event occurs while a time period, it will be also send and the timer will be reset.

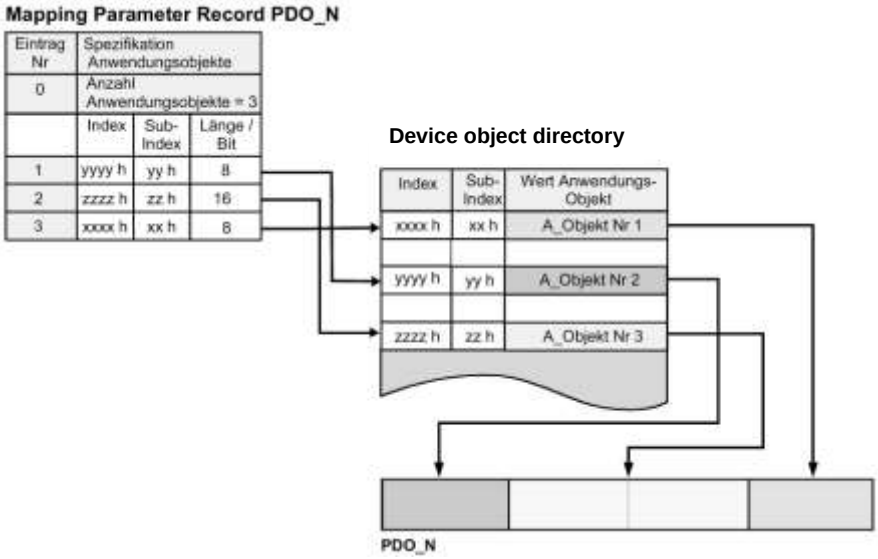



At reception PDOs, the event timer will be used to set the watch time for this PDO: If no corresponding PDO will be received during the programmed time, the application will be informed.

PDO Mapping

The determination of the transmitted application objects in a process data object und the position within the PDOs is known as PDO-Mapping. Application objects are specified with index and Sub-index of the corresponding object dictionary, thus the arrangement of the application data can be described easily via a list of objects. This list represents each object via index, Sub-index and length of fields.
The CANopen- device profiles provides for each device type a default mapping This fits is for most application. The default mappings reproduce for digital in- / output modules the inputs or outputs acc. their physical sequence in the send- or receive process data objects. The current mapping can be read through the appropriate entries in the data object dictionary, so-called mapping tables. In first place of the mapping tables (Sub-index 0) contains the number of mapped objects, which are listed in the following. The tables are located in the object dictionary under index 0x1600. for RxPDOs, or 0x1A00 for TxPDOs.

PDO mapping - basic representation:




Reading the number of in- and outputs

Die Anzahl der digitalen und analogen Ein-/Ausgänge lässt sich durch Auslesen der entsprechenden Einträge im Objektverzeichnis ermitteln bzw. verifizieren:

The number of digital and analog in-/ outputs can be determined or verified via reading the corresponding entries in the object dictionary

| **Parameter** | **Adress in the object ditectory** |
|---|---|
| Number of digital input bytes | Index 0x6000, Sub-index 0 |
| Number of digital output bytes | Index 0x6200, Sub-index 0 |
| Number of analog inputs | Index 0x6401, Sub-index 0 |
| Number of analog outputs | Index 0x6411, Sub-index 0 |

Variable mapping

In most cases, the default value of the process data objects (Default Mapping) satisfies the requirements of the application. For all other applications the values can be changed.

combo slave- devices support the variable mapping, the application objects (in- and output data) can be freely assigned to the PDOs. The mapping tables have to be configured.

As CANopen version 4 is only the following practice permitted, that absolutely must be complied with:

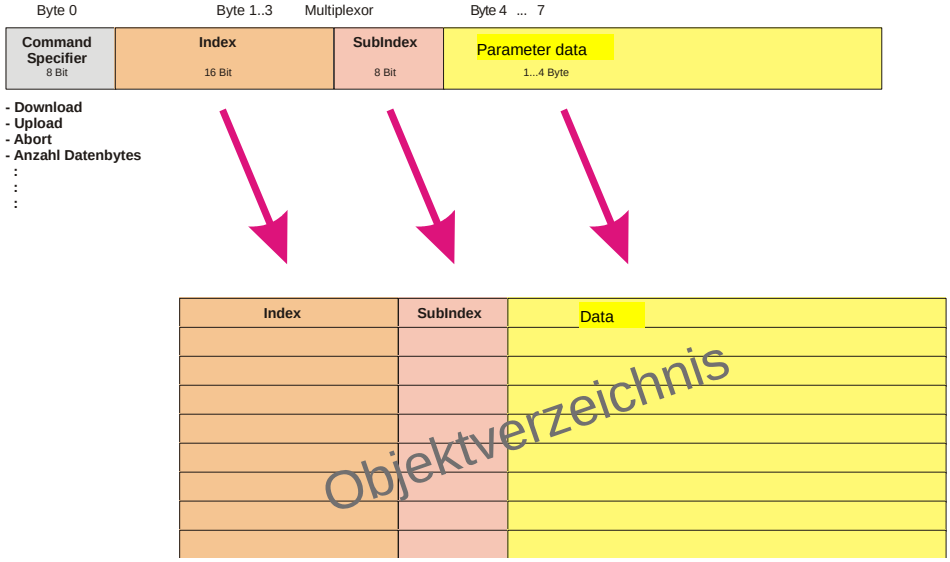
- Delete PDO (0x1400, or 0x1800, Sub-index 1, set bit 31 on"1")
- Set Sub-index 0 in the mapping-parameter (0x1600 bzw. 0x1A00) on "0"
- Change mapping entries (0x1600 bzw. 0x1A00, SI 1..8)
- Set valid value Sub-index 0 in mapping parameter.
- Check the device and the entries for consistency.
- Create PDO via enter the identifier (0x1400 or 0x1800 Sub-index 1).

### *6.1.4 Service data objects (SDO)*

The confirmed transfer between data and two network users occurs via SDO services. The data transfer from one device to another is described in the client-server model. A SDO-client (user initiating) direct access to individual entries of the object dictionary of a SDO-server. Records in arbitrary lengths can be downloaded or loaded from a server. The transferred record will be specified by index and sub-index of the object dictionary input, which represents the record. Per one transmission direction is used one message identifier, thus the connection between a SDO client and a SDO server requires two CAN-identifiers. The connection between a client and a server is indicated as a SDO channel.

CANopen enables management of up to 128 client and server SDO connections per user. To ensure, that it’s accessible for other devices, a CANopen device has to support minimum one SDO server- object, so-called default SDO. The listed parameters in the object dictionary will be read and floppied. These SDOs are multiplexed domains, this means data structures of any size which are provided with a multiplexor (address). The multiplexor consists of a 6-bit index and 8-bit-sub index. The entries will be addressed in the object dictionary.

SDO-acces of the object directory:




A single handshake satisfies, if the transmitted parameter up to 4 bytes contains. During the download the client send the data together with the index and the sub index. The server confirmed the receipt. By uploading the client queries the data via transmitting the index and the sub index of the desired parameters. The server sends the parameters (inc. index and sub index) in a reply telegram.
For upload und download is used the same handshake. In the telegrams of 8 byte are coded in the first byte the different services. (Command Specifier). Except the objects 1008h, 1009h und 100Ah (name of device, hardware- or software version) are all parameters of the device 4 byte large. This description is limited only to the transfer of this data in the accelerated transfer (expedited transfer).
The following describes the structure of the SDO tegrams:

Client -> Server, Upload Request

| 11-bit identifier | 8 byte user data | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0x600 (=1536dez) + Node-ID | 0x40 | Index0 | Index1 | SubIdx | 0x00 | 0x00 | 0x00 | 0x00 |

| **Parameters** | **Explanation** | |
|---|---|---|
| Index0 | Index Low-Byte | (Unsigned16, LSB) |
| Index1 | Index High-Byte | (Unsigned16, MSB) |
| SubIdx | Sub-index | (Unsigned8) |

Client -> Server, Upload Response

| 11-bit Identifier | 8 Byte User data | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0x580 (=1408dez) + Node-ID | 0x4x | Index0 | Index1 | SubIdx | Data0 | Data1 | Data2 | Data3 |

| Parameter | Explanation |
|---|---|
| Index0 | Index Low-Byte (Unsigned16, LSB) |
| Index1 | Index High-Byte (Unsigned16, MSB) |
| SubIdx | Sub-index (Unsigned8) |
| Data0 | Daten Low-Low-Byte (LLSB) |
| Data3 | Daten High-High-Byte (MMSB) |

The parameters of the data types Unsigned8 are transmitted in Byte Data0, the parameters of the data types Unsigned16 in Data0 and Data1.
The number of the valid data bytes is coded in the first CAN-Datenbyte (0x4x) as follows:

| Number of parameter-bytes | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| First CAN-Datenbyte | 0x4F | 0x4B | 0x47 | 0x43 |

Client -> Server, Download Request

| 11-bit Identifier | 8 Byte user data | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0x600 (=1536dez) + Node-ID | 0x22 | Index0 | Index1 | SubIdx | Data0 | Data1 | Data2 | Data3 |

| **Parameter** | **Explanation** |
|---|---|
| Index0 | Index Low-Byte (Unsigned16, LSB) |
| Index1 | Index High-Byte (Unsigned16, MSB) |
| SubIdx | Sub-index (Unsigned8) |
| Data0 | Daten Low-Low-Byte (LLSB) |
| Data3 | Daten High-High-Byte (MMSB) |

Optionally, it‘s possilble to specify the number of the valid parameter data bytes in the first CAN- data byte:

| Number of parameter bytes | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| First CAN data byte | 0x2F | 0x2B | 0x27 | 0x23 |

Generally, it is not necessary, because only the least significant data bytes are evaluated up to the length of the the object directory input.

Cancelling of parameter communication.

In case of a wrong parameter communication, it will be cancelled. Client or server sends a SDO tegram with the structure.

| 11-bit Identifier | 8 Byte User data | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0x580(Client) oder 0x600(Server) + Node-ID | 0x80 | Index0 | Index1 | SubIdx | Error0 | Error1 | Error2 | Error3 |

| **Parameter** | **Explanation** |
|---|---|
| Index0 | Index Low-Byte (Unsigned16, LSB) |
| Index1 | Index High-Byte (Unsigned16, MSB) |
| SubIdx | Sub-index (Unsigned8) |
| Error0 | SDO error-code Low-Low-Byte (LLSB) |
| Error3 | SDO error-code High-High-Byte (MMSB) |

List of the SDO-error -codes (reason for the interrupt of the SDO-transfer)

| SDO error-code | Explanation |
|---|---|
| 0x05 03 00 00 | Toggle Bit not alternated |
| 0x05 04 00 01 | SDO Command Specifier invalid or unknown. |
| 0x06 01 00 00 | Access to this object is not supported |
| 0x06 01 00 02 | Try, to write to a read-only parameter |
| 0x06 02 00 00 | Object not present in the object dictionary |
| 0x06 04 00 41 | Object cannot be mapped to the PDO |
| 0x06 04 00 42 | Number and/or length of mapped objects would exceed PDO length |
| 0x06 04 00 43 | General indication of incompatibility |
| 0x06 04 00 47 | General internal error in the device |
| 0x06 06 00 00 | Access is aborted, because of hardware error |
| 0x06 07 00 10 | Data type or parameter length does not correspond or unknown |
| 0x06 07 00 12 | Data type does not correspond, parameter length too large |
| 0x06 07 00 13 | Data type does not correspond, parameter length too small |
| 0x06 09 00 11 | Sub-index not existing |
| 0x06 09 00 30 | Common range mistake |
| 0x06 09 00 31 | Range mistake: parameter value too large |
| 0x06 09 00 32 | Range mistake: parameter value too small |
| 0x06 0A 00 23 | Resources are not available |
| 0x08 00 00 21 | Access not possible, because of local application |
| 0x08 00 00 22 | Access not possible, because of current device status |

### *6.1.5 Identifier- distribution*

Default-identifier

CANopen provides for the important communications objects a default-identifier, they have been derived to the following scheme from the 7 bit node address (Node-ID) and a 4 bit function code:
For the broadcast-objects will be used the Node-ID 0. Thus, the following default identifier results:

Broadcast Objects

| Object | Function | Function Code | Resulting COB ID | | Object for Comm. parameter / mapping |
|---|---|---|---|---|---|
| | | | hex | dez | |
| NMT | Boot-Up | 0 | 0x00 | 0 | - / - |
| SYNC | Synchronization | 1 | 0x80 | 128 | 0x1005 + 0x1006 / - |

Peer-to-Peer-Objects

| Object | Function | Function Code | Resulting COB ID | | Object for Comm. parameter / mapping |
|---|---|---|---|---|---|
| | | | hex | dez | |
| Emergency | Status / error | 1 | 0x81 - 0xFF | 129 - 255 | - / - |
| PDO1 (tx) | digital inputs | 11 | 0x181 - 0x1FF | 385 - 511 | 0x1800 / 0x1A00 |
| PDO1 (rx) | digital outputs | 100 | 0x201 - 0x27F | 513 - 639 | 0x1400 / 0x1600 |
| PDO2 (tx) | analog inputs | 101 | 0x281 - 0x2FF | 641 - 767 | 0x1801 / 0x1A01 |
| PDO2 (rx) | analoge outputs | 110 | 0x301 - 0x37F | 769 - 895 | 0x1401 / 0x1601 |
| PDO3 (tx) | analoge outputs * | 111 | 0x381 - 0x3FF | 897 - 1023 | 0x1802 / 0x1A02 |
| PDO3 (rx) | analoge outputs * | 1000 | 0x401 - 0x47F | 1025 - 1151 | 0x1402 / 0x1602 |
| PDO4 (tx) | analoge inputs * | 1001 | 0x481 - 0x4FF | 1153 - 1279 | 0x1803 / 0x1A03 |
| PDO4 (rx) | analoge outputs * | 1010 | 0x501 - 0x57F | 1281 - 1407 | 0x1403 / 0x1603 |
| SDO (tx) | Parameter | 1011 | 0x581 - 0x5FF | 1409 - 1535 | - / - |
| SDO (rx) | Parameter | 1100 | 0x601 - 0x67F | 1537 - 1663 | - / - |
| Guarding | Life-/Node-guarding, Heartbeat, Boot-Up message | 1110 | 0x701 - 0x77F | 1793 - 1919 | (0x100C, 0x100D, 0x100E, 0x1016, 0x1017) |

## 6.2 CANopen object dictionary

Object directory - structure

In the CANopen object directory will be entered all CANopen objects, which are relevant for the robusto slave devices. The object directory is subdivided into three separate areas:

Communication specific profile area (0x1000 - 0x1FFF)

Contains the description of all relevant parameters for the communication.

Vendor specific profil area (Index 0x2000 - 0x5FFF).

Contains the description of vendor specific entries

Device profile segment (0x6000 - 0x9FFF).

Contains the objects for the device profile acc. DS-401.

Basic structure of the object directory

| Index | Beschreibung |
|---|---|
| 0000h | Nicht verwendet |
| 0001h – 001Fh | Statische Datentypen |
| 0020h – 003Fh | Komplexe Datentypen |
| 0040h – 005Fh | Herstellerspezifische komplexe Datentypen |
| 0060h – 007Fh | Geräteprofil-spezifische statische Datentypen |
| 0080h – 009Fh | Geräteprofil-spezifische komplexe Datentypen |
| 00A0h – 025Fh | Reserviert für weitere Geräteprofil-spezifische Datentypen |
| 0260h – 0FFFh | Reserviert |
| 1000h – 1FFFh | Kommunikationsprofil |
| 2000h – 5FFFh | Hersteller-spezifischer Bereich |
| 6000h – 9FFFh | Standardisierte Geräteprofile |
| A000h - BFFFh | Standardisierte Interfaceprofile |
| C000h - FFFFh | Reserviert |

The entries of the object directory are addressed by a 16-bit index. If an object exists of several components (e.g. object type Array or Record), the components are marked via an 8Bit sub-index. The object name describes its function. The data type attribute specifies the data type of the input. Via the access attribute it is specified, if an input may only be read, only be written or read and written.

Communication specific profile area

In this area are all necessary parameters and objects for the communication of the device available. In the area 0x1000 - 0x1018 are the different, general communication specific parameters available (e.g. name of device).
The communication parameters (e.g. identifier) of the receive PDOs are in the area 0x1400 - 0x140F available (plus Sub-index) The mapping parameters of the receive PDOs are in the area up to 0x1600 - 0x160F (plus Sub-index) available.
The mapping parameters contain the references to the application objects, which are mapped in the PDOs and the data width corresponding the objects (see chapter PDO-Mapping).
The communication- and mapping parameters of the transmit-PDOs are in the areas 0x1800 - 0x180F or 0x1A00 - 0x1A0F available.

Vendor specific area

The entires are in this area, especifically for the combo Slave devices, e.g. data objects for thandling the values of the analog in-/ outputs.

Standardized device profile segment

In the standardized device profile segment will be supported the CANopen device profile DS-401 version 1. For analog inputs are functions available for fitting the communication of the event-controlled modes to the application requirements and to minimize the bus loading:

- Delta function
- Activate/deactivate the event control

## Objects

Below the list of the objects, which will be supported of the robusto Slave devices:

| Parameter | Index |
|---|---|
| Device type | 0x1000 |
| Error register | 0x1001 |
| Error memory | 0x1003 |
| Sync-identifier | 0x1005 |
| Name of device | 0x1008 |
| Hardware-version | 0x1009 |
| Software-version | 0x100A |
| Node number | 0x100B |
| Guard time | 0x100C |
| Life time factor | 0x100D |
| Emergency identifier | 0x1014 |
| Producer heartbeat time | 0x1017 |
| Device identification (identity object) | 0x1018 |
| State changesof error | 0x1029 |
| Server SDO parameters | 0x1200 |
| Communication parameter 1.- 8. RxPDO | 0x1400 - 0x1407 |
| Mapping 1.- 8. RxPDO | 0x1600 - 0x1607 |
| Communication parameter 1.- 8. TxPDO | 0x1800 - 0x1807 |
| Mapping 1.- 8. TxPDO | 0x1A00 - 0x1A07 |
| Firmwareinfo | 0x2010 |
| HardwareiInfo | 0x2020 |
| Analog Chanels | 0x2101 – 0x2110 |
| Digital inputs | 0x6000 |
| Digital outputs | 0x6200 |
| Errormode digital outputs | 0x6206 |
| Errorvalue digital outputs | 0x6207 |
| Analog inputs 16 bit | 0x6401 |
| Analog outputs 16 bit | 0x6411 |
| Event control analog inputs | 0x6423 |
| Delta function analoge inputs | 0x6426 |
| Error mode analog outputs | 0x6443 |
| Error value analog outputs | 0x6444 |

### *6.2.1 Description of the objects and data*

Device type

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1000 | 0 | Device Type | Unsigned32 | RO | N | 0 | Specification of the device type |

The 32Bit value is divided in two 16Bit fields:

| MSB | LSB |
|---|---|
| Additional information | Device profil-number |
| 0000 0000 0000 wxyz | 0x191 (401dez) |

The "Additional Information" contains information about the signal types of the I/O device:

z = 1 means: the device has hat digital inputs,

y = 1 means: he device has digital outputs,

x = 1 means: the device has analog inputs,

w = 1 means: the device has analog outputs.

The type of device gives only a rough classification of the device. Each combo Slave device supports all kinds of in- and outputs, because the devices can be added with an extension module to expand the system as needed. => immer 0x00 0F 01 91

Error register

| Index | Sub-index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1001 | 0 | Error Register | Unsigned8 | RO | N | 0 | Error register |

The 8 Bit value is coded as follows:

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|
| ManufSpec. | reserved | reserved | Comm. | reserved | reserved | reserved | generic |

ManufSpec. Manufacturer-specific error will be more exactly specified.in object 1003.

Comm Communication error (Overrun CAN)

Generic A not more precisely specified error occurred (flag is set at every error message)

Error memories

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1003 | 0 | Predefined error field | Unsigned8 | RO | N | 0 | Object 1003h contains a description, errors that have occurred on this device. - Sub-index 0 the number of errors saved. |
| | 1 | Actual error | Unsigned32 | RO | N | -- | Last occurred error |
| | … | … | -- | -- | … | … | … |
| | 10 | Standard error field | Unsigned32 | RO | N | -- | Maximum 10 failure signals will be stored |

The 32 bitvalue is divided in two 16 bit fileds:

| MSB | LSB |
|---|---|
| Additional Information | Error Code |

As usual, the LSB will be at first, and the MSB at last transmitted.
The additional code contains the error trigger (see emergency object) and thus a detailed error description.
New New errors are always saved at subindex 1; all other subindices are incremented accordingly. By means of writing a "0" to subindex 0, the complete error memory is deleted. If there were no error since power-on, the object 0x1003 only exists of a subindex 0 with entered "0". The fault memory will be deleted by a reset.

Sync-Identifier

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1005 | 0 | COB-ID Sync Message | Unsigned32 | RW | N | 0x80000008 | Identifier for the SYNC message |

The lower 11 bit of the 32-bit value contain the Identifier (0x80=128dez). Bit 30 indicates whether the device receives the SYNC telegram (1) or not (0). The CANopen- I/O devices receive the SYNC telegram, accordingly, Bit 30=0. Bit 31 is due to downward-compatibility irrelevant.

Device name

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1008 | 0 | Manufacturer device name | Visible string | RO | N | Visible string | Device name of the bus node |

For the returned value is larger than 4Byte, the segmented SDO protocol is used for transmission.

Software-Version

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x100A | 0 | Manufacturer software-version | Visible String | RO | N | | Software version number of the device. |

For the returned value is larger than 4Byte, the segmented SDO protocol is used for transmission.

Guard-Time

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x100C | 0 | Guard-time [ms] | Unsigned16 | RO | N | 0 | The distance between two guard telegrams will be set by an NMT master or the configuration tool. |

Life Time Factor

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x100D | 0 | Life time factor | Unsigned8 | RO | N | 0 | Life time factor x guard time = life time (watchdog for life guarding) |

If a guarding telegram is not received within the life time, the node enters the error state.

If life time factor and/or guard time are = 0, the node doesn't handle lifeguarding, but may however be monitored by the master (node guarding).

Emergency Identifier

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1014 | 0 | COB-ID Emergency | Unsigned32 | RO | N | 0x00000000 + NodeID | Indentifier of the emergency-telegramm |

The lower 11Bit of the 32Bit value contain the identifier (0x80=128dez). Via the MSBit can be set, if the emergency telegram is sent SYNC telegram (1) or not (0).

Producer Heartbeat Time

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1017 | 0 | Producer heartbeat time [ms] | Unsigned16 | RW | N | 0 | Time (in ms) between 2 transmitted heartbeat-telegramms |

Identity Object

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1018 | 0 | Number of elements identity object | Unsigned8 | RO | N | 4 | The „identity object“ contains general information for the type and design of the device. |
| | 1 | Vendor ID | Unsigned32 | RO | N | 0x00000032 | Manufacturerer code: elrest => 50 |
| | 2 | Product code | Unsigned32 | RO | N | 0 | device identification, depending on the design |
| | 3 | Revision number | Unsigned32 | RO | N | 0 | Version number |
| | 4 | Serial number | Unsigned32 | RO | N | 0 | Serial numner |

The 32 bit value of the product code is divided in two 16Bit fields:

| MSB | | | LSB | | |
|---|---|---|---|---|---|
| Product code CE1xx | | | Product code CS1xx | | |
| Produkt Code CE1xx | dez | hex | Product code CS1xx | Dez | Hex |
| CE100 | 100 | 0x64 | CS100 | 100 | 0x64 |
| CE101 | 101 | 0x65 | CS101 | 101 | 0x65 |
| CE150 | 150 | 0x96 | CS110 | 110 | 0x6E |
| CS152 | 152 | 0x98 | CS111 | 111 | 0x6F |

Change of state in case of error:

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1029 | 0 | Number of elements | Unsigned8 | RO | N | 1 | Number of elements |
| | 1 | Change of state | Unsigned8 | RW | N | 1 | Configured the set value, the status of the stack will be changed in case of error, acc. the norm. |

Server SDO parameters

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1200 | 0 | Number of elements | Unsigned8 | RO | N | 2 | Number of elements |
| | 1 | COB ID client=> server | Unsigned32 | RO | N | 0x00000600 + node-ID of the clientt | COB-ID RxSDO (client => server) |
| | 2 | COB ID server=> client | Unsigned32 | RO | N | 0x00000600 + Node-ID | COB-ID TxSDO (client => server) |

For reasons of the backward compatibility, it will be contained in the object dictionary.

Communication parameters 1: RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1400 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000200 + Node-ID | COB-ID (communication object identifier) RxPDO1 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer:<br>Time for monitoring (watchdog) of the receive PDOs |

Sub-index 1 (COB-ID):

The lower 11 bit of the 32-bit value (Bits 0-10) contain the CAN-Identifier,
the MSBit (Bit 31) shows, if the PDO is active (1) or not (0),
Bit 30 monitors, if a RTR access to this PDO is allowed (0) or not (1).
It is not permitted to change the identifier (bit 0-10) while the object exists (Bit 31=0).
The Subindex 2 contains the transmission type (see introduction PDOs).

## Communication parameter 2. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1401 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000300 + Node-ID | COB-ID (communication object identifier) RxPDO2 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer: Time for monitoring (watchdog) of the receive PDOs |

## Communication parameter 3. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1402 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000300 + Node-ID | COB-ID (communication object identifier) RxPDO2 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer: Time for monitoring (watchdog) of the receive PDOs |

## Communication parameter 4. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1403 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000500 + Node-ID | COB-ID (communication object identifier) RxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer: Time for monitoring (watchdog) of the receive PDOs |

## Communication parameter 5. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1404 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | | COB-ID (communication object identifier) RxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer:<br>Time for monitoring (watchdog) of the receive PDOs |

## Communication parameter 6. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1405 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Communication parameters of the 4. reception PDOs (RxPDO4).<br>Sub-index0: Number of elements |
| | 1 | COB ID | Unsigned32 | RW | N | | COB-ID (communication object identifier) RxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer:<br>Time for monitoring (watchdog) of the receive PDOs |

## Communication parameter 7. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1406 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Communication parameters of the 4. reception PDOs (RxPDO4).<br>Sub-index0: Number of elements |
| | 1 | COB ID | Unsigned32 | RW | N | | COB-ID (communication object identifier) RxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer:<br>Time for monitoring (watchdog) of the receive PDOs |

Communication parameter 8. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1407 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Communication parameters of the 4. reception PDOs (RxPDO4).<br>Sub-index0: Number of elements |
| | 1 | COB ID | Unsigned32 | RW | N | | COB-ID (communication object identifier) RxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | Irrelevant for RxPDOs |
| | 4 | -- | Unsigned8 | RW | N | - | Unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer:<br>Time for monitoring (watchdog) of the receive PDOs |

Mapping-parameter 1. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1600 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x62000108 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | Transmission type | Unsigned8 | RW | N | 0x62000208 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0x62000308 | 3 mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | -- | Unsigned8 | RW | N | 0x62000408 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The first receive-PDO is per default planned for digital outputs.

Mapping-changes
For changing the mapping, the following sequence must be observed (since CANopen Version 4 required):
Delete PDO (set bit 31 to 0 in the identifier entry (Sub-index1) of the communication parameter)
Deactivate mapping (set sub-index 0 of the mapping entries to 0)
Change mapping entries (Subindices 1...8)
Activate mapping (set sub index 0 of the mapping entry to the correct number of the mapped objects)
Create PDO (set bit 31 in the identifier entry of the communication parameter (Sub-index 1) to 0.

Mapping-parameter 2. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1601 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x64110110 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0x64110210 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0x64110310 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0x64110410 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The second receive-PDO (RxPDO1) is per default planned for digital outputs.
To change the mapping, a certain order has to be observed (see object Index 0x1600).

Mapping-parameter 3. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1602 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x64110510 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0x64110610 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0x64110710 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0x64110810 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The third receipt PDO is per default planned fo analog output 5 to 8.
To change the mapping, a certain order has to be observed (see object Index 0x1600).

Mapping-parameter 4. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1603 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x64110910 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0x64110A10 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0x64110B10 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0x64110C10 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The fourth receipt PDO is per default planned fo analog output 9 to 12.
To change the mapping, a certain order has to be observed (see object Index 0x1600).

Mapping-parameter 5. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1604 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

Mapping-parameter 6. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1605 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

Mapping-parameter 7. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1606 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

Mapping-parameter 8. RxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1607 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

Communication parameter 1. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1800 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000180 + Node-ID | COB-ID (communication object identifier) TxPDO1 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer |

Sub-index 1 (COB-ID):
The lower 11 bit of the 32-bit value (Bits 0-10) contain the CAN-Identifier,
the MSBit (Bit 31) shows, if the PDO is active (1) or not (0),
Bit 30 monitors, if a RTR access to this PDO is allowed (0) or not (1).
It is not permitted to change the identifier (Bit 0-10) during the object exists (Bit 31=0).

Communication parameter 2. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1801 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000280 + Node-ID | COB-ID (communication object identifier) TxPDO2 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer |

The second send-PDO (RxPDO1) is per default planned for analog inputs 1 to 4 and configured for event driven transmission (Transmission Type 255).
The event control must first be activated (see object 0x6423).

Communication parameter 3. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1802 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000380 + Node-ID | COB-ID (communication object identifier) TxPDO3 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer |

The third send-PDO is per default planned for analog inputs 5 to 8 and configured for event driven transmission (Transmission Type 255).
The event control must first be activated (see object 0x6423).

Communication parameter 4. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1803 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0x00000480 + Node-ID | COB-ID (communication object identifier) TxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer |

Communication parameter 5. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1804 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0 | COB-ID (communication object identifier) TxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer |

Communication parameter 6. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1805 | 0 | Number of elements | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0 | COB-ID (communication object identifier) TxPDO4 |
| | 2 | Transmission type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event timer | Unsigned16 | RW | N | 0 | Event timer |

Communication parameter 7. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1806 | 0 | Anzahl Elemente | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0 | COB-ID (communication object identifier) TxPDO4 |
| | 2 | Transmission Type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit Time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event Timer | Unsigned16 | RW | N | 0 | Event timer |

Communication parameter 8. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1807 | 0 | Anzahl Elemente | Unsigned8 | RO | N | 5 | Number of available sub-index numbers |
| | 1 | COB ID | Unsigned32 | RW | N | 0 | COB-ID (communication object identifier) TxPDO4 |
| | 2 | Transmission Type | Unsigned8 | RW | N | 255 | Transmission type of the PDOs |
| | 3 | Inhibit Time | Unsigned16 | RW | N | 0 | repetition delay time [value x 100µs] |
| | 4 | -- | Unsigned8 | RW | N | - | unused |
| | 5 | Event Timer | Unsigned16 | RW | N | 0 | Event timer |

Mapping parameter 1. TxPDO

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A00 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x60000108 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0x60000208 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0x60000308 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0x60000408 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The first send-PDO is per default planned for digital inputs.
For changing the mapping, the following sequence must be observed (see object index 0x1600).

Mapping parameter 2. TxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A01 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x64010110 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0x64010210 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0x64010310 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0x64010410 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The second send-PDO is per default planned for analog inputs 1 to 4.
To change the mapping, a certain order has to be observed (see object Index 0x1600)

Mapping parameter 3. TxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A02 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x64010510 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0x64010610 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0x64010710 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0x64010810 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The third send-PDO is per default planned for analog inputs 5 to 8.
To change the mapping, a certain order has to be observed (see object Index 0x1600).

Mapping parameter 4. TxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A03 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0x64010910 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0x64010A10 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0x64010B10 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0x64010C10 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

The fourth send-PDO is per default planned for analog inputs 8 to 12.
To change the mapping, a certain order has to be observed (see object Index 0x1600).

Mapping parameter 5. TxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A04 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

Mapping parameter 6. TxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A05 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

## Mapping arameter 7. TxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A06 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

## Mapping Parameter 8. TxPDO

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x1A07 | 0 | Number of elements | Unsigned8 | RO | N | 0 | Number of available sub-index numbers |
| | 1 | 1. mapped object | Unsigned32 | RW | N | 0 | 1. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 2 | 2. mapped object | Unsigned32 | RW | N | 0 | 2. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 3 | 3. mapped object | Unsigned32 | RW | N | 0 | 3. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |
| | 4 | 4. mapped object | Unsigned32 | RW | N | 0 | 4. mappped application object:<br>2 Byte: Index<br>1 Byte: Sub-index<br>1 Byte: bit width |

## Firmware info

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x2010 | 0 | Number of elements | Unsigned8 | RO | N | 1 | Number of available sub-index numbers |
| | 1 | Firmware version | Unsigned32 | RO | N | | Firmware version |

## Hardeware info

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x2020 | 0 | Number of elements | Unsigned8 | RO | N | 8 | Number of available sub-index numbers |
| | 1 | Firmware version | Unsigned32 | RO | N | | Firmware version |
| | 2 | Number of IO channels | Unsigned32 | RO | N | | Number of IO channels |
| | 3 | Current temperature | Unsigned32 | RO | N | | Current temperature |
| | 4 | Maximum temperature | Unsigned32 | RO | N | | Maximum temperature |
| | 5 | Minimum temperature | Unsigned32 | RO | N | | Minimum temperature |
| | 6 | Reboot counter | Unsigned32 | RO | N | | Reboot counter |
| | 7 | Calibration data | Unsigned32 | RO | N | | Data of the latest calibration |
| | 8 | Operating hours counter | Unsigned32 | RO | N | | Operating hours counter |

## Analog channel

| Index | Sub Index | Name | Type | Attr b. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x2101 … 0x2110 | 0 | Number of elements | Unsigned8 | RO | N | 11 | Number of available sub-index numbers |
| | 1 | Type | Unsigned8 | RW | N | 55 | Type of channel |
| | 2 | Value | Signed16 | RW | N | | Current value oft he channel |
| | 3 | Status | Unsigned8 | RO | N | | Status display of the channel |
| | 4 | Elements of the averaging | Unsigned8 | RW | N | 5 | Number of grid points for the averaging between 5 and 10 |
| | 5 | MinDigit | Unsigned16 | RO | N | | Value of calibration for the setting type |
| | 6 | MinValue | Signed16 | RO | N | | Value of calibration for the setting type |
| | 7 | MaxDigit | Unsigned16 | RO | N | | Value of calibration for the setting type |
| | 8 | MaxValue | Signed16 | RO | N | | Value of calibration for the setting type |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9 | DAC value | Unsigned16 | RW | N | | Value is created on DAC between 0…4095 |
| | 10 | ADC- value 1 | Unsigned16 | RO | N | | ADC value for A-IO |
| | 11 | ADC- value 2 | Unsigned16 | RO | N | | ADC value for A-IN |
| | 12 | NTC B-value | Float | RW | N | 3987.75 | Coefficient, results of the resistance at 25 °C and 100°C |
| | 13 | NTC resistance at 25°C | Float | RW | N | 10000 | Resistance at 25°C |
| | 14 | NTC resistance at 100°C | Float | RW | N | 680 | Resistance at 100°C |
| | 15 | Parallel resistance via clamb | Float | RW | N | 10000 | Parallel resistance, switched via the input clamb |

## Digital Inputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6000 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available digital 8 Bit – Input blocks |
| | 1 | 1. Input block | Unsigned8 | RO | Y | 0 | 1.Input block (DI1…DI8) |
| | 2 | 2. Input block | Unsigned8 | RO | Y | 0 | 2. Input block (DI9…DI16) |
| | 3 | 3. Input block | Unsigned8 | RO | Y | 0 | 3. Input block (DI17…DI24) |
| | 4 | 4. Input block | Unsigned8 | RO | Y | 0 | 4. Input block (DI25…DI32) |

Via default each change of a value in the event triggered PDO leads to the sending of a telegram.

## Digital Outputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6200 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available digital 8 Bit – Output block |
| | 1 | 1. Output block | Unsigned8 | RW | Y | 0 | 1. Output block (DO1…DO8) |
| | 2 | 2. Output block | Unsigned8 | RW | Y | 0 | 2. Output block (DO9…DO16) |
| | 3 | 3. Output block | Unsigned8 | RW | Y | 0 | 3. Output block (DO17…DO24) |
| | 4 | 4. Output block | Unsigned8 | RW | Y | 0 | 4. Output block (DO25…DO32) |

Error mode of the digital outputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6206 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available digital 8 Bit – Output block |
| | 1 | 1. Output block | Unsigned8 | RW | N | 0 | 1. Output block (DO1…DO8) |
| | 2 | 2. Output block | Unsigned8 | RW | N | 0 | 2. Output block (DO9…DO16) |
| | 3 | 3. Output block | Unsigned8 | RW | N | 0 | 3. Output block (DO17…DO24) |
| | 4 | 4. Output block | Unsigned8 | RW | N | 0 | 4. Output block (DO25…DO32) |

When guarding error, the setting value in object 0x6207 will be createtd in DOx equal ONE at the output. When DOx equal ZERO, the old value is retained.

Error value of digital outputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6207 | 0 | Number of elements | Unsigned8 | RO | N | 4 | Number of available digital 8 Bit – Output block |
| | 1 | 1. Output block | Unsigned8 | RW | N | 0 | 1. Output block (DO1…DO8) |
| | 2 | 2. Output block | Unsigned8 | RW | N | 0 | 2. Output block (DO9…DO16) |
| | 3 | 3. Output block | Unsigned8 | RW | N | 0 | 3. Output block (DO17…DO24) |
| | 4 | 4. Output block | Unsigned8 | RW | N | 0 | 4. Output block (DO25…DO32) |

When guarding error and setting object 0x6206, the setting value will be set on the output.

Analog inputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6401 | 0 | Number of elements | Unsigned8 | RO | N | 16 | Number of available analog input channels |
| | 1 | 1. Input channel | Signed16 | RO | Y | 0 | 1. analog input AI1 |
| | 2 | 2. Input channel | Signed16 | RO | Y | 0 | 2. analog inut AI2 |
| | … | | | | | | |
| | 15 | 15. Input channel | Signed16 | RO | Y | 0 | 15. analog input AI15 |
| | 16 | 16 Input channel | Signed16 | RO | Y | 0 | 16. analog input AI16 |

Depending on the chosen sensor type, it results different range of values

| Sensor-type | Input | Range of values |
|---|---|---|
| AIN_M10_10VOLT | -10V … 10V | -10000 … 10000 |
| AIN_0_20mA | 0mA … 20 mA | 0 … 20000 |
| AIN_PT100_2WIRE | -30,0 … 500,0 °C | -300 … 5000 |
| | | |

Analog Outputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6411 | 0 | Index | Sub Index | Name | Type | Attrb. | Number of available analog output channels |
| | 1 | 1. Input channel | Signed16 | RW | Y | 0 | 1. analog outputs AO1 |
| | 2 | 2. Input channel | Signed16 | RW | Y | 0 | 2. analog outputs AO2 |
| | … | | | | | | |
| | 15 | 15. Input channel | Signed16 | RW | Y | 0 | 15. analog outputs AO15 |
| | 16 | 16 Input channel | Signed16 | RW | Y | 0 | 16. analog outputs AO16 |

Depending on the chosen sensor type, it results different range of values

| Sensor-type | Input | Range of values |
|---|---|---|
| AOUT_M10_10VOLT | -10V … 10V | -10000 … 10000 |
| AOUT_0_20mA | 0mA … 20 mA | 0 … 20000 |
| | | |

Event control of analog inputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6423 | 0 | Global interrupt Enable | Boolean | RW | N | 0 | Activate the event-driven sending of PDOs with analog iputs |

According CANopen the analog inputs in TxPDO2.4 are configured event driven (255) via default to the transmission type. But the event (changing of the input value) is deactivated via the event control in the object 0x6423 to avoid a submergence of the bus with analog signals.
It is advisable to control the data volume of the analog PDOs via synchronous communication or via the use of the event timer. In the event driven operation the transmission of the analog PDOS can be parameterized before the activating via adjust the inhibit time (object 0x1800ff, Sub-index 3) and/or the delta function (object 0x6426).

Delta function of analog inputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6426 | 0 | Number of elements | Unsigned8 | RO | N | 16 | Number of available analog input channels |
| | 1 | 1. Delta Input channel | Signed16 | RW | N | 0 | Delta 1. analog input |
| | 2 | 2. Delta Input channel | Signed16 | RW | N | 0 | Delta 2. analog input |
| | … | | | | | | |
| | 15 | 15. Delta Input channel | Signed16 | RW | N | 0 | Delta 15. analog input |
| | 16 | 16. Delta Input channel | Signed16 | RW | N | 0 | Delta 16. analog input |

Values unequal to zero are activating the delta function for the assigned channel. A PDO is then transmitted when the value has been changed for more than the delta value since the last transmission. In addition, the event trigger has to be active (object 0x6423). The data format corresponds to the analog inputs. (The delta function accepts only positive values).

Sensor type analog inputs
The analog inputs oft he robusto slave dievices are configurable. This means, each analog input channel has to be assigned a senspor type.

Error mode of the analog outputs

| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6443 | 0 | Number of elements | Unsigned8 | RO | N | 16 | Number of available analog input channels |
| | 1 | 1. Output channel | Unsigned8 | RW | N | 0 | 1. analog outputs AO1 |
| | 2 | 2. Output channel | Unsigned8 | RW | N | 0 | 2. analog outputs AO2 |
| | … | | | | | | |
| | 15 | 15 Output channel | Unsigned8 | RW | N | 0 | 15. analog outputs AO15 |
| | 16 | 16. Output channel | Unsigned8 | RW | Y | 0 | 16. analog outputs AO16 |

If guarding error, the output will be set according the parameterized value.
If parameter value ONE, the value which is written in the object 0x6444 will be created at the output.
If value ZERO, the output remains unchanged.

Error valueof the analog outputs

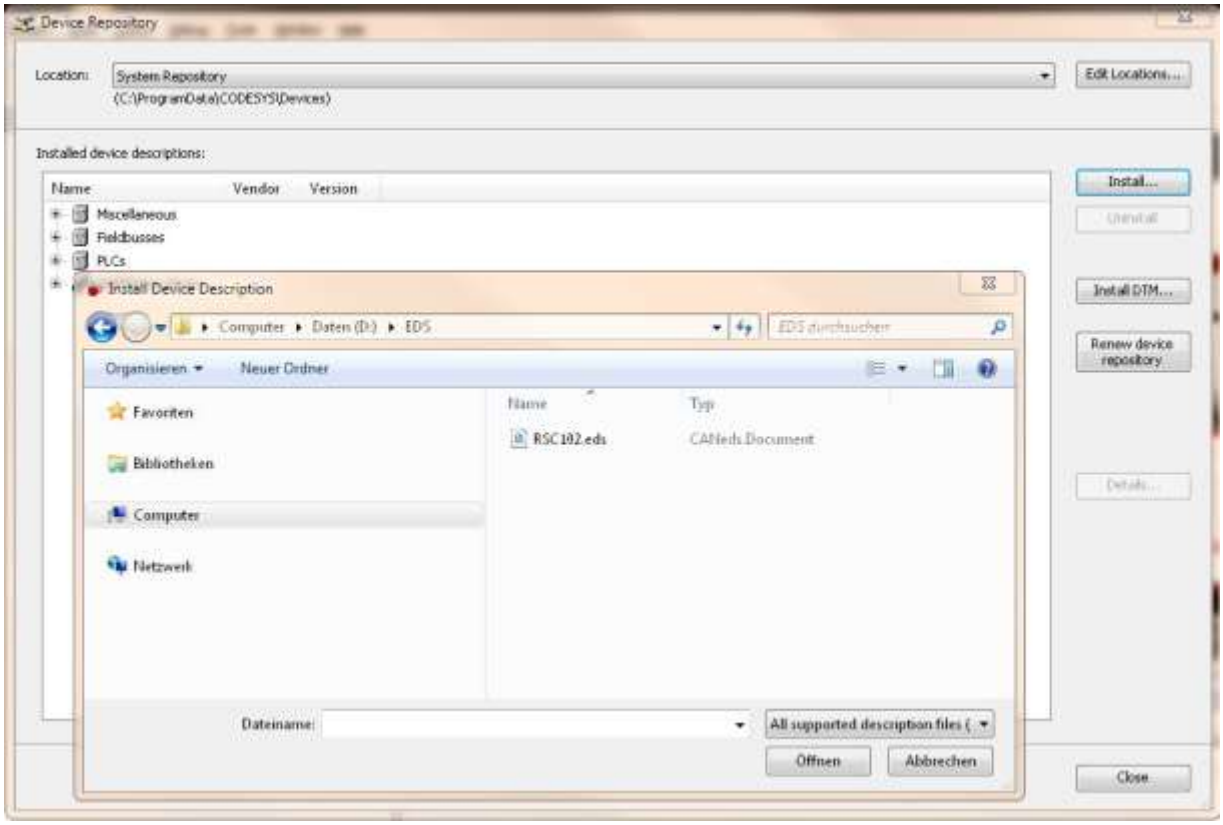
| Index | Sub Index | Name | Type | Attrb. | Map. | Default-value | Importance |
|---|---|---|---|---|---|---|---|
| 0x6444 | 0 | Number of elements | Unsigned 8 | RO | N | 16 | Number of available analog input channels |
| | 1 | 1. Output channel | Signed32 | RW | N | 0 | 1. analog outputs AO1 |
| | 2 | 2. Output channel | Signed32 | RW | N | 0 | 2. analog outputs AO2 |
| | … | | | | | | |
| | 15 | 15 Output channel | Signed32 | RW | N | 0 | 15. analog outputs AO15 |
| | 16 | 16. Output channel | Signed32 | RW | N | 0 | 16. analog outputs AO16 |

If guarding error and the setting object 0x6443, the setting value will be created at the output.

# 7 CODESYS V3

## 7.1 Integrate EDS file

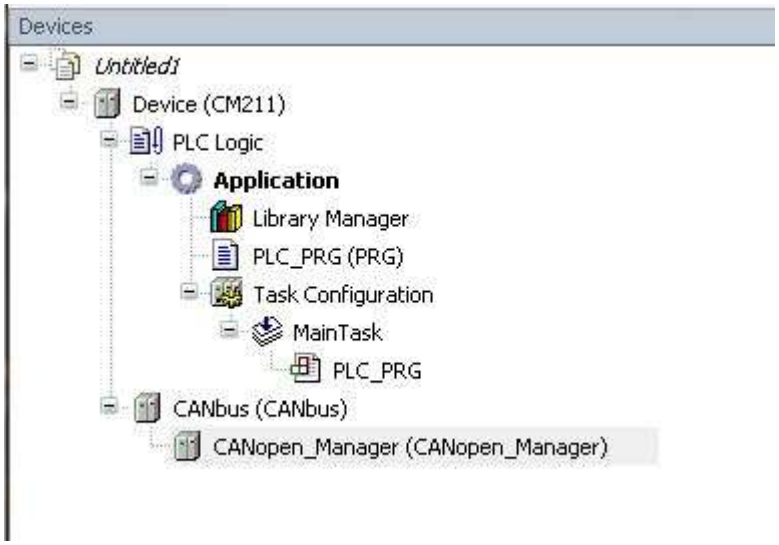
In CODESYS V3, the RSC102 will be notified by installing of the EDS file in the development system and can be integrated in the configuration.
Installation is carried out via the menue item „Tools\Device-Repository“ in the CODESYS DIE”



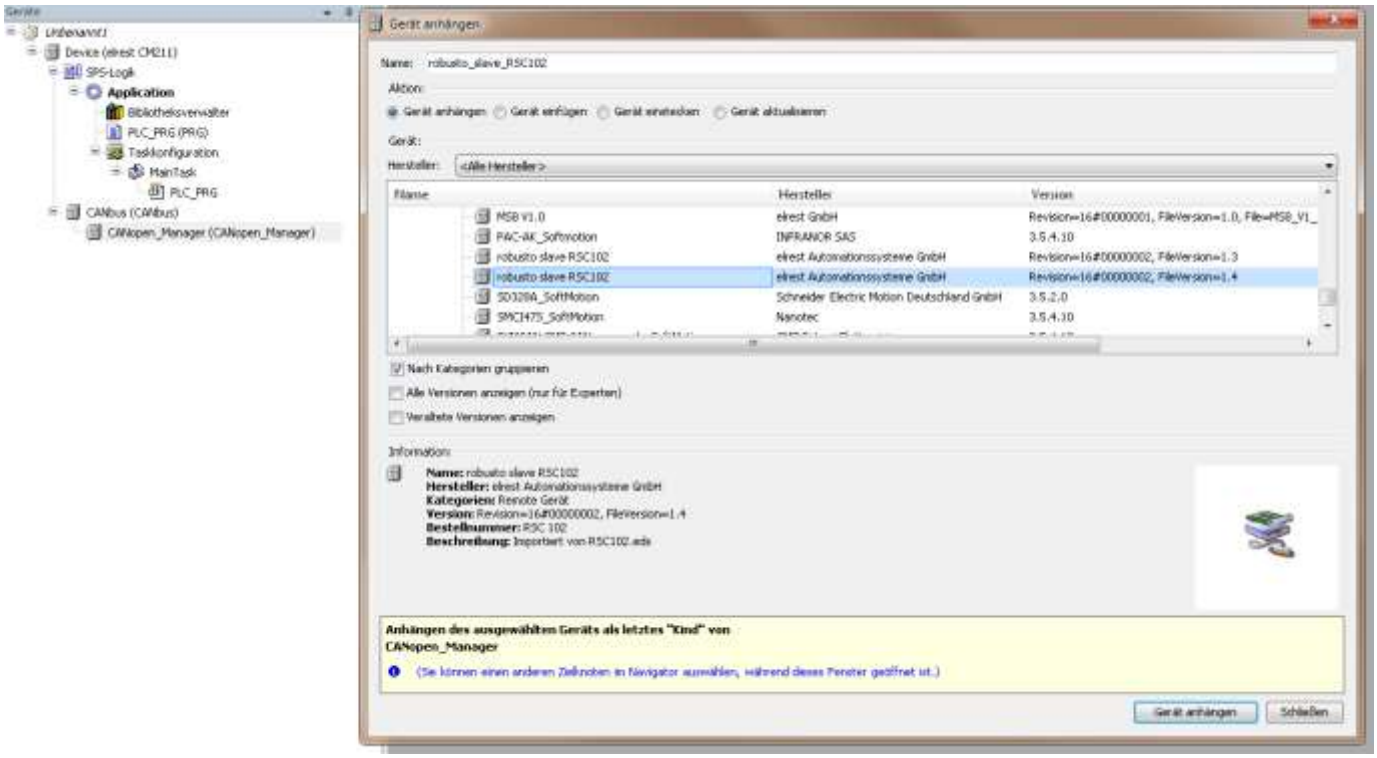

After pressing the button „install“, the choice will be taken for the corresponding EDS file. Its will be selected with “Open” and transmitted in the system repository via the CODESYS DIE. Now, the RSC102 can be integrated in a CANopen configuration.

## 7.2 CANopen configuration

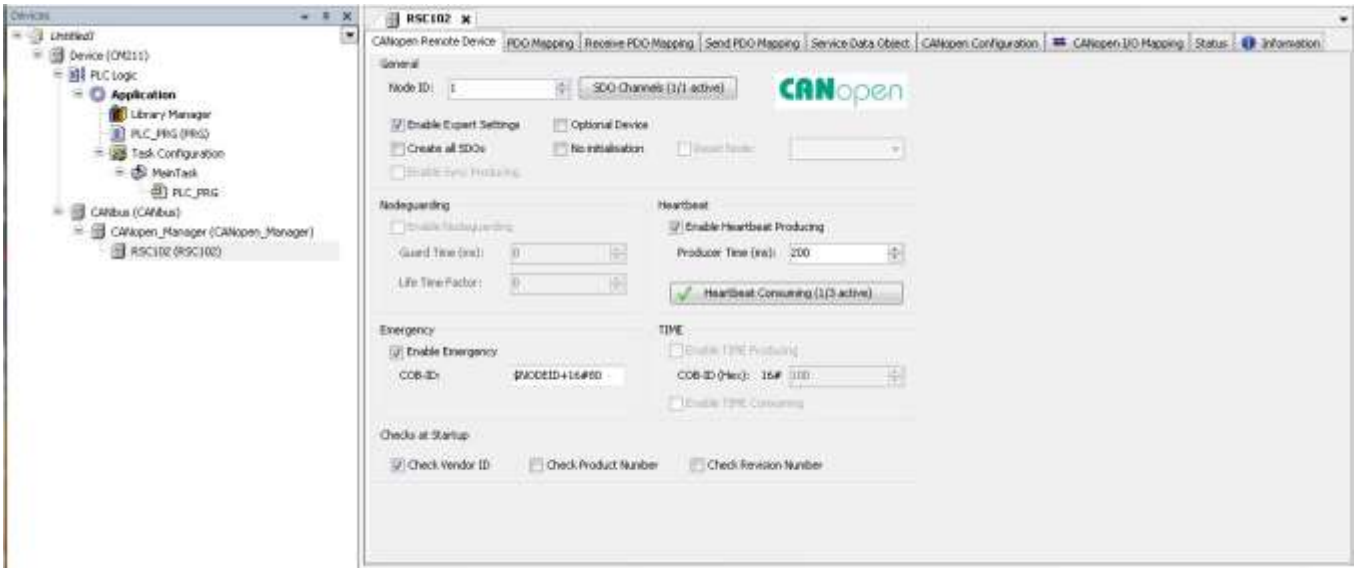
In the CODESYS application, the CANbus will be integrated with CANopen_Manager via „taching device”.




Via „taching device” the used RSC 102 node can be added to the configuration.



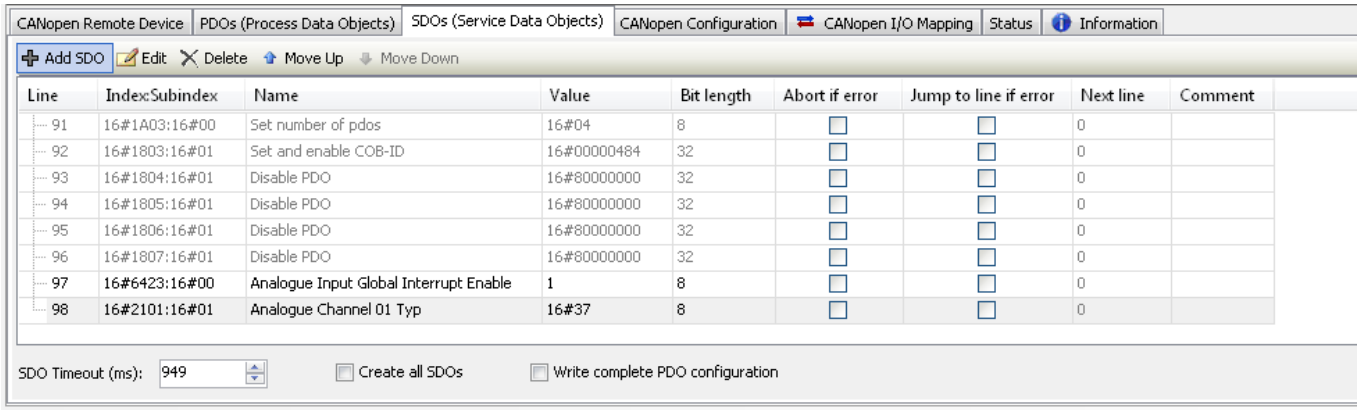
The included RSC102 node can now in the expert mode be configured and parameterized.
The setting Node ID hast to be configured, the supervision type of the node, properties of the PDOs and if necessary to configure the used analog channels.




If using analog channels, in the tab „Service Data Object“ the type of the used channel has to be set in the subindex 16#01 of the respective channel.

All channels are defaulted on the value 16#37, according the sensor type AOUT_AI08_OFF.

If using analog inputs, the cofigured transmit PDOs have to be activated.The SDO object „Analogue Inpunt Global Interrupt“ has to be send with the data content 1 to the device.




List of analog channel types

Default

| Type | Number | Measuring range | Display range |
|---|---|---|---|
| AOUT_AI08_OFF | 16#3F | 0 | 0 |

Analog Outputs

| Type | Number | Output range | Value range |
|---|---|---|---|
| AOUT_M10_10VOLT | 16#33 | -10 ... 10Volt | -10000 ... 10000 |
| AOUT_0_20MA | 16#34 | 0 ... 20mA | 0 ... 20000 |

Analog inputs

| Type | Number | Measuring range | Display range |
|---|---|---|---|
| AIN_0_1Volt | 16#01 | 0 ... 1.Volt | 0 ... 1000 |
| AIN_0_20MA | 16#03 | 0 ... 20.mA | 0 ... 20000 |
| AIN_TC_TYPE_K | 16#0F | 0 ... 1150°C | 0 ... 11500 |
| AIN_PT100_2WIRE | 16#15 | -30 ... 500°C | -300 ... 500 |
| AIN_M10_10VOLT | 16#64 | -10 ... 10.Volt | -10000 ... 10000 |
| AIN_500_OHM | 16#67 | 0 ... 500 Ohm | 0 ... 500 |
| AIN_NTC_10KOHM | 16#68 | -40 ... 60°C | -400 .. 600 |

Settings of sensor type AIN_NTC_10KOHM

If selecting the sensor AIN_NTC_10KOHM, the parameters will be used according the characteristics in chapter 4.1.3.

By using sensors with different resistance characteristics, the input channel has to be configured accordingly for an exactly measurment

If the B- value is available, it has to be send via channel SDO and subindex 0x0C to the device.

Also the values of 25°C (subIndex 0x0D) and the value of 100°C (0x0E) can be send to the device. These both values consitute the value B, and will be taken in account.


For further information please contact our application department.
Service and support

# 8 Maintenance and service

## 8.1 Maintenance

### *8.1.1 General*

Please ensure you observe and check the following points:

- The ambient conditions must be assured.I
- Is the housing temperature unusually high?

#### 8.1.1.1 Device temperature

**The device temperature** of the robusto RSC102 during the operation should not be lower than 0°C and not higher than 50 °C sein.

Otherwise all warranty claims and the device can be destroyed).

### *8.1.2 Function earth (FE)*

Power plug X1

The cable screens of the communication ports X27 /CAN-IN and X28 /CAN-OUT are connected with FE:


## 8.2 Device failure

The RSCxxx device was tested before delivery and has left our premises in good order and conditions. Should an error occur, on our webside „service/ redelivery“ you can fill out the RMA form and send us. We'll attend to it directly and answer as soon as possible.

## 8.3 Accessories

| Designation | Artikle number | Description | |
|---|---|---|---|
| Patch cable | commercial | Connection to CM1xx or 2xx und further slaves. |  |
| Cable D-Sub-9 to RJ-45 | 240020100 | Connection to visio control PMC4xx and further slaves. |  |
| Connector set | 25001.0001 | "8 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,0 mm², 8 A Series 714-110"<br>16 x multipoint socket connector eCOM with straight solder pin; with hilt plate; 3-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 …1,5 mm², WAGO: 2091-1103<br>1 x socket 3-pole , Wago 734-103/037-000 |  <br>  |

## Notice

| Note for devices with the index = „ PROTOTYPE”. | Chapter |
|---|---|
| Prototypes are used only for test purposes. | Security regulations and safty precautions |
| ModeC: Bootloader: | HEX- modi |
| Mode F: Service-mode don‘t exist software-sided | HEX- modi |
| Interface X26: this interface is not assigned | Frontview of the interfaces |
| Firmware Info:<br>Firmware version data firmware downloads (not for rtotype) | Description of the objects and data |

# 9 Troubleshooting

## 9.1 Service and Support

Hotline

For additional support and information contact our hotline with the following times:

Mon-Fri: 8.00- 12.00 and 13.00 - 16.30

Phone: +49 (0) 7021 / 92025-33

Besides, you can of course always contact us by mail or fax.

Fax.: +49 (0) 7021 / 92025-29
e-mail: support@elrest.de

Training und Workshops

We offer education or project-based workshops for the elrest products.

Please contact our sales deparment for further information.

Phone: +49 (0) 7021/92025-0
Fax: +49 (0) 7021/92025-29
E-mail: vertrieb@elrest.de

# 10 History

| *Date* | *Name* | *Chapter* | *Changing* |
|---|---|---|---|
| 17.11.2014 | Hm/GS | | Created |
| 14.07.2015 | Hm | | Complemented |
| | | | |
| | | | |
| | | | |

# 11 Appendix

## 11.1 Resistance tables

Below are the measuring range for the temperature of analog in- and outputs. The tables show each type and ist measuring range.

### *11.1.1 Resistance characteristics for the temperature probe NTC-25-10k-100-680*

| °C | |
|---|---|
| -50,00 | 667,83 |
| -40,00 | 335,67 |
| -30,00 | 176,68 |
| -20,00 | 96,97 |
| -10,00 | 55,30 |
| 0,00 | 32,65 |
| 10,00 | 19,90 |
| 20,00 | 12,49 |
| 25,00 | 10,00 |
| 30,00 | 8,06 |
| 40,00 | 5,32 |
| 50,00 | 3,60 |
| 60,00 | 2,49 |
| 70,00 | 1,75 |
| 80,00 | 1,26 |
| 90,00 | 0,92 |
| 100,00 | 0,68 |
| 110,00 | 0,51 |
| 120,00 | 0,39 |
| 130,00 | 0,30 |
| 140,00 | 0,23 |
| 150,00 | 0,18 |

### *11.1.2 Resistance characteristics for the temperature probe NTC-25-10k-100-970*

| °C | |
|---|---|
| -50,00 | 329,50 |
| -40,00 | 188,50 |
| -30,00 | 111,30 |
| -20,00 | 67,77 |
| -10,00 | 42,47 |
| 0,00 | 27,28 |
| 10,00 | 17,96 |
| 20,00 | 12,09 |
| 25,00 | 10,00 |
| 30,00 | 8,31 |
| 40,00 | 5,83 |
| 50,00 | 4,16 |
| 60,00 | 3,02 |
| 70,00 | 2,23 |
| 80,00 | 1,67 |
| 90,00 | 1,27 |
| 100,00 | 0,97 |
| 110,00 | 0,76 |
| 120,00 | 0,59 |
| 130,00 | 0,48 |
| 140,00 | 0,39 |
| 150,00 | 0,31 |

### *11.1.3 KTY 110/130*

*Temperature range -50°C....+150°C*

*All resistance value in Ω*

| °C | Ω |
|---|---|
| **-50** | 1036,000 |
| **-40** | 1140,000 |
| **-30** | 1250,000 |
| **-20** | 1370,000 |
| **-10** | 1496,000 |
| **0** | 1630,000 |
| **10** | 1772,000 |
| **20** | 1922,000 |
| **25** | 2000,000 |
| **30** | 2080,000 |
| **40** | 2246,000 |
| **50** | 2418,000 |
| **60** | 2600,000 |
| **70** | 2788,000 |
| **80** | 2984,000 |
| **90** | 3188,000 |
| **100** | 3400,000 |
| **110** | 3620,000 |
| **120** | 3846,000 |
| **130** | 4082,000 |
| **140** | 4256,000 |
| **150** | 4470,000 |

### *11.1.4 KTY 81-1*

*Temperature range -55°C....+150°C*

*All resistance value in Ω*

| °C | Ω |
|---|---|
| **-55** | 490,000 |
| **-50** | 515,000 |
| **-40** | 567,000 |
| **-30** | 624,000 |
| **-20** | 684,000 |
| **-10** | 747,000 |
| **0** | 815,000 |
| **10** | 886,000 |
| **20** | 961,000 |
| **25** | 1000,000 |
| **30** | 1040,000 |
| **40** | 1122,000 |
| **50** | 1209,000 |
| **60** | 1299,000 |
| **70** | 1392,000 |
| **80** | 1490,000 |
| **90** | 1591,000 |
| **100** | 1696,000 |
| **110** | 1805,000 |
| **120** | 1915,000 |
| **125** | 1970,000 |
| **130** | 2023,000 |
| **140** | 2124,000 |
| **150** | 2211,000 |

### *11.1.5 KTY 81-2*

*Temperature range -55°C....+150°C*

*All resistance value in Ω*

| °C | Ω |
|---|---|
| **-55** | 980,000 |
| **-50** | 1030,000 |
| **-40** | 1135,000 |
| **-30** | 1247,000 |
| **-20** | 1367,000 |
| **-10** | 1495,000 |
| **0** | 1630,000 |
| **10** | 1772,000 |
| **20** | 1922,000 |
| **25** | 2000,000 |
| **30** | 2080,000 |
| **40** | 2245,000 |
| **50** | 2417,000 |
| **60** | 2597,000 |
| **70** | 2785,000 |
| **80** | 2980,000 |
| **90** | 3182,000 |
| **100** | 3392,000 |
| **110** | 3607,000 |
| **120** | 3817,000 |
| **125** | 3915,000 |
| **130** | 4008,000 |
| **140** | 4166,000 |
| **150** | 4280,000 |

### *11.1.6 NI1000*

*Temperature range -50°C....+690°C*

*All resistance value in Ω*

| °C in steps of 10 ⇩ | °C tended to zero in step of one ⇨ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-50** | 742,550 | 747,360 | 752,190 | 757,030 | 761,890 | 766,760 | 771,640 | 776,540 | 781,450 | 786,370 |
| **-40** | 791,310 | 796,260 | 801,230 | 806,210 | 811,210 | 816,210 | 821,230 | 826,270 | 831,320 | 836,380 |
| **-30** | 841,460 | 846,550 | 851,650 | 856,770 | 861,900 | 867,040 | 872,200 | 877,370 | 882,560 | 887,750 |
| **-20** | 892,960 | 898,190 | 903,430 | 908,680 | 913,340 | 919,220 | 924,510 | 929,820 | 935,140 | 940,470 |
| **-10** | 945,820 | 951,170 | 956,550 | 961,930 | 967,330 | 972,740 | 978,170 | 983,600 | 989,060 | 994,520 |

| °C in steps of 10 ⇩ | °C ascending in step of one ⇨ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 1000,000 | 1005,490 | 1011,000 | 1016,510 | 1022,050 | 1027,590 | 1033,150 | 1038,720 | 1044,310 | 1049,900 |
| **10** | 1055,520 | 1061,140 | 1066,780 | 1072,430 | 1078,090 | 1083,770 | 1089,460 | 1095,170 | 1100,890 | 1106,620 |
| **20** | 1112,360 | 1118,120 | 1123,900 | 1129,680 | 1135,480 | 1141,290 | 1147,120 | 1152,960 | 1158,810 | 1164,680 |
| **30** | 1170,560 | 1176,450 | 1182,360 | 1188,280 | 1194,210 | 1200,160 | 1206,130 | 1212,100 | 1218,090 | 1224,090 |
| **40** | 1230,110 | 1236,140 | 1242,190 | 1248,250 | 1254,320 | 1260,410 | 1266,510 | 1272,620 | 1278,750 | 1284,890 |
| **50** | 1291,050 | 1297,220 | 1303,410 | 1309,610 | 1315,820 | 1322,050 | 1328,290 | 1334,550 | 1340,820 | 1347,100 |
| **60** | 1353,400 | 1359,720 | 1366,050 | 1372,290 | 1378,750 | 1385,120 | 1391,510 | 1397,910 | 1404,330 | 1410,760 |
| **70** | 1417,210 | 1423,670 | 1430,150 | 1436,640 | 1443,150 | 1449,670 | 1456,210 | 1462,760 | 1469,330 | 1475,950 |
| **80** | 1482,510 | 1489,130 | 1495,760 | 1502,400 | 1509,070 | 1515,740 | 1522,440 | 1529,140 | 1535,870 | 1542,610 |
| **90** | 1549,370 | 1556,140 | 1562,930 | 1569,730 | 1576,550 | 1583,390 | 1590,240 | 1597,110 | 1604,000 | 1610,900 |
| **100** | 1617,830 | 1624,760 | 1631,720 | 1638,690 | 1645,670 | 1652,680 | 1659,700 | 1666,740 | 1673,790 | 1680,870 |
| **110** | 1687,960 | 1695,070 | 1702,190 | 1709,330 | 1716,490 | 1723,670 | 1730,870 | 1738,080 | 1745,320 | 1772,570 |
| **120** | 1759,840 | 1767,120 | 1774,430 | 1781,750 | 1789,090 | 1796,460 | 1803,840 | 1811,230 | 1818,650 | 1826,090 |
| **130** | 1833,540 | 1841,020 | 1848,510 | 1856,020 | 1863,560 | 1871,110 | 1878,680 | 1886,270 | 1893,880 | 1901,510 |
| **140** | 1909,170 | 1916,840 | 1924,530 | 1932,240 | 1939,970 | 1947,730 | 1955,500 | 1963,259 | 1971,110 | 1978,950 |
| **150** | 1986,800 | 1994,680 | 2002,580 | 2010,500 | 2018,440 | 2026,410 | 2034,400 | 2042,400 | 2050,430 | 2058,480 |
| **160** | 2066,560 | 2074,650 | 2082,770 | 2090,910 | 2099,080 | 2107,270 | 2115,480 | 2123,710 | 2131,960 | 2140,240 |
| **170** | 2148,550 | 2156,870 | 2165,220 | 2173,590 | 2181,990 | 2190,410 | 2198,860 | 2207,330 | 2215,820 | 2224,340 |
| **180** | 2232,890 | 2241,450 | 2250,050 | 2258,670 | 2267,310 | 2275,980 | 2284,670 | 2293,390 | 2302,140 | 2310,910 |
| **190** | 2319,710 | 2328,540 | 2337,390 | 2346,260 | 2355,170 | 2364,100 | 2373,060 | 2382,040 | 2391,050 | 2400,090 |

| °C in steps of 10 | °C ascending in steps of two | | | | |
|---|---|---|---|---|---|
| | **0** | **2** | **4** | **6** | **8** |
| **200** | 2409,160 | 2427,380 | 2445,710 | 2464,150 | 2482,710 |
| **210** | 2501,380 | 2520,170 | 2539,080 | 2558,110 | 2577,260 |
| **220** | 2596,540 | 2615,930 | 2635,460 | 2655,110 | 2674,880 |
| **230** | 2694,790 | 2714,830 | 2735,000 | 2755,310 | 2775,750 |
| **240** | 2796,330 | 2817,040 | 2837,900 | 2858,900 | 2880,040 |
| **250** | 2901,330 | 2922,760 | 2944,350 | 2966,080 | 2987,960 |
| **260** | 3010,000 | 3032,190 | 3054,540 | 3077,050 | 3099,720 |
| **270** | 3122,550 | 3145,550 | 3168,710 | 3192,040 | 3215,540 |
| **280** | 3239,210 | 3263,050 | 3287,070 | 3311,270 | 3335,650 |
| **290** | 3360,200 | 3384,940 | 3409,870 | 3434,990 | 3460,590 |
| **300** | 3485,790 | 3511,000 | 3537,360 | 3563,440 | 3589,730 |
| **310** | 3616,210 | 3642,900 | 3669,800 | 3969,910 | 3724,230 |
| **320** | 3751,760 | 3779,510 | 3807,480 | 3835,670 | 3864,080 |
| **330** | 3892,720 | 3921,580 | 3950,680 | 3980,010 | 4009,570 |
| **340** | 4039,380 | 4069,420 | 4099,710 | 4130,250 | 4161,030 |
| **350** | 4192,070 | 4223,350 | 4254,900 | 4286,710 | 4318,770 |
| **360** | 4351,110 | 4383,710 | 4416,580 | 4449,730 | 4483,150 |
| **370** | 4516,850 | 4550,840 | 4585,110 | 4619,660 | 4654,510 |
| **380** | 4689,660 | 4725,100 | 4760,840 | 4796,890 | 4833,250 |
| **390** | 4869,910 | 4906,890 | 4944,180 | 4981,800 | 5019,740 |
| **400** | 5058,000 | 5096,590 | 5135,520 | 5174,790 | 5214,390 |
| **410** | 5254,340 | 5294,640 | 5335,290 | 5376,290 | 5417,650 |
| **420** | 5459,370 | 5501,460 | 5543,910 | 5586,740 | 5629,950 |
| **430** | 5673,540 | 5717,510 | 5761,860 | 5806,610 | 5851,760 |
| **440** | 5897,310 | 5943,260 | 5689,610 | 6036,380 | 6083,570 |
| **450** | 6131,180 | 6179,210 | 6227,660 | 6276,560 | 6325,880 |
| **460** | 6375,650 | 6425,870 | 6476,530 | 6527,650 | 6579,230 |
| **470** | 6631,270 | 6683,780 | 6736,760 | 6790,200 | 6844,160 |
| **480** | 6898,580 | 6953,500 | 7008,910 | 7064,820 | 7121,240 |
| **490** | 7178,170 | 7235,610 | 7293,570 | 7352,060 | 7411,070 |
| **500** | 7470,630 | 7530,720 | 7591,350 | 7652,540 | 7714,280 |
| **510** | 7776,580 | 7839,450 | 7902,890 | 7966,900 | 8031,500 |
| **520** | 8096,680 | 8162,460 | 8228,830 | 8295,810 | 8363,400 |
| **530** | 8431,600 | 8500,430 | 8569,880 | 8639,960 | 8710,680 |
| **540** | 8782,050 | 8854,060 | 8926,730 | 9000,060 | 9074,060 |
| **550** | 9148,740 | 9224,090 | 9300,130 | 9376,870 | 9454,300 |
| **560** | 9532,440 | 9611,280 | 9690,850 | 9771,140 | 9852,160 |
| **570** | 9933,920 | 10016,430 | 10099,680 | 10183,690 | 10268,470 |
| **580** | 10354,010 | 10440,330 | 10527,440 | 10615,340 | 10704,040 |
| **590** | 10793,550 | 10883,860 | 10975,000 | 11066,960 | 11159,760 |
| **600** | 11253,400 | 11347,890 | 11443,230 | 11539,440 | 11636,520 |
| **610** | 11734,480 | 11833,330 | 11933,070 | 12033,710 | 12135,260 |
| **620** | 12237,730 | 12341,120 | 12445,450 | 12550,720 | 12656,940 |
| **630** | 12764,110 | 12872,250 | 12981,370 | 13091,460 | 13202,550 |
| **640** | 13314,640 | 13427,730 | 13541,840 | 13656,980 | 13773,140 |
| **650** | 13890,350 | 14008,610 | 14127,930 | 14248,320 | 14369,780 |
| **660** | 14492,330 | 14615,980 | 14740,730 | 14866,690 | 14993,570 |
| **670** | 15121,690 | 15250,950 | 15381,360 | 15512,930 | 15645,670 |
| **680** | 15779,590 | 15914,690 | 16051,000 | 16188,510 | 16327,240 |
| **690** | 16467,210 | | | | |

### *11.1.7 NI1000TK5000*

*Temperature range -50°C....+690°C*

*All resistance value in Ω*

| °C in steps of 10 ⇩ | °C tended to zero in step of one ⇨ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-50** | 790,880 | 794,840 | 798,800 | 802,780 | 806,760 | 810,750 | 814,750 | 818,760 | 822,780 | 826,800 |
| **-40** | 830,840 | 834,880 | 838,940 | 843,000 | 847,070 | 851,150 | 855,240 | 859,340 | 863,450 | 867,570 |
| **-30** | 871,690 | 875,830 | 879,980 | 884,130 | 888,300 | 892,470 | 896,650 | 900,850 | 905,050 | 909,260 |
| **-20** | 913,480 | 917,720 | 921,960 | 926,210 | 930,470 | 934,740 | 939,020 | 943,310 | 947,610 | 951,920 |
| **-10** | 956,240 | 960,570 | 964,910 | 969,260 | 973,620 | 977,990 | 982,370 | 986,770 | 991,170 | 995,580 |

| °C in steps of 10 ⇩ | °C ascending in step of one ⇨ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 1000,000 | 1004,430 | 1008,870 | 1013,330 | 1017,790 | 1022,260 | 1026,750 | 1031,240 | 1035,750 | 1040,270 |
| **10** | 1044,790 | 1049,330 | 1053,880 | 1058,440 | 1063,010 | 1067,590 | 1072,180 | 1076,780 | 1081,390 | 1086,020 |
| **20** | 1090,650 | 1095,300 | 1099,960 | 1104,620 | 1109,300 | 1113,990 | 1118,700 | 1123,410 | 1128,130 | 1132,870 |
| **30** | 1137,620 | 1142,370 | 1147,140 | 1151,920 | 1156,720 | 1161,520 | 1166,340 | 1171,160 | 1176,000 | 1180,850 |
| **40** | 1185,710 | 1190,590 | 1195,470 | 1200,370 | 1205,280 | 1210,200 | 1215,130 | 1220,070 | 1225,030 | 1230,000 |
| **50** | 1234,980 | 1239,970 | 1244,970 | 1249,990 | 1255,020 | 1260,060 | 1265,110 | 1270,180 | 1275,250 | 1280,340 |
| **60** | 1285,450 | 1290,560 | 1295,690 | 1300,830 | 1305,980 | 1311,140 | 1316,320 | 1321,510 | 1326,710 | 1331,920 |
| **70** | 1337,150 | 1342,390 | 1347,640 | 1352,910 | 1358,180 | 1363,470 | 1368,780 | 1374,090 | 1379,420 | 1384,770 |
| **80** | 1390,120 | 1395,490 | 1400,870 | 1406,260 | 1411,600 | 1417,090 | 1422,530 | 1427,970 | 1433,430 | 1438,910 |
| **90** | 1444,390 | 1449,900 | 1455,410 | 1460,940 | 1466,480 | 1472,030 | 1477,600 | 1483,180 | 1488,770 | 1494,380 |
| **100** | 1500,010 | 1505,640 | 1511,290 | 1516,950 | 1522,630 | 1528,320 | 1534,030 | 1539,750 | 1545,480 | 1551,220 |
| **110** | 1556,980 | 1562,760 | 1568,550 | 1574,350 | 1580,170 | 1586,000 | 1591,840 | 1597,700 | 1603,580 | 1609,470 |
| **120** | 1615,370 | 1621,280 | 1627,220 | 1633,160 | 1639,120 | 1645,100 | 1651,080 | 1657,090 | 1663,110 | 1669,140 |
| **130** | 1675,190 | 1681,250 | 1687,330 | 1693,420 | 1699,520 | 1705,650 | 1711,780 | 1717,930 | 1724,100 | 1730,280 |
| **140** | 1736,480 | 1742,690 | 1748,910 | 1755,150 | 1761,410 | 1767,680 | 1773,970 | 1780,270 | 1786,590 | 1792,920 |
| **150** | 1799,270 | 1805,630 | 1812,010 | 1818,410 | 1824,820 | 1831,240 | 1837,680 | 1844,140 | 1850,610 | 1857,100 |
| **160** | 1863,600 | 1870,120 | 1876,650 | 1883,200 | 1889,770 | 1896,350 | 1902,950 | 1909,560 | 1916,190 | 1922,840 |
| **170** | 1929,500 | 1936,180 | 1942,870 | 1949,580 | 1956,310 | 1963,050 | 1969,810 | 1976,580 | 1983,370 | 1990,180 |
| **180** | 1997,000 | 2003,840 | 2010,700 | 2017,570 | 2024,460 | 2031,370 | 2038,290 | 2045,230 | 2052,190 | 2059,160 |
| **190** | 2066,150 | 2073,150 | 2080,170 | 2087,210 | 2094,270 | 2101,340 | 2108,430 | 2115,540 | 2122,660 | 2129,800 |
| **200** | 2139,960 | 2145,645 | 2151,330 | 2158,545 | 2165,760 | 2173,010 | 2180,260 | 2187,550 | 2194,840 | 2202,160 |
| **210** | 2209,480 | 2216,835 | 2224,190 | 2231,580 | 2238,970 | 2246,395 | 2253,820 | 2261,280 | 2268,740 | 2276,235 |
| **220** | 2283,730 | 2291,265 | 2298,800 | 2306,365 | 2313,930 | 2321,535 | 2329,140 | 2336,775 | 2344,410 | 2352,085 |
| **230** | 2359,760 | 2367,380 | 2375,000 | 2382,840 | 2390,680 | 2398,460 | 2406,240 | 2414,060 | 2421,880 | 2429,735 |
| **240** | 2437,590 | 2445,485 | 2453,380 | 2461,310 | 2469,240 | 2477,205 | 2485,170 | 2493,175 | 2501,180 | 2509,225 |
| **250** | 2517,270 | 2525,345 | 2533,420 | 2541,540 | 2549,660 | 2557,810 | 2565,960 | 2574,155 | 2582,350 | 2590,580 |
| **260** | 2598,810 | 2607,080 | 2615,350 | 2623,655 | 2631,960 | 2640,305 | 2648,650 | 2657,030 | 2665,410 | 2673,835 |
| **270** | 2682,260 | 2690,720 | 2699,180 | 2707,680 | 2716,180 | 2724,720 | 2733,260 | 2741,835 | 2750,410 | 2759,030 |
| **280** | 2767,650 | 2776,305 | 2784,960 | 2793,655 | 2802,350 | 2811,085 | 2819,820 | 2828,600 | 2837,380 | 2846,195 |
| **290** | 2855,010 | 2863,865 | 2872,720 | 2881,615 | 2890,510 | 2899,450 | 2908,390 | 2917,365 | 2926,340 | 2935,360 |
| **300** | 2944,380 | 2953,435 | 2962,490 | 2971,590 | 2980,690 | 2989,830 | 2998,970 | 3008,155 | 3017,340 | 3026,560 |
| **310** | 3035,780 | 3045,045 | 3054,310 | 3063,615 | 3072,920 | 3082,270 | 3091,620 | 3101,010 | 3110,400 | 3119,830 |
| **320** | 3129,260 | 3138,735 | 3148,210 | 3157,725 | 3167,240 | 3176,800 | 3186,360 | 3195,960 | 3205,560 | 3215,205 |
| **330** | 3224,850 | 3234,535 | 3244,220 | 3253,950 | 3263,680 | 3273,455 | 3283,230 | 3293,045 | 3302,860 | 3312,720 |
| **340** | 3322,580 | 3332,480 | 3342,380 | 3352,325 | 3362,270 | 3372,260 | 3382,250 | 3392,285 | 3402,320 | 3412,400 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 350 | 3422,480 | 3432,600 | 3442,720 | 3452,885 | 3463,050 | 3473,260 | 3483,470 | 3493,730 | 3503,990 | 3514,285 |
| 360 | 3524,580 | 3534,925 | 3545,270 | 3555,660 | 3566,050 | 3576,485 | 3586,920 | 3597,400 | 3607,880 | 3618,405 |
| 370 | 3628,930 | 3639,505 | 3650,080 | 3660,695 | 3671,310 | 3681,970 | 3692,630 | 3703,340 | 3714,050 | 3724,805 |
| 380 | 3735,560 | 3746,360 | 3757,160 | 3768,005 | 3778,850 | 3789,745 | 3800,640 | 3811,580 | 3822,520 | 3833,505 |
| 390 | 3844,490 | 3855,520 | 3866,550 | 3877,630 | 3888,710 | 3899,840 | 3910,970 | 3922,145 | 3933,320 | 3944,540 |
| 400 | 3955,760 | 3967,030 | 3978,300 | 3989,615 | 4000,930 | 4012,295 | 4023,660 | 4035,075 | 4046,490 | 4057,950 |
| 410 | 4069,410 | 4080,915 | 4092,420 | 4103,980 | 4115,540 | 4127,145 | 4138,750 | 4150,405 | 4162,060 | 4173,760 |
| 420 | 4185,460 | 4197,215 | 4208,970 | 4220,770 | 4232,570 | 4244,420 | 4256,270 | 4268,165 | 4280,060 | 4292,010 |
| 430 | 4303,960 | 4315,955 | 4327,950 | 4340,000 | 4352,050 | 4364,145 | 4376,240 | 4388,390 | 4400,540 | 4412,735 |
| 440 | 4424,930 | 4437,180 | 4449,430 | 4461,725 | 4474,020 | 4486,370 | 4498,720 | 4511,115 | 4523,510 | 4535,960 |
| 450 | 4548,410 | 4560,910 | 4573,410 | 4585,965 | 4598,520 | 4611,120 | 4623,720 | 4636,375 | 4649,030 | 4791,640 |
| 460 | 4674,440 | 4687,195 | 4699,950 | 4712,760 | 4725,570 | 4738,430 | 4751,290 | 4764,200 | 4777,110 | 4790,075 |
| 470 | 4803,040 | 4816,055 | 4829,070 | 4842,135 | 4855,200 | 4868,325 | 4881,450 | 4894,620 | 4907,790 | 4921,020 |
| 480 | 4934,250 | 4947,525 | 4960,800 | 4974,135 | 4987,470 | 5000,855 | 5014,240 | 5027,675 | 5041,110 | 5054,605 |
| 490 | 5068,100 | 5081,645 | 5095,190 | 5108,790 | 5122,390 | 5136,040 | 5149,690 | 5163,395 | 5177,100 | 5190,865 |
| 500 | 5204,630 | 5218,440 | 5232,250 | 5246,120 | 5259,990 | 5273,915 | 5287,840 | 5301,820 | 5315,800 | 5329,830 |
| 510 | 5343,860 | 5357,950 | 5372,040 | 5386,180 | 5400,320 | 5414,520 | 5428,720 | 5442,975 | 5457,230 | 5471,535 |
| 520 | 5485,840 | 5500,205 | 5514,570 | 5528,990 | 5543,410 | 5557,885 | 5572,360 | 5586,895 | 5601,430 | 5616,015 |
| 530 | 5630,600 | 5645,245 | 5659,890 | 5674,590 | 5689,290 | 5704,045 | 5718,800 | 5733,615 | 5748,430 | 5763,300 |
| 540 | 5778,170 | 5793,100 | 5808,030 | 5823,010 | 5837,990 | 5853,035 | 5868,080 | 5883,175 | 5898,270 | 5913,425 |
| 550 | 5928,580 | 5943,795 | 5959,010 | 5974,280 | 5989,550 | 6004,880 | 6020,210 | 6035,595 | 6050,980 | 6066,425 |
| 560 | 6081,870 | 6097,375 | 6112,880 | 6128,440 | 6144,000 | 6159,620 | 6175,240 | 6190,920 | 6206,600 | 6222,340 |
| 570 | 6238,080 | 6253,875 | 6269,670 | 6285,525 | 6301,380 | 6317,295 | 6333,210 | 6349,185 | 6365,160 | 6381,190 |
| 580 | 6397,220 | 6413,315 | 6429,410 | 6445,560 | 6461,710 | 6477,925 | 6494,140 | 6510,410 | 6526,680 | 6543,010 |
| 590 | 6559,340 | 6575,735 | 6592,130 | 6608,585 | 6625,040 | 6641,550 | 6658,060 | 6674,635 | 6691,210 | 6707,845 |
| 600 | 6724,480 | 6741,175 | 6757,870 | 6774,625 | 6791,380 | 6808,200 | 6825,020 | 6841,900 | 6858,780 | 6875,720 |
| 610 | 6892,660 | 6909,660 | 6926,660 | 6943,725 | 6960,790 | 6977,915 | 6995,040 | 7012,230 | 7029,420 | 7046,670 |
| 620 | 7063,920 | 7081,230 | 7098,540 | 7115,915 | 7133,290 | 7150,730 | 7168,170 | 7185,665 | 7203,160 | 7220,725 |
| 630 | 7238,290 | 7255,915 | 7273,540 | 7291,230 | 7308,920 | 7326,670 | 7344,420 | 7362,235 | 7380,050 | 7397,930 |
| 640 | 7415,810 | 7433,750 | 7451,690 | 7469,695 | 7487,700 | 7505,770 | 7523,840 | 7541,975 | 7560,110 | 7578,305 |
| 650 | 7596,500 | 7614,760 | 7633,020 | 7651,350 | 7669,680 | 7688,070 | 7706,460 | 7724,915 | 7743,370 | 7761,890 |
| 660 | 7780,410 | 7798,995 | 7817,580 | 7836,230 | 7854,880 | 7873,595 | 7892,310 | 7911,090 | 7929,870 | 7948,715 |
| 670 | 7967,560 | 7986,475 | 8005,390 | 8024,365 | 8043,340 | 8062,385 | 8081,430 | 8100,535 | 8119,640 | 8138,820 |
| 680 | 8158,000 | 8177,240 | 8196,480 | 8215,785 | 8235,090 | 8254,465 | 8273,840 | 8293,285 | 8312,730 | 8332,235 |
| 690 | 8351,740 | | | | | | | | | |

### *11.1.8 PT100*

*Temperature range -200°C....+850°C*

*All resistance value in Ω*

| °C in steps of 10 ⇩ | °C tended to zero in step of one ⇨ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-200** | 18,493 | 18,926 | 19,358 | 19,790 | 20,221 | 20,653 | 21,083 | 21,514 | 21,944 | 22,374 |
| **-190** | 22,803 | 23,232 | 23,661 | 24,089 | 24,517 | 24,945 | 25,372 | 25,799 | 26,226 | 26,652 |
| **-180** | 27,078 | 27,504 | 27,929 | 28,354 | 28,779 | 29,203 | 29,627 | 30,051 | 30,474 | 30,897 |
| **-170** | 31,320 | 31,742 | 32,165 | 32,587 | 33,008 | 33,429 | 33,850 | 34,271 | 34,691 | 35,111 |
| **-160** | 35,531 | 35,951 | 36,370 | 36,789 | 37,208 | 37,626 | 38,044 | 38,462 | 38,879 | 39,297 |
| **-150** | 39,714 | 40,130 | 40,547 | 40,963 | 41,379 | 41,795 | 42,210 | 42,625 | 43,040 | 43,455 |
| **-140** | 43,869 | 44,283 | 44,697 | 45,111 | 45,524 | 45,937 | 46,350 | 46,763 | 47,175 | 47,587 |
| **-130** | 47,999 | 48,411 | 48,822 | 49,234 | 49,645 | 50,055 | 50,466 | 50,876 | 51,286 | 51,696 |
| **-120** | 52,106 | 52,515 | 52,924 | 53,333 | 53,742 | 54,151 | 54,559 | 54,967 | 55,375 | 55,783 |
| **-110** | 56,190 | 56,598 | 57,005 | 57,412 | 57,818 | 58,225 | 58,631 | 59,037 | 59,443 | 59,849 |
| **-100** | 60,254 | 60,659 | 61,065 | 61,469 | 61,874 | 62,279 | 62,683 | 63,087 | 63,491 | 63,895 |
| **-90** | 64,299 | 64,702 | 65,105 | 65,508 | 65,911 | 66,314 | 66,717 | 67,119 | 67,521 | 67,923 |
| **-80** | 68,325 | 68,727 | 69,128 | 69,530 | 69,931 | 70,332 | 70,733 | 71,134 | 71,534 | 71,934 |
| **-70** | 72,335 | 72,735 | 73,135 | 73,534 | 73,934 | 74,333 | 74,733 | 75,132 | 75,531 | 75,930 |
| **-60** | 76,328 | 76,727 | 77,125 | 77,523 | 77,921 | 78,319 | 78,717 | 79,115 | 79,512 | 79,910 |
| **-50** | 80,307 | 80,704 | 81,101 | 81,498 | 81,894 | 82,291 | 82,687 | 83,083 | 83,479 | 83,875 |
| **-40** | 84,271 | 84,667 | 85,063 | 85,458 | 85,853 | 86,248 | 86,643 | 87,038 | 87,433 | 87,828 |
| **-30** | 88,222 | 88,617 | 89,011 | 89,405 | 89,799 | 90,193 | 90,587 | 90,980 | 91,374 | 91,767 |
| **-20** | 92,160 | 92,553 | 92,946 | 93,339 | 93,732 | 94,125 | 94,517 | 94,910 | 95,302 | 95,694 |
| **-10** | 96,086 | 96,478 | 96,870 | 97,262 | 97,653 | 98,045 | 98,436 | 98,827 | 99,218 | 99,609 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 100,000 | 100,391 | 100,781 | 101,172 | 101,562 | 101,953 | 102,343 | 102,733 | 103,123 | 103,513 |
| **10** | 103,902 | 104,681 | 104,681 | 105,071 | 105,460 | 105,849 | 106,238 | 106,627 | 107,016 | 107,404 |
| **20** | 107,793 | 108,181 | 108,570 | 108,958 | 109,346 | 109,734 | 110,122 | 110,509 | 110,897 | 111,284 |
| **30** | 111,672 | 112,059 | 112,446 | 112,833 | 113,220 | 113,607 | 113,994 | 114,380 | 114,767 | 115,153 |
| **40** | 115,539 | 115,925 | 116,311 | 116,697 | 117,083 | 117,469 | 117,854 | 118,240 | 118,625 | 119,010 |
| **50** | 119,395 | 119,780 | 120,165 | 120,550 | 120,934 | 121,319 | 121,703 | 122,087 | 122,471 | 122,855 |
| **60** | 123,239 | 123,623 | 124,007 | 124,390 | 124,774 | 125,157 | 125,540 | 125,923 | 126,306 | 126,689 |
| **70** | 127,072 | 127,454 | 127,837 | 128,219 | 128,602 | 128,984 | 129,366 | 129,748 | 130,130 | 130,511 |
| **80** | 130,893 | 131,274 | 131,656 | 132,037 | 132,418 | 132,799 | 133,180 | 133,561 | 133,941 | 134,322 |
| **90** | 134,702 | 135,083 | 135,463 | 135,843 | 136,223 | 136,603 | 136,982 | 137,362 | 137,741 | 138,121 |
| **100** | 138,500 | 138,879 | 139,258 | 139,637 | 140,016 | 140,395 | 140,773 | 141,152 | 141,530 | 141,908 |
| **110** | 142,286 | 142,664 | 143,042 | 143,420 | 143,797 | 144,175 | 144,552 | 144,930 | 145,307 | 145,684 |
| **120** | 146,061 | 146,438 | 146,814 | 147,191 | 147,567 | 147,944 | 148,320 | 148,696 | 149,072 | 149,448 |
| **130** | 149,824 | 150,199 | 150,575 | 150,950 | 151,326 | 151,701 | 152,076 | 152,451 | 152,826 | 153,200 |
| **140** | 153,575 | 153,950 | 154,324 | 154,698 | 155,072 | 155,446 | 155,820 | 156,194 | 156,568 | 156,941 |
| **150** | 157,315 | 157,688 | 158,061 | 158,435 | 158,808 | 159,180 | 159,553 | 159,926 | 160,298 | 160,671 |
| **160** | 161,043 | 161,415 | 161,787 | 162,159 | 162,531 | 162,903 | 163,274 | 163,646 | 164,017 | 164,388 |
| **170** | 164,760 | 165,131 | 165,501 | 165,872 | 166,243 | 166,614 | 166,984 | 167,354 | 167,724 | 168,095 |
| **180** | 168,465 | 168,834 | 169,204 | 169,574 | 169,943 | 170,313 | 170,682 | 171,051 | 171,420 | 171,789 |
| **190** | 172,158 | 172,527 | 172,895 | 173,264 | 173,632 | 174,000 | 174,368 | 174,736 | 175,104 | 175,472 |
| **200** | 175,840 | 176,207 | 176,575 | 176,942 | 177,309 | 177,676 | 178,043 | 178,410 | 178,777 | 179,143 |
| **210** | 179,510 | 179,876 | 180,242 | 180,609 | 180,975 | 181,340 | 181,706 | 182,072 | 182,438 | 182,803 |
| **220** | 183,168 | 183,534 | 183,899 | 184,264 | 184,628 | 184,993 | 185,358 | 185,722 | 186,087 | 186,451 |
| **230** | 186,815 | 187,179 | 187,543 | 187,907 | 188,271 | 188,634 | 188,998 | 189,361 | 189,724 | 190,088 |
| **240** | 190,451 | 190,813 | 191,176 | 191,539 | 191,901 | 192,264 | 192,626 | 192,988 | 193,350 | 193,712 |
| **250** | 194,074 | 194,436 | 194,798 | 195,159 | 195,521 | 195,882 | 196,243 | 196,604 | 196,965 | 197,326 |
| **260** | 197,686 | 198,047 | 198,407 | 198,768 | 199,128 | 199,488 | 199,848 | 200,208 | 200,568 | 200,927 |
| **270** | 201,287 | 201,646 | 202,006 | 202,365 | 202,724 | 203,083 | 203,442 | 203,800 | 204,159 | 204,517 |
| **280** | 204,876 | 205,234 | 205,592 | 205,950 | 206,308 | 206,666 | 207,024 | 207,381 | 207,739 | 208,096 |
| **290** | 208,453 | 208,810 | 209,167 | 209,524 | 209,881 | 210,237 | 210,594 | 210,950 | 211,307 | 211,663 |
| **300** | 212,019 | 212,375 | 212,731 | 213,086 | 213,442 | 213,797 | 214,153 | 214,508 | 214,863 | 215,218 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 310 | 215,573 | 215,928 | 216,282 | 216,637 | 216,991 | 217,346 | 217,700 | 218,054 | 218,408 | 218,762 |
| 320 | 219,115 | 219,469 | 219,823 | 220,176 | 220,529 | 220,882 | 221,235 | 221,588 | 221,941 | 222,294 |
| 330 | 222,646 | 222,999 | 223,351 | 223,703 | 224,055 | 224,407 | 224,759 | 225,111 | 225,463 | 225,814 |
| 340 | 226,166 | 226,517 | 226,868 | 227,219 | 227,570 | 227,921 | 228,272 | 228,622 | 228,973 | 229,323 |
| 350 | 229,673 | 230,023 | 230,373 | 230,723 | 231,073 | 231,423 | 231,772 | 232,122 | 232,471 | 232,820 |
| 360 | 233,169 | 233,518 | 233,867 | 234,216 | 234,565 | 234,913 | 235,261 | 235,610 | 235,958 | 236,306 |
| 370 | 236,654 | 237,002 | 237,349 | 237,697 | 238,044 | 238,392 | 238,739 | 239,086 | 239,433 | 239,780 |
| 380 | 240,127 | 240,473 | 240,820 | 241,166 | 241,513 | 241,859 | 242,205 | 242,551 | 242,897 | 243,242 |
| 390 | 243,588 | 243,934 | 244,279 | 244,624 | 244,969 | 245,314 | 245,659 | 246,004 | 246,349 | 246,693 |
| 400 | 247,038 | 247,382 | 247,726 | 248,070 | 248,414 | 248,758 | 249,102 | 249,446 | 249,789 | 250,132 |
| 410 | 250,476 | 250,819 | 251,162 | 251,505 | 251,848 | 252,190 | 252,533 | 252,875 | 253,218 | 253,560 |
| 420 | 253,902 | 254,244 | 254,586 | 254,928 | 255,270 | 255,611 | 255,953 | 256,294 | 256,635 | 256,976 |
| 430 | 257,317 | 257,658 | 257,999 | 258,339 | 258,680 | 259,020 | 259,360 | 259,701 | 260,041 | 260,381 |
| 440 | 260,720 | 261,060 | 261,400 | 261,739 | 262,078 | 262,418 | 262,757 | 263,096 | 263,435 | 263,773 |
| 450 | 264,112 | 264,450 | 264,789 | 265,127 | 265,465 | 265,803 | 266,141 | 266,479 | 266,817 | 267,155 |
| 460 | 267,492 | 267,829 | 268,167 | 268,504 | 268,841 | 269,178 | 269,514 | 269,851 | 270,188 | 270,524 |
| 470 | 270,860 | 271,197 | 271,533 | 271,869 | 272,205 | 272,540 | 272,876 | 273,211 | 273,547 | 273,882 |
| 480 | 274,217 | 274,552 | 274,887 | 275,222 | 275,557 | 275,891 | 276,226 | 276,560 | 276,894 | 277,228 |
| 490 | 277,562 | 277,896 | 278,230 | 278,564 | 278,897 | 279,231 | 279,564 | 279,897 | 280,230 | 280,563 |
| 500 | 280,896 | 281,229 | 281,561 | 281,894 | 282,226 | 282,559 | 282,891 | 283,223 | 283,555 | 283,886 |
| 510 | 284,218 | 284,550 | 284,881 | 285,212 | 285,544 | 285,875 | 286,206 | 286,537 | 286,867 | 287,198 |
| 520 | 287,529 | 287,859 | 288,189 | 288,519 | 288,849 | 289,179 | 289,509 | 289,839 | 290,169 | 290,498 |
| 530 | 290,827 | 291,157 | 291,486 | 291,815 | 292,144 | 292,472 | 292,801 | 293,130 | 293,458 | 293,786 |
| 540 | 294,115 | 294,443 | 294,771 | 295,098 | 295,426 | 295,754 | 296,081 | 296,409 | 296,736 | 297,063 |
| 550 | 297,390 | 297,717 | 298,044 | 298,371 | 298,697 | 299,024 | 299,350 | 299,676 | 300,002 | 300,328 |
| 560 | 300,654 | 300,980 | 301,306 | 301,631 | 301,957 | 302,282 | 302,607 | 302,932 | 303,257 | 303,582 |
| 570 | 303,907 | 304,231 | 304,556 | 304,880 | 305,204 | 305,528 | 305,852 | 306,176 | 306,500 | 306,824 |
| 580 | 307,147 | 307,471 | 307,794 | 308,117 | 308,440 | 308,763 | 309,086 | 309,409 | 309,732 | 310,054 |
| 590 | 310,377 | 310,699 | 311,021 | 311,343 | 311,665 | 311,987 | 312,309 | 312,630 | 312,952 | 313,273 |
| 600 | 313,594 | 313,915 | 314,236 | 314,557 | 314,878 | 315,199 | 315,519 | 315,840 | 316,160 | 316,480 |
| 610 | 316,800 | 317,120 | 317,440 | 317,760 | 318,079 | 318,399 | 318,718 | 319,037 | 319,357 | 319,676 |
| 620 | 319,995 | 320,313 | 320,632 | 320,951 | 321,269 | 321,587 | 321,906 | 322,224 | 322,542 | 322,860 |
| 630 | 323,177 | 323,495 | 323,812 | 324,130 | 324,447 | 324,764 | 325,081 | 325,398 | 325,715 | 326,032 |
| 640 | 326,348 | 326,665 | 326,981 | 327,298 | 327,614 | 327,930 | 328,246 | 328,561 | 328,877 | 329,193 |
| 650 | 329,508 | 329,823 | 330,139 | 330,454 | 330,769 | 331,083 | 331,398 | 331,713 | 332,027 | 332,342 |
| 660 | 332,656 | 332,970 | 333,284 | 333,598 | 333,912 | 334,226 | 334,539 | 334,853 | 335,166 | 335,479 |
| 670 | 335,792 | 336,105 | 336,418 | 336,731 | 337,044 | 337,356 | 337,669 | 337,981 | 338,293 | 338,605 |
| 680 | 338,917 | 339,229 | 339,541 | 339,852 | 340,164 | 340,475 | 340,786 | 341,098 | 341,409 | 341,720 |
| 690 | 342,030 | 342,341 | 342,652 | 342,962 | 343,272 | 343,583 | 343,893 | 344,203 | 344,512 | 344,822 |
| 700 | 345,132 | 345,441 | 345,751 | 346,060 | 346,369 | 346,678 | 346,987 | 347,296 | 347,605 | 347,913 |
| 710 | 348,222 | 348,530 | 348,838 | 349,147 | 349,455 | 349,762 | 350,070 | 350,378 | 350,685 | 350,993 |
| 720 | 351,300 | 351,607 | 351,914 | 352,221 | 352,528 | 352,835 | 353,142 | 353,448 | 353,754 | 354,061 |
| 730 | 354,367 | 354,673 | 354,979 | 355,285 | 355,590 | 355,896 | 356,201 | 356,507 | 356,812 | 357,117 |
| 740 | 357,422 | 357,727 | 358,032 | 358,336 | 358,641 | 358,945 | 359,250 | 359,554 | 359,858 | 360,162 |
| 750 | 360,466 | 360,769 | 361,073 | 361,376 | 361,680 | 361,983 | 362,286 | 362,589 | 362,892 | 363,195 |
| 760 | 363,497 | 363,800 | 364,102 | 364,405 | 364,707 | 365,009 | 365,311 | 365,613 | 365,915 | 366,216 |
| 770 | 366,518 | 366,819 | 367,120 | 367,422 | 367,723 | 368,024 | 368,324 | 368,625 | 368,926 | 369,226 |
| 780 | 369,526 | 369,827 | 370,127 | 370,427 | 370,727 | 371,027 | 371,326 | 371,626 | 371,925 | 372,224 |
| 790 | 372,524 | 372,823 | 373,122 | 373,420 | 373,719 | 374,018 | 374,316 | 374,615 | 374,913 | 375,211 |
| 800 | 375,509 | 375,807 | 376,105 | 376,403 | 376,700 | 376,998 | 377,295 | 377,592 | 377,889 | 378,186 |
| 810 | 378,483 | 378,780 | 379,076 | 379,373 | 379,669 | 379,966 | 380,262 | 380,558 | 380,854 | 381,150 |
| 820 | 381,445 | 381,741 | 382,036 | 382,332 | 382,627 | 382,922 | 383,217 | 383,512 | 383,512 | 384,101 |
| 830 | 384,396 | 384,690 | 384,985 | 385,279 | 385,573 | 385,867 | 386,161 | 386,455 | 386,455 | 387,042 |
| 840 | 387,335 | 387,628 | 387,922 | 388,215 | 388,508 | 388,800 | 389,093 | 389,386 | 389,386 | 389,970 |
| 850 | 390,263 | | | | | | | | | |

### *11.1.9 PT500*

*Temperature range -200°C....+850°C*

*All resistance value in Ω*

| °C in steps of 10 | °C tended to zero in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-200** | 92,600 | 94,761 | 96,920 | 99,077 | 101,230 | 103,390 | 105,540 | 107,690 | 109,840 | 111,980 |
| **-190** | 114,130 | 116,270 | 118,410 | 120,550 | 122,690 | 124,830 | 126,960 | 129,090 | 131,220 | 133,350 |
| **-180** | 135,480 | 137,610 | 139,730 | 141,860 | 143,980 | 146,100 | 148,220 | 150,330 | 152,450 | 154,560 |
| **-170** | 156,680 | 158,790 | 160,900 | 163,000 | 165,110 | 167,210 | 169,320 | 171,420 | 173,520 | 175,620 |
| **-160** | 177,720 | 179,810 | 181,910 | 184,000 | 186,090 | 188,180 | 190,270 | 192,360 | 194,450 | 196,530 |
| **-150** | 198,620 | 200,700 | 202,780 | 204,860 | 206,940 | 209,020 | 211,090 | 213,170 | 215,240 | 217,310 |
| **-140** | 219,380 | 221,450 | 223,520 | 225,590 | 227,650 | 229,720 | 231,780 | 233,840 | 235,910 | 237,970 |
| **-130** | 240,020 | 242,080 | 244,140 | 246,190 | 248,250 | 250,300 | 252,350 | 254,400 | 256,450 | 258,500 |
| **-120** | 260,550 | 262,600 | 264,640 | 266,690 | 268,730 | 270,770 | 272,810 | 274,850 | 276,890 | 278,930 |
| **-110** | 280,970 | 283,000 | 285,040 | 287,070 | 289,100 | 291,130 | 293,170 | 295,200 | 297,220 | 299,250 |
| **-100** | 301,280 | 303,310 | 305,330 | 307,360 | 309,380 | 311,400 | 313,420 | 315,440 | 317,460 | 319,480 |
| **-90** | 321,500 | 323,520 | 325,530 | 327,550 | 329,560 | 331,570 | 333,590 | 335,600 | 337,610 | 339,620 |
| **-80** | 341,630 | 343,640 | 345,640 | 347,650 | 349,660 | 351,660 | 353,660 | 355,670 | 357,670 | 359,670 |
| **-70** | 361,670 | 363,670 | 365,670 | 367,670 | 369,670 | 371,670 | 373,660 | 375,660 | 377,650 | 379,650 |
| **-60** | 381,640 | 383,630 | 385,620 | 387,610 | 389,610 | 391,590 | 393,580 | 395,570 | 397,560 | 399,550 |
| **-50** | 401,530 | 403,520 | 405,500 | 407,490 | 409,470 | 411,450 | 413,430 | 415,410 | 417,390 | 419,370 |
| **-40** | 421,350 | 423,330 | 425,310 | 427,290 | 429,260 | 431,240 | 433,210 | 435,190 | 437,160 | 439,140 |
| **-30** | 441,110 | 443,080 | 445,050 | 447,020 | 448,990 | 450,960 | 452,930 | 454,900 | 456,870 | 458,830 |
| **-20** | 460,800 | 462,770 | 464,730 | 466,700 | 468,660 | 470,620 | 472,590 | 474,550 | 476,510 | 478,470 |
| **-10** | 480,430 | 482,390 | 484,350 | 486,310 | 488,270 | 490,220 | 492,180 | 494,140 | 496,090 | 498,050 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 500,000 | 501,950 | 503,910 | 505,860 | 507,810 | 509,760 | 511,720 | 513,670 | 515,620 | 517,560 |
| **10** | 519,510 | 521,460 | 523,410 | 525,360 | 527,300 | 529,250 | 531,190 | 533,140 | 535,080 | 537,030 |
| **20** | 538,970 | 540,910 | 542,850 | 544,790 | 546,730 | 548,670 | 550,610 | 552,550 | 554,490 | 556,430 |
| **30** | 558,370 | 560,300 | 562,240 | 564,170 | 566,110 | 568,040 | 569,980 | 571,910 | 573,840 | 575,770 |
| **40** | 577,700 | 579,640 | 581,570 | 583,500 | 585,420 | 587,350 | 589,280 | 591,210 | 593,130 | 595,060 |
| **50** | 596,990 | 598,910 | 600,840 | 602,760 | 604,680 | 606,610 | 608,530 | 610,450 | 612,370 | 614,290 |
| **60** | 616,210 | 618,130 | 620,050 | 621,970 | 623,880 | 625,800 | 627,720 | 629,630 | 631,550 | 633,460 |
| **70** | 635,380 | 637,290 | 639,200 | 641,110 | 643,030 | 644,940 | 646,850 | 648,760 | 650,670 | 652,580 |
| **80** | 654,480 | 656,390 | 658,300 | 660,210 | 662,110 | 664,020 | 665,920 | 667,830 | 669,730 | 671,000 |
| **90** | 673,540 | 675,440 | 677,340 | 679,240 | 681,140 | 683,040 | 684,940 | 686,840 | 688,730 | 690,630 |
| **100** | 692,530 | 694,420 | 696,320 | 698,210 | 700,110 | 702,000 | 703,900 | 705,790 | 707,680 | 709,570 |
| **110** | 711,460 | 713,350 | 715,240 | 717,130 | 719,020 | 720,910 | 722,800 | 724,680 | 726,570 | 728,460 |
| **120** | 730,340 | 732,230 | 734,110 | 735,990 | 737,880 | 739,760 | 741,640 | 743,520 | 745,400 | 747,280 |
| **130** | 749,160 | 751,040 | 752,920 | 754,790 | 756,670 | 758,550 | 760,420 | 762,300 | 764,170 | 766,050 |
| **140** | 767,920 | 769,800 | 771,670 | 773,540 | 775,410 | 777,280 | 779,150 | 781,020 | 782,890 | 784,760 |
| **150** | 786,630 | 788,490 | 790,360 | 792,230 | 794,090 | 795,960 | 797,820 | 799,680 | 801,550 | 803,410 |
| **160** | 805,270 | 807,130 | 808,990 | 810,860 | 812,710 | 814,570 | 816,430 | 818,290 | 820,150 | 822,000 |
| **170** | 823,860 | 825,720 | 827,570 | 829,430 | 831,280 | 833,130 | 834,990 | 836,840 | 838,690 | 840,540 |
| **180** | 842,390 | 844,240 | 846,090 | 847,940 | 849,790 | 851,640 | 853,480 | 855,330 | 857,180 | 859,020 |
| **190** | 860,870 | 862,710 | 864,550 | 866,400 | 868,240 | 870,080 | 871,920 | 873,760 | 875,600 | 877,440 |
| **200** | 879,280 | 881,120 | 882,960 | 884,790 | 886,630 | 888,470 | 890,300 | 892,140 | 893,970 | 895,800 |
| **210** | 897,640 | 899,470 | 901,300 | 903,130 | 904,970 | 906,800 | 908,620 | 910,450 | 912,280 | 914,110 |
| **220** | 915,940 | 917,760 | 919,590 | 921,420 | 923,240 | 925,070 | 926,890 | 928,710 | 930,540 | 932,360 |
| **230** | 934,180 | 936,000 | 937,820 | 939,640 | 941,460 | 943,280 | 945,100 | 946,920 | 948,730 | 950,550 |
| **240** | 952,360 | 954,180 | 955,990 | 957,810 | 959,620 | 961,440 | 963,250 | 965,060 | 966,870 | 968,680 |
| **250** | 970,490 | 972,300 | 974,110 | 975,920 | 977,730 | 979,530 | 981,340 | 983,150 | 984,950 | 986,760 |
| **260** | 988,560 | 990,360 | 992,170 | 993,970 | 995,770 | 997,570 | 999,370 | 1001,200 | 1003,000 | 1004,800 |
| **270** | 1006,600 | 1008,400 | 1010,200 | 1012,000 | 1013,800 | 1015,600 | 1017,400 | 1019,100 | 1020,900 | 1022,700 |
| **280** | 1024,500 | 1026,300 | 1028,100 | 1029,900 | 1031,700 | 1033,500 | 1035,300 | 1037,100 | 1038,800 | 1040,600 |
| **290** | 1042,400 | 1044,200 | 1046,000 | 1047,800 | 1049,600 | 1051,300 | 1053,100 | 1054,900 | 1056,700 | 1058,500 |
| **300** | 1060,300 | 1062,000 | 1063,800 | 1065,600 | 1067,400 | 1069,200 | 1070,900 | 1072,700 | 1074,500 | 1076,300 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 310 | 1078,000 | 1079,800 | 1081,600 | 1083,400 | 1085,100 | 1086,900 | 1088,700 | 1090,400 | 1092,200 | 1094,000 |
| 320 | 1095,800 | 1097,500 | 1099,300 | 1101,100 | 1102,800 | 1104,600 | 1106,400 | 1108,100 | 1109,900 | 1111,700 |
| 330 | 1113,400 | 1115,200 | 1117,000 | 1118,700 | 1120,500 | 1122,200 | 1124,000 | 1125,800 | 1127,500 | 1129,300 |
| 340 | 1131,000 | 1132,800 | 1134,500 | 1136,300 | 1138,100 | 1139,800 | 1141,600 | 1143,300 | 1145,100 | 1146,800 |
| 350 | 1148,600 | 1150,300 | 1152,100 | 1153,800 | 1155,600 | 1157,300 | 1159,100 | 1160,800 | 1162,600 | 1164,300 |
| 360 | 1166,100 | 1167,800 | 1169,600 | 1171,300 | 1173,100 | 1174,800 | 1176,500 | 1178,300 | 1180,000 | 1181,800 |
| 370 | 1183,500 | 1185,200 | 1187,000 | 1188,700 | 1190,500 | 1192,200 | 1193,900 | 1195,700 | 1197,400 | 1199,100 |
| 380 | 1200,900 | 1202,600 | 1204,400 | 1206,100 | 1207,800 | 1209,500 | 1211,300 | 1213,000 | 1214,700 | 1216,500 |
| 390 | 1218,200 | 1219,900 | 1221,700 | 1223,400 | 1225,100 | 1226,800 | 1228,600 | 1230,300 | 1232,000 | 1233,700 |
| 400 | 1235,500 | 1237,200 | 1238,900 | 1240,600 | 1242,300 | 1244,100 | 1245,800 | 1247,500 | 1249,200 | 1250,900 |
| 410 | 1252,700 | 1254,400 | 1256,100 | 1257,800 | 1259,500 | 1261,200 | 1263,000 | 1264,700 | 1266,400 | 1268,100 |
| 420 | 1269,800 | 1271,500 | 1273,200 | 1274,900 | 1276,600 | 1278,400 | 1280,100 | 1281,800 | 1283,500 | 1285,200 |
| 430 | 1286,900 | 1288,600 | 1290,300 | 1292,000 | 1293,700 | 1295,400 | 1297,100 | 1298,800 | 1300,500 | 1302,200 |
| 440 | 1303,900 | 1305,600 | 1307,300 | 1309,000 | 1310,700 | 1312,400 | 1314,100 | 1315,800 | 1317,500 | 1319,200 |
| 450 | 1320,900 | 1322,600 | 1324,300 | 1326,000 | 1327,700 | 1329,400 | 1331,100 | 1332,700 | 1334,400 | 1336,100 |
| 460 | 1337,800 | 1339,500 | 1341,200 | 1342,900 | 1344,600 | 1346,200 | 1347,900 | 1349,600 | 1351,300 | 1353,000 |
| 470 | 1354,700 | 1356,300 | 1358,000 | 1359,700 | 1361,400 | 1363,100 | 1364,800 | 1366,400 | 1368,100 | 1369,800 |
| 480 | 1371,500 | 1373,100 | 1374,800 | 1376,500 | 1378,200 | 1379,800 | 1381,500 | 1383,200 | 1384,900 | 1386,500 |
| 490 | 1388,200 | 1389,900 | 1391,500 | 1393,200 | 1394,900 | 1396,600 | 1398,200 | 1399,900 | 1401,600 | 1403,200 |
| 500 | 1404,900 | 1406,600 | 1408,200 | 1409,900 | 1411,500 | 1413,200 | 1414,900 | 1416,500 | 1418,200 | 1419,900 |
| 510 | 1421,500 | 1423,200 | 1424,800 | 1426,500 | 1428,100 | 1429,800 | 1431,500 | 1433,100 | 1434,800 | 1436,400 |
| 520 | 1438,100 | 1439,700 | 1441,400 | 1443,000 | 1444,700 | 1446,300 | 1448,000 | 1449,600 | 1451,300 | 1452,900 |
| 530 | 1454,600 | 1456,200 | 1457,900 | 1459,500 | 1461,200 | 1462,800 | 1464,500 | 1466,100 | 1467,800 | 1469,400 |
| 540 | 1471,000 | 1472,700 | 1474,300 | 1476,000 | 1477,600 | 1479,200 | 1480,900 | 1482,500 | 1484,200 | 1485,800 |
| 550 | 1487,400 | 1489,100 | 1490,700 | 1492,300 | 1494,000 | 1495,600 | 1497,200 | 1498,900 | 1500,500 | 1502,100 |
| 560 | 1503,800 | 1505,400 | 1507,000 | 1508,700 | 1510,300 | 1511,900 | 1513,500 | 1515,200 | 1516,800 | 1518,400 |
| 570 | 1520,100 | 1521,700 | 1523,300 | 1524,900 | 1526,500 | 1528,200 | 1529,800 | 1531,400 | 1533,000 | 1534,700 |
| 580 | 1536,300 | 1537,900 | 1539,500 | 1541,100 | 1542,700 | 1544,400 | 1546,000 | 1547,600 | 1549,200 | 1550,800 |
| 590 | 1552,400 | 1554,000 | 1555,700 | 1557,310 | 1558,900 | 1560,500 | 1562,100 | 1563,700 | 1565,300 | 1566,900 |
| 600 | 1568,500 | 1570,100 | 1571,800 | 1573,400 | 1575,000 | 1576,600 | 1578,200 | 1579,800 | 1581,400 | 1583,000 |
| 610 | 1584,600 | 1586,200 | 1587,800 | 1589,400 | 1591,000 | 1592,600 | 1594,200 | 1595,800 | 1597,400 | 1599,000 |
| 620 | 1600,600 | 1602,200 | 1603,800 | 1605,400 | 1607,000 | 1608,600 | 1610,100 | 1611,700 | 1613,300 | 1614,900 |
| 630 | 1616,500 | 1618,100 | 1619,700 | 1621,300 | 1622,900 | 1624,500 | 1626,000 | 1627,600 | 1629,200 | 1630,800 |
| 640 | 1632,400 | 1634,000 | 1635,600 | 1637,100 | 1638,700 | 1640,300 | 1641,900 | 1643,500 | 1645,000 | 1646,600 |
| 650 | 1648,200 | 1649,800 | 1651,400 | 1652,900 | 1654,500 | 1656,100 | 1657,700 | 1659,200 | 1660,800 | 1662,400 |
| 660 | 1664,000 | 1665,500 | 1667,100 | 1668,700 | 1670,200 | 1671,800 | 1673,400 | 1675,000 | 1676,500 | 1678,100 |
| 670 | 1679,700 | 1681,200 | 1682,800 | 1684,400 | 1685,900 | 1687,500 | 1689,100 | 1690,600 | 1692,200 | 1693,700 |
| 680 | 1695,300 | 1696,900 | 1698,400 | 1700,000 | 1701,500 | 1703,100 | 1704,700 | 1706,200 | 1707,800 | 1709,300 |
| 690 | 1710,900 | 1712,400 | 1714,000 | 1715,600 | 1717,100 | 1718,700 | 1720,200 | 1721,800 | 1723,300 | 1724,900 |
| 700 | 1726,400 | 1728,000 | 1729,500 | 1731,100 | 1732,600 | 1734,200 | 1735,700 | 1737,300 | 1738,800 | 1740,300 |
| 710 | 1741,900 | 1743,400 | 1745,000 | 1746,500 | 1748,100 | 1749,600 | 1751,100 | 1752,700 | 1754,200 | 1755,800 |
| 720 | 1757,300 | 1758,800 | 1760,400 | 1761,900 | 1763,400 | 1765,000 | 1766,500 | 1768,100 | 1769,600 | 1771,100 |
| 730 | 1772,700 | 1774,200 | 1775,700 | 1777,300 | 1778,800 | 1780,300 | 1781,800 | 1783,400 | 1784,900 | 1786,400 |
| 740 | 1788,000 | 1789,500 | 1791,000 | 1792,500 | 1794,100 | 1795,600 | 1797,100 | 1798,600 | 1800,100 | 1801,700 |
| 750 | 1803,200 | 1804,700 | 1806,200 | 1807,800 | 1809,300 | 1810,800 | 1812,300 | 1813,800 | 1815,300 | 1816,900 |
| 760 | 1818,400 | 1819,900 | 1821,400 | 1822,900 | 1824,400 | 1825,900 | 1827,500 | 1829,000 | 1830,500 | 1832,000 |
| 770 | 1833,500 | 1835,000 | 1836,500 | 1838,000 | 1839,500 | 1841,000 | 1842,500 | 1844,000 | 1845,600 | 1847,100 |
| 780 | 1848,600 | 1850,100 | 1851,600 | 1853,100 | 1854,600 | 1856,100 | 1857,600 | 1859,100 | 1860,600 | 1862,100 |
| 790 | 1863,600 | 1865,100 | 1866,600 | 1868,100 | 1869,600 | 1871,100 | 1872,500 | 1874,000 | 1875,500 | 1877,000 |
| 800 | 1878,500 | 1880,000 | 1881,500 | 1883,000 | 1884,500 | 1886,000 | 1887,500 | 1889,000 | 1890,400 | 1891,900 |
| 810 | 1893,400 | 1894,900 | 1896,400 | 1897,900 | 1899,400 | 1900,800 | 1902,300 | 1903,800 | 1905,300 | 1906,800 |
| 820 | 1908,200 | 1909,700 | 1911,200 | 1912,700 | 1914,200 | 1915,600 | 1917,100 | 1918,600 | 1920,100 | 1921,600 |
| 830 | 1923,000 | 1924,500 | 1926,000 | 1927,400 | 1928,900 | 1930,400 | 1931,900 | 1933,300 | 1934,800 | 1936,300 |
| 840 | 1937,700 | 1939,200 | 1940,700 | 1942,100 | 1943,600 | 1945,100 | 1946,500 | 1948,000 | 1949,500 | 1950,900 |

| °C in 10-er Schritten | °C in 1-er Schritten aufsteigend | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 310 | 1078,000 | 1079,800 | 1081,600 | 1083,400 | 1085,100 | 1086,900 | 1088,700 | 1090,400 | 1092,200 | 1094,000 |
| 320 | 1095,800 | 1097,500 | 1099,300 | 1101,100 | 1102,800 | 1104,600 | 1106,400 | 1108,100 | 1109,900 | 1111,700 |
| 330 | 1113,400 | 1115,200 | 1117,000 | 1118,700 | 1120,500 | 1122,200 | 1124,000 | 1125,800 | 1127,500 | 1129,300 |
| 340 | 1131,000 | 1132,800 | 1134,500 | 1136,300 | 1138,100 | 1139,800 | 1141,600 | 1143,300 | 1145,100 | 1146,800 |
| 350 | 1148,600 | 1150,300 | 1152,100 | 1153,800 | 1155,600 | 1157,300 | 1159,100 | 1160,800 | 1162,600 | 1164,300 |
| 360 | 1166,100 | 1167,800 | 1169,600 | 1171,300 | 1173,100 | 1174,800 | 1176,500 | 1178,300 | 1180,000 | 1181,800 |
| 370 | 1183,500 | 1185,200 | 1187,000 | 1188,700 | 1190,500 | 1192,200 | 1193,900 | 1195,700 | 1197,400 | 1199,100 |
| 380 | 1200,900 | 1202,600 | 1204,400 | 1206,100 | 1207,800 | 1209,500 | 1211,300 | 1213,000 | 1214,700 | 1216,500 |
| 390 | 1218,200 | 1219,900 | 1221,700 | 1223,400 | 1225,100 | 1226,800 | 1228,600 | 1230,300 | 1232,000 | 1233,700 |
| 400 | 1235,500 | 1237,200 | 1238,900 | 1240,600 | 1242,300 | 1244,100 | 1245,800 | 1247,500 | 1249,200 | 1250,900 |
| 410 | 1252,700 | 1254,400 | 1256,100 | 1257,800 | 1259,500 | 1261,200 | 1263,000 | 1264,700 | 1266,400 | 1268,100 |
| 420 | 1269,800 | 1271,500 | 1273,200 | 1274,900 | 1276,600 | 1278,400 | 1280,100 | 1281,800 | 1283,500 | 1285,200 |
| 430 | 1286,900 | 1288,600 | 1290,300 | 1292,000 | 1293,700 | 1295,400 | 1297,100 | 1298,800 | 1300,500 | 1302,200 |
| 440 | 1303,900 | 1305,600 | 1307,300 | 1309,000 | 1310,700 | 1312,400 | 1314,100 | 1315,800 | 1317,500 | 1319,200 |
| 450 | 1320,900 | 1322,600 | 1324,300 | 1326,000 | 1327,700 | 1329,400 | 1331,100 | 1332,700 | 1334,400 | 1336,100 |
| 460 | 1337,800 | 1339,500 | 1341,200 | 1342,900 | 1344,600 | 1346,200 | 1347,900 | 1349,600 | 1351,300 | 1353,000 |
| 470 | 1354,700 | 1356,300 | 1358,000 | 1359,700 | 1361,400 | 1363,100 | 1364,800 | 1366,400 | 1368,100 | 1369,800 |
| 480 | 1371,500 | 1373,100 | 1374,800 | 1376,500 | 1378,200 | 1379,800 | 1381,500 | 1383,200 | 1384,900 | 1386,500 |
| 490 | 1388,200 | 1389,900 | 1391,500 | 1393,200 | 1394,900 | 1396,600 | 1398,200 | 1399,900 | 1401,600 | 1403,200 |
| 500 | 1404,900 | 1406,600 | 1408,200 | 1409,900 | 1411,500 | 1413,200 | 1414,900 | 1416,500 | 1418,200 | 1419,900 |
| 510 | 1421,500 | 1423,200 | 1424,800 | 1426,500 | 1428,100 | 1429,800 | 1431,500 | 1433,100 | 1434,800 | 1436,400 |
| 520 | 1438,100 | 1439,700 | 1441,400 | 1443,000 | 1444,700 | 1446,300 | 1448,000 | 1449,600 | 1451,300 | 1452,900 |
| 530 | 1454,600 | 1456,200 | 1457,900 | 1459,500 | 1461,200 | 1462,800 | 1464,500 | 1466,100 | 1467,800 | 1469,400 |
| 540 | 1471,000 | 1472,700 | 1474,300 | 1476,000 | 1477,600 | 1479,200 | 1480,900 | 1482,500 | 1484,200 | 1485,800 |
| 550 | 1487,400 | 1489,100 | 1490,700 | 1492,300 | 1494,000 | 1495,600 | 1497,200 | 1498,900 | 1500,500 | 1502,100 |
| 560 | 1503,800 | 1505,400 | 1507,000 | 1508,700 | 1510,300 | 1511,900 | 1513,500 | 1515,200 | 1516,800 | 1518,400 |
| 570 | 1520,100 | 1521,700 | 1523,300 | 1524,900 | 1526,500 | 1528,200 | 1529,800 | 1531,400 | 1533,000 | 1534,700 |
| 580 | 1536,300 | 1537,900 | 1539,500 | 1541,100 | 1542,700 | 1544,400 | 1546,000 | 1547,600 | 1549,200 | 1550,800 |
| 590 | 1552,400 | 1554,000 | 1555,700 | 1557,310 | 1558,900 | 1560,500 | 1562,100 | 1563,700 | 1565,300 | 1566,900 |
| 600 | 1568,500 | 1570,100 | 1571,800 | 1573,400 | 1575,000 | 1576,600 | 1578,200 | 1579,800 | 1581,400 | 1583,000 |
| 610 | 1584,600 | 1586,200 | 1587,800 | 1589,400 | 1591,000 | 1592,600 | 1594,200 | 1595,800 | 1597,400 | 1599,000 |
| 620 | 1600,600 | 1602,200 | 1603,800 | 1605,400 | 1607,000 | 1608,600 | 1610,100 | 1611,700 | 1613,300 | 1614,900 |
| 630 | 1616,500 | 1618,100 | 1619,700 | 1621,300 | 1622,900 | 1624,500 | 1626,000 | 1627,600 | 1629,200 | 1630,800 |
| 640 | 1632,400 | 1634,000 | 1635,600 | 1637,100 | 1638,700 | 1640,300 | 1641,900 | 1643,500 | 1645,000 | 1646,600 |
| 650 | 1648,200 | 1649,800 | 1651,400 | 1652,900 | 1654,500 | 1656,100 | 1657,700 | 1659,200 | 1660,800 | 1662,400 |
| 660 | 1664,000 | 1665,500 | 1667,100 | 1668,700 | 1670,200 | 1671,800 | 1673,400 | 1675,000 | 1676,500 | 1678,100 |
| 670 | 1679,700 | 1681,200 | 1682,800 | 1684,400 | 1685,900 | 1687,500 | 1689,100 | 1690,600 | 1692,200 | 1693,700 |
| 680 | 1695,300 | 1696,900 | 1698,400 | 1700,000 | 1701,500 | 1703,100 | 1704,700 | 1706,200 | 1707,800 | 1709,300 |
| 690 | 1710,900 | 1712,400 | 1714,000 | 1715,600 | 1717,100 | 1718,700 | 1720,200 | 1721,800 | 1723,300 | 1724,900 |
| 700 | 1726,400 | 1728,000 | 1729,500 | 1731,100 | 1732,600 | 1734,200 | 1735,700 | 1737,300 | 1738,800 | 1740,300 |
| 710 | 1741,900 | 1743,400 | 1745,000 | 1746,500 | 1748,100 | 1749,600 | 1751,100 | 1752,700 | 1754,200 | 1755,800 |
| 720 | 1757,300 | 1758,800 | 1760,400 | 1761,900 | 1763,400 | 1765,000 | 1766,500 | 1768,100 | 1769,600 | 1771,100 |
| 730 | 1772,700 | 1774,200 | 1775,700 | 1777,300 | 1778,800 | 1780,300 | 1781,800 | 1783,400 | 1784,900 | 1786,400 |
| 740 | 1788,000 | 1789,500 | 1791,000 | 1792,500 | 1794,100 | 1795,600 | 1797,100 | 1798,600 | 1800,100 | 1801,700 |
| 750 | 1803,200 | 1804,700 | 1806,200 | 1807,800 | 1809,300 | 1810,800 | 1812,300 | 1813,800 | 1815,300 | 1816,900 |
| 760 | 1818,400 | 1819,900 | 1821,400 | 1822,900 | 1824,400 | 1825,900 | 1827,500 | 1829,000 | 1830,500 | 1832,000 |
| 770 | 1833,500 | 1835,000 | 1836,500 | 1838,000 | 1839,500 | 1841,000 | 1842,500 | 1844,000 | 1845,600 | 1847,100 |
| 780 | 1848,600 | 1850,100 | 1851,600 | 1853,100 | 1854,600 | 1856,100 | 1857,600 | 1859,100 | 1860,600 | 1862,100 |
| 790 | 1863,600 | 1865,100 | 1866,600 | 1868,100 | 1869,600 | 1871,100 | 1872,500 | 1874,000 | 1875,500 | 1877,000 |
| 800 | 1878,500 | 1880,000 | 1881,500 | 1883,000 | 1884,500 | 1886,000 | 1887,500 | 1889,000 | 1890,400 | 1891,900 |
| 810 | 1893,400 | 1894,900 | 1896,400 | 1897,900 | 1899,400 | 1900,800 | 1902,300 | 1903,800 | 1905,300 | 1906,800 |
| 820 | 1908,200 | 1909,700 | 1911,200 | 1912,700 | 1914,200 | 1915,600 | 1917,100 | 1918,600 | 1920,100 | 1921,600 |
| 830 | 1923,000 | 1924,500 | 1926,000 | 1927,400 | 1928,900 | 1930,400 | 1931,900 | 1933,300 | 1934,800 | 1936,300 |
| 840 | 1937,700 | 1939,200 | 1940,700 | 1942,100 | 1943,600 | 1945,100 | 1946,500 | 1948,000 | 1949,500 | 1950,900 |

### *11.1.10 PT1000*

*Temperature range -200°C....+850°C*

*All resistance value in Ω*

| °C in steps of 10 | °C tended to zero in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-200** | 185,201 | 189,522 | 193,840 | 198,154 | 202,465 | 206,772 | 211,076 | 215,376 | 219,672 | 223,965 |
| **-190** | 228,255 | 232,541 | 236,824 | 241,103 | 245,379 | 249,651 | 253,920 | 258,186 | 262,449 | 266,708 |
| **-180** | 270,964 | 275,217 | 279,467 | 283,713 | 287,956 | 292,197 | 296,434 | 300,667 | 304,898 | 309,126 |
| **-170** | 313,350 | 317,572 | 321,791 | 326,006 | 330,219 | 334,429 | 338,635 | 342,839 | 347,040 | 351,238 |
| **-160** | 355,433 | 359,626 | 363,815 | 368,002 | 372,186 | 376,367 | 380,545 | 384,721 | 388,894 | 393,064 |
| **-150** | 397,232 | 401,397 | 405,559 | 409,719 | 413,876 | 418,030 | 422,182 | 426,331 | 430,478 | 434,622 |
| **-140** | 438,764 | 442,904 | 447,040 | 451,175 | 455,307 | 459,436 | 463,563 | 467,688 | 471,810 | 475,930 |
| **-130** | 480,048 | 484,163 | 488,276 | 492,386 | 496,495 | 500,601 | 504,705 | 508,806 | 512,906 | 517,003 |
| **-120** | 521,098 | 525,191 | 529,281 | 533,370 | 537,456 | 541,540 | 545,622 | 549,702 | 553,780 | 557,856 |
| **-110** | 561,930 | 566,002 | 570,072 | 574,139 | 578,205 | 582,269 | 586,331 | 590,391 | 594,448 | 598,504 |
| **-100** | 602,558 | 606,611 | 610,661 | 614,709 | 618,756 | 622,800 | 626,843 | 630,884 | 634,923 | 638,960 |
| **-90** | 642,996 | 647,030 | 651,062 | 655,092 | 659,120 | 663,147 | 667,172 | 671,195 | 675,217 | 679,236 |
| **-80** | 683,254 | 687,271 | 691,286 | 695,299 | 699,310 | 703,320 | 707,328 | 711,335 | 715,340 | 719,344 |
| **-70** | 723,345 | 727,346 | 731,344 | 735,341 | 739,337 | 743,331 | 747,324 | 751,315 | 755,304 | 759,292 |
| **-60** | 763,278 | 767,263 | 771,247 | 775,229 | 779,210 | 783,189 | 787,166 | 791,143 | 795,117 | 799,091 |
| **-50** | 803,063 | 807,033 | 811,003 | 814,970 | 818,937 | 822,902 | 826,865 | 830,828 | 834,789 | 838,748 |
| **-40** | 842,707 | 846,663 | 850,619 | 854,573 | 858,526 | 862,478 | 866,428 | 870,377 | 874,325 | 878,271 |
| **-30** | 882,217 | 886,160 | 890,103 | 894,044 | 897,985 | 901,923 | 905,861 | 909,797 | 913,732 | 917,666 |
| **-20** | 921,599 | 925,530 | 929,461 | 933,390 | 937,317 | 941,244 | 945,169 | 949,093 | 953,016 | 956,938 |
| **-10** | 960,859 | 964,778 | 968,696 | 972,613 | 976,529 | 980,444 | 984,358 | 988,270 | 992,181 | 996,091 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| | 500,000 | 501,950 | 503,910 | 505,860 | 507,810 | 509,760 | 511,720 | 513,670 | 515,620 | 517,560 |
| **10** | 1039,025 | 1042,921 | 1046,816 | 1050,710 | 1054,603 | 1058,495 | 1062,385 | 1066,274 | 1070,162 | 1074,049 |
| **20** | 1077,935 | 1081,820 | 1085,703 | 1089,585 | 1093,467 | 1097,347 | 1101,225 | 1105,103 | 1108,980 | 1112,855 |
| **30** | 1116,729 | 1120,602 | 1124,474 | 1128,345 | 1132,215 | 1136,083 | 1139,950 | 1143,817 | 1147,681 | 1151,545 |
| **40** | 1155,408 | 1159,270 | 1163,130 | 1166,989 | 1170,847 | 1174,704 | 1178,560 | 1182,414 | 1186,268 | 1190,120 |
| **50** | 1193,971 | 1197,821 | 1201,670 | 1205,518 | 1209,364 | 1213,210 | 1217,054 | 1220,897 | 1224,739 | 1228,579 |
| **60** | 1232,419 | 1236,257 | 1240,095 | 1243,931 | 1247,766 | 1251,600 | 1255,432 | 1259,264 | 1263,094 | 1266,923 |
| **70** | 1270,751 | 1274,578 | 1278,404 | 1282,228 | 1286,052 | 1289,874 | 1293,695 | 1297,515 | 1301,334 | 1305,152 |
| **80** | 1308,968 | 1312,783 | 1316,597 | 1320,411 | 1324,222 | 1328,033 | 1331,843 | 1335,651 | 1339,458 | 1343,264 |
| **90** | 1347,069 | 1350,873 | 1354,676 | 1358,477 | 1362,277 | 1366,077 | 1369,875 | 1373,671 | 1377,467 | 1381,262 |
| **100** | 1385,055 | 1388,847 | 1392,638 | 1396,428 | 1400,217 | 1404,005 | 1407,791 | 1411,576 | 1415,360 | 1419,143 |
| **110** | 1422,925 | 1426,706 | 1430,485 | 1434,264 | 1438,041 | 1441,817 | 1445,592 | 1449,366 | 1453,138 | 1456,910 |
| **120** | 1460,680 | 1464,449 | 1468,217 | 1471,984 | 1475,750 | 1479,514 | 1483,277 | 1487,040 | 1490,801 | 1494,561 |
| **130** | 1498,319 | 1502,077 | 1505,833 | 1509,589 | 1513,343 | 1517,096 | 1520,847 | 1524,598 | 1528,347 | 1532,096 |
| **140** | 1535,843 | 1539,589 | 1543,334 | 1547,078 | 1550,820 | 1554,562 | 1558,302 | 1562,041 | 1565,779 | 1569,516 |
| **150** | 1573,251 | 1576,986 | 1580,719 | 1584,451 | 1588,182 | 1591,912 | 1595,641 | 1599,368 | 1603,095 | 1606,820 |
| **160** | 1610,544 | 1614,267 | 1617,989 | 1621,709 | 1625,429 | 1629,147 | 1632,864 | 1636,580 | 1640,295 | 1644,009 |
| **170** | 1647,721 | 1651,433 | 1655,143 | 1658,852 | 1662,560 | 1666,267 | 1669,972 | 1673,677 | 1677,380 | 1681,082 |
| **180** | 1684,783 | 1688,483 | 1692,181 | 1695,879 | 1699,575 | 1703,271 | 1706,965 | 1710,658 | 1714,349 | 1718,040 |
| **190** | 1721,729 | 1725,418 | 1729,105 | 1732,791 | 1736,475 | 1740,159 | 1743,842 | 1747,523 | 1751,203 | 1754,882 |
| **200** | 1758,560 | 1762,237 | 1765,912 | 1769,587 | 1773,260 | 1776,932 | 1780,603 | 1784,273 | 1787,941 | 1791,609 |
| **210** | 1795,275 | 1798,940 | 1802,604 | 1806,267 | 1809,929 | 1813,590 | 1817,249 | 1820,907 | 1824,564 | 1828,220 |
| **220** | 1831,875 | 1835,529 | 1839,181 | 1842,832 | 1846,483 | 1850,132 | 1853,779 | 1857,426 | 1861,072 | 1864,716 |
| **230** | 1868,359 | 1872,001 | 1875,642 | 1879,282 | 1882,921 | 1886,558 | 1890,194 | 1893,830 | 1897,463 | 1901,096 |
| **240** | 1904,728 | 1908,359 | 1911,988 | 1915,616 | 1919,243 | 1922,869 | 1926,494 | 1930,117 | 1933,740 | 1937,361 |
| **250** | 1940,981 | 1944,600 | 1948,218 | 1951,835 | 1955,450 | 1959,065 | 1962,678 | 1966,290 | 1969,901 | 1973,510 |
| **260** | 1977,119 | 1980,726 | 1984,333 | 1987,938 | 1991,542 | 1995,145 | 1998,746 | 2002,347 | 2005,946 | 2009,544 |
| **270** | 2013,141 | 2016,737 | 2020,332 | 2023,925 | 2027,518 | 2031,109 | 2034,699 | 2038,288 | 2041,876 | 2045,463 |
| **280** | 2049,048 | 2052,632 | 2056,215 | 2059,798 | 2063,378 | 2066,958 | 2070,537 | 2074,114 | 2077,690 | 2081,265 |
| **290** | 2084,839 | 2088,412 | 2091,984 | 2095,554 | 2099,123 | 2102,692 | 2106,259 | 2109,824 | 2113,389 | 2116,953 |
| **300** | 2120,515 | 2124,076 | 2127,636 | 2131,195 | 2134,753 | 2138,310 | 2141,865 | 2145,419 | 2148,972 | 2152,524 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 310 | 2156,075 | 2159,625 | 2163,173 | 2166,721 | 2170,267 | 2173,812 | 2177,356 | 2180,899 | 2184,440 | 2187,981 |
| 320 | 2191,520 | 2195,058 | 2198,595 | 2202,131 | 2205,666 | 2209,199 | 2212,731 | 2216,263 | 2219,793 | 2223,322 |
| 330 | 2226,849 | 2230,376 | 2233,901 | 2237,426 | 2240,949 | 2244,471 | 2247,991 | 2251,511 | 2255,029 | 2258,547 |
| 340 | 2262,063 | 2265,578 | 2269,092 | 2272,605 | 2276,116 | 2279,627 | 2283,136 | 2286,644 | 2290,151 | 2293,657 |
| 350 | 2297,161 | 2300,665 | 2304,167 | 2307,668 | 2311,168 | 2314,667 | 2318,165 | 2321,661 | 2325,157 | 2328,651 |
| 360 | 2332,144 | 2335,636 | 2339,127 | 2342,616 | 2346,105 | 2349,592 | 2353,078 | 2356,563 | 2360,047 | 2363,530 |
| 370 | 2367,011 | 2370,492 | 2373,971 | 2377,449 | 2380,926 | 2384,402 | 2387,876 | 2391,350 | 2394,822 | 2398,293 |
| 380 | 2401,763 | 2405,232 | 2408,699 | 2412,166 | 2415,631 | 2419,096 | 2422,559 | 2426,021 | 2429,481 | 2432,941 |
| 390 | 2436,399 | 2439,857 | 2443,313 | 2446,768 | 2450,221 | 2453,674 | 2457,126 | 2460,576 | 2464,025 | 2467,473 |
| 400 | 2470,920 | 2474,366 | 2477,810 | 2481,254 | 2484,696 | 2488,137 | 2491,577 | 2495,016 | 2498,453 | 2501,890 |
| 410 | 2505,325 | 2508,759 | 2512,192 | 2515,624 | 2519,055 | 2522,485 | 2525,913 | 2529,340 | 2532,766 | 2536,191 |
| 420 | 2539,615 | 2543,038 | 2546,459 | 2549,879 | 2553,299 | 2556,717 | 2560,133 | 2563,549 | 2566,964 | 2570,377 |
| 430 | 2573,789 | 2577,200 | 2580,610 | 2584,019 | 2587,427 | 2590,833 | 2594,238 | 2597,643 | 2601,045 | 2604,447 |
| 440 | 2607,848 | 2611,248 | 2614,646 | 2618,043 | 2621,439 | 2624,834 | 2628,228 | 2631,620 | 2635,012 | 2638,402 |
| 450 | 2641,791 | 2645,179 | 2648,566 | 2651,952 | 2655,336 | 2658,720 | 2662,102 | 2665,483 | 2668,863 | 2672,241 |
| 460 | 2675,619 | 2678,995 | 2682,371 | 2685,745 | 2689,118 | 2692,490 | 2695,860 | 2699,230 | 2702,598 | 2705,965 |
| 470 | 2709,331 | 2712,696 | 2716,060 | 2719,422 | 2722,784 | 2726,144 | 2729,503 | 2732,861 | 2736,218 | 2739,574 |
| 480 | 2742,928 | 2746,281 | 2749,633 | 2752,985 | 2756,334 | 2759,683 | 2763,031 | 2766,377 | 2769,722 | 2773,066 |
| 490 | 2776,409 | 2779,751 | 2783,092 | 2786,431 | 2789,769 | 2793,107 | 2796,443 | 2799,777 | 2803,111 | 2806,444 |
| 500 | 2809,775 | 2813,105 | 2816,434 | 2819,762 | 2823,089 | 2826,415 | 2829,739 | 2833,062 | 2836,384 | 2839,705 |
| 510 | 2843,025 | 2846,344 | 2849,661 | 2852,978 | 2856,293 | 2859,607 | 2862,920 | 2866,232 | 2869,542 | 2872,852 |
| 520 | 2876,160 | 2879,467 | 2882,773 | 2886,078 | 2889,382 | 2892,684 | 2895,985 | 2899,286 | 2902,585 | 2905,883 |
| 530 | 2909,179 | 2912,475 | 2915,769 | 2919,063 | 2922,355 | 2925,646 | 2928,935 | 2932,224 | 2935,511 | 2938,798 |
| 540 | 2942,083 | 2945,367 | 2948,650 | 2951,932 | 2955,212 | 2958,492 | 2961,770 | 2965,047 | 2968,323 | 2971,598 |
| 550 | 2974,871 | 2978,144 | 2981,415 | 2984,685 | 2987,954 | 2991,222 | 2994,489 | 2997,754 | 3001,019 | 3004,282 |
| 560 | 3007,544 | 3010,805 | 3014,065 | 3017,323 | 3020,581 | 3023,837 | 3027,092 | 3030,346 | 3033,599 | 3036,851 |
| 570 | 3040,101 | 3043,351 | 3046,599 | 3049,846 | 3053,092 | 3056,337 | 3059,580 | 3062,823 | 3066,064 | 3069,304 |
| 580 | 3072,543 | 3075,781 | 3079,017 | 3082,253 | 3085,487 | 3088,721 | 3091,953 | 3095,184 | 3098,413 | 3101,642 |
| 590 | 3104,869 | 3108,096 | 3111,321 | 3114,545 | 3117,767 | 3120,989 | 3124,210 | 3127,429 | 3130,647 | 3133,864 |
| 600 | 3137,080 | 3140,295 | 3143,508 | 3146,721 | 3149,932 | 3153,142 | 3156,351 | 3159,559 | 3162,765 | 3165,971 |
| 610 | 3169,175 | 3172,378 | 3175,580 | 3178,781 | 3181,981 | 3185,180 | 3188,377 | 3191,573 | 3194,768 | 3197,962 |
| 620 | 3201,155 | 3204,347 | 3207,537 | 3210,726 | 3213,915 | 3217,102 | 3220,287 | 3223,472 | 3226,656 | 3229,838 |
| 630 | 3233,019 | 3236,199 | 3239,378 | 3242,556 | 3245,733 | 3248,908 | 3252,082 | 3255,256 | 3258,427 | 3261,598 |
| 640 | 3264,768 | 3267,937 | 3271,104 | 3274,270 | 3277,435 | 3280,599 | 3283,762 | 3286,923 | 3290,084 | 3293,243 |
| 650 | 3296,401 | 3299,558 | 3302,714 | 3305,869 | 3309,022 | 3312,175 | 3315,326 | 3318,476 | 3321,625 | 3324,772 |
| 660 | 3327,919 | 3331,064 | 3334,209 | 3337,352 | 3340,494 | 3343,635 | 3346,774 | 3349,913 | 3353,050 | 3356,186 |
| 670 | 3359,321 | 3362,455 | 3365,588 | 3368,719 | 3371,850 | 3374,979 | 3378,107 | 3381,234 | 3384,360 | 3387,485 |
| 680 | 3390,608 | 3393,730 | 3396,851 | 3399,972 | 3403,090 | 3406,208 | 3409,325 | 3412,440 | 3415,554 | 3418,667 |
| 690 | 3421,779 | 3424,890 | 3428,000 | 3431,108 | 3434,215 | 3437,322 | 3440,427 | 3443,530 | 3446,633 | 3449,735 |
| 700 | 3452,835 | 3455,934 | 3459,032 | 3462,129 | 3465,225 | 3468,320 | 3471,413 | 3474,505 | 3477,596 | 3480,686 |
| 710 | 3483,775 | 3486,863 | 3489,949 | 3493,035 | 3496,119 | 3499,202 | 3502,284 | 3505,365 | 3508,444 | 3511,523 |
| 720 | 3514,600 | 3517,676 | 3520,751 | 3523,825 | 3526,898 | 3529,969 | 3533,039 | 3536,109 | 3539,177 | 3542,244 |
| 730 | 3545,309 | 3548,374 | 3551,437 | 3554,500 | 3557,561 | 3560,621 | 3563,679 | 3566,737 | 3569,793 | 3572,849 |
| 740 | 3575,903 | 3578,956 | 3582,008 | 3585,059 | 3588,108 | 3591,157 | 3594,204 | 3597,250 | 3600,295 | 3603,339 |
| 750 | 3606,381 | 3609,423 | 3612,463 | 3615,502 | 3618,540 | 3621,577 | 3624,613 | 3627,647 | 3630,681 | 3633,713 |
| 760 | 3636,744 | 3639,774 | 3642,803 | 3645,830 | 3648,857 | 3651,882 | 3654,906 | 3657,929 | 3660,951 | 3663,972 |
| 770 | 3666,991 | 3670,010 | 3673,027 | 3676,043 | 3679,058 | 3682,072 | 3685,084 | 3688,096 | 3691,106 | 3694,115 |
| 780 | 3697,123 | 3700,130 | 3703,135 | 3706,140 | 3709,143 | 3712,146 | 3715,147 | 3718,147 | 3721,145 | 3724,143 |
| 790 | 3727,139 | 3730,135 | 3733,129 | 3736,122 | 3739,113 | 3742,104 | 3745,094 | 3748,082 | 3751,069 | 3754,055 |
| 800 | 3757,040 | 3760,024 | 3763,006 | 3765,988 | 3768,968 | 3771,947 | 3774,925 | 3777,902 | 3780,877 | 3783,852 |
| 810 | 3786,825 | 3789,797 | 3792,768 | 3795,738 | 3798,707 | 3801,675 | 3804,641 | 3807,606 | 3810,570 | 3813,533 |
| 820 | 3816,495 | 3819,456 | 3822,415 | 3825,373 | 3828,331 | 3831,287 | 3834,241 | 3837,195 | 3840,148 | 3843,099 |
| 830 | 3846,049 | 3848,998 | 3851,946 | 3854,893 | 3857,839 | 3860,783 | 3863,726 | 3866,669 | 3869,609 | 3872,549 |
| 840 | 3875,488 | 3878,426 | 3881,362 | 3884,297 | 3887,231 | 3890,164 | 3893,096 | 3896,026 | 3898,956 | 3901,884 |
| 850 | 3904,811 | | | | | | | | | |

## *11.1.11 TC Typ B*

*Temperature range 0°C....+1820°C*

*All resistance value in mV*

| °C in steps of 10 ⇩ | °C ascending in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **°C** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,000 | 0,000 | -0,001 | -0,001 | -0,001 | -0,001 | -0,001 | -0,002 | -0,002 |
| **10** | -0,002 | -0,002 | -0,002 | -0,002 | -0,002 | -0,002 | -0,002 | -0,002 | -0,003 | -0,003 |
| **20** | -0,003 | -0,003 | -0,003 | -0,003 | -0,003 | -0,002 | -0,002 | -0,002 | -0,002 | -0,002 |
| **30** | -0,002 | -0,002 | -0,002 | -0,002 | -0,002 | -0,001 | -0,001 | -0,001 | -0,001 | 0,001 |
| **40** | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,002 | 0,002 |
| **50** | 0,002 | 0,002 | 0,003 | 0,003 | 0,004 | 0,004 | 0,004 | 0,005 | 0,005 | 0,006 |
| **60** | 0,006 | 0,007 | 0,007 | 0,008 | 0,008 | 0,009 | 0,009 | 0,010 | 0,010 | 0,011 |
| **70** | 0,011 | 0,012 | 0,012 | 0,013 | 0,014 | 0,014 | 0,015 | 0,015 | 0,016 | 0,017 |
| **80** | 0,017 | 0,018 | 0,019 | 0,020 | 0,020 | 0,021 | 0,022 | 0,022 | 0,023 | 0,024 |
| **90** | 0,025 | 0,026 | 0,026 | 0,027 | 0,028 | 0,029 | 0,030 | 0,031 | 0,031 | 0,032 |
| **100** | 0,033 | 0,034 | 0,035 | 0,036 | 0,037 | 0,038 | 0,039 | 0,040 | 0,041 | 0,042 |
| **110** | 0,043 | 0,044 | 0,045 | 0,046 | 0,047 | 0,048 | 0,049 | 0,050 | 0,051 | 0,052 |
| **120** | 0,053 | 0,055 | 0,056 | 0,057 | 0,058 | 0,059 | 0,060 | 0,062 | 0,063 | 0,064 |
| **130** | 0,065 | 0,066 | 0,068 | 0,069 | 0,070 | 0,072 | 0,073 | 0,074 | 0,075 | 0,077 |
| **140** | 0,078 | 0,079 | 0,081 | 0,082 | 0,084 | 0,085 | 0,086 | 0,088 | 0,089 | 0,091 |
| **150** | 0,092 | 0,094 | 0,095 | 0,096 | 0,098 | 0,099 | 0,101 | 0,102 | 0,104 | 0,106 |
| **160** | 0,107 | 0,109 | 0,110 | 0,112 | 0,113 | 0,115 | 0,117 | 0,118 | 0,120 | 0,122 |
| **170** | 0,123 | 0,125 | 0,127 | 0,128 | 0,130 | 0,132 | 0,134 | 0,135 | 0,137 | 0,139 |
| **180** | 0,141 | 0,142 | 0,144 | 0,146 | 0,148 | 0,150 | 0,151 | 0,153 | 0,155 | 0,157 |
| **190** | 0,159 | 0,161 | 0,163 | 0,165 | 0,166 | 0,168 | 0,170 | 0,172 | 0,174 | 0,176 |
| **200** | 0,178 | 0,180 | 0,182 | 0,184 | 0,186 | 0,188 | 0,190 | 0,192 | 0,195 | 0,197 |
| **210** | 0,199 | 0,201 | 0,203 | 0,205 | 0,207 | 0,209 | 0,212 | 0,214 | 0,216 | 0,218 |
| **220** | 0,220 | 0,222 | 0,225 | 0,227 | 0,229 | 0,231 | 0,234 | 0,236 | 0,238 | 0,241 |
| **230** | 0,243 | 0,245 | 0,248 | 0,250 | 0,252 | 0,255 | 0,257 | 0,259 | 0,262 | 0,264 |
| **240** | 0,267 | 0,269 | 0,271 | 0,274 | 0,276 | 0,279 | 0,281 | 0,284 | 0,286 | 0,289 |
| **250** | 0,291 | 0,294 | 0,296 | 0,299 | 0,301 | 0,304 | 0,307 | 0,309 | 0,312 | 0,314 |
| **260** | 0,317 | 0,320 | 0,322 | 0,325 | 0,328 | 0,330 | 0,333 | 0,336 | 0,338 | 0,341 |
| **270** | 0,344 | 0,347 | 0,349 | 0,352 | 0,355 | 0,358 | 0,360 | 0,363 | 0,366 | 0,369 |
| **280** | 0,372 | 0,375 | 0,377 | 0,380 | 0,383 | 0,386 | 0,389 | 0,392 | 0,395 | 0,398 |
| **290** | 0,401 | 0,404 | 0,407 | 0,410 | 0,413 | 0,416 | 0,419 | 0,422 | 0,425 | 0,428 |
| **300** | 0,431 | 0,434 | 0,437 | 0,440 | 0,443 | 0,446 | 0,449 | 0,452 | 0,455 | 0,458 |
| **310** | 0,462 | 0,465 | 0,468 | 0,471 | 0,474 | 0,478 | 0,481 | 0,484 | 0,487 | 0,490 |
| **320** | 0,494 | 0,497 | 0,500 | 0,503 | 0,507 | 0,510 | 0,513 | 0,517 | 0,520 | 0,523 |
| **330** | 0,527 | 0,530 | 0,533 | 0,537 | 0,540 | 0,544 | 0,547 | 0,550 | 0,554 | 0,557 |
| **340** | 0,561 | 0,564 | 0,568 | 0,571 | 0,575 | 0,578 | 0,582 | 0,585 | 0,589 | 0,592 |
| **350** | 0,596 | 0,599 | 0,603 | 0,607 | 0,610 | 0,614 | 0,617 | 0,621 | 0,625 | 0,628 |
| **360** | 0,632 | 0,636 | 0,639 | 0,643 | 0,647 | 0,650 | 0,654 | 0,658 | 0,662 | 0,665 |
| **370** | 0,669 | 0,673 | 0,677 | 0,680 | 0,684 | 0,688 | 0,692 | 0,696 | 0,700 | 0,703 |
| **380** | 0,707 | 0,711 | 0,715 | 0,719 | 0,723 | 0,727 | 0,731 | 0,735 | 0,738 | 0,742 |
| **390** | 0,746 | 0,750 | 0,754 | 0,758 | 0,762 | 0,766 | 0,770 | 0,774 | 0,778 | 0,782 |
| **400** | 0,787 | 0,791 | 0,795 | 0,799 | 0,803 | 0,807 | 0,811 | 0,815 | 0,819 | 0,824 |
| **410** | 0,828 | 0,832 | 0,836 | 0,840 | 0,844 | 0,849 | 0,853 | 0,857 | 0,861 | 0,866 |
| **420** | 0,870 | 0,874 | 0,878 | 0,883 | 0,887 | 0,891 | 0,895 | 0,900 | 0,904 | 0,909 |
| **430** | 0,913 | 0,917 | 0,922 | 0,926 | 0,930 | 0,935 | 0,939 | 0,944 | 0,948 | 0,953 |
| **440** | 0,957 | 0,961 | 0,966 | 0,970 | 0,975 | 0,979 | 0,984 | 0,988 | 0,993 | 0,997 |
| **450** | 1,002 | 1,007 | 1,011 | 1,016 | 1,020 | 1,025 | 1,029 | 1,034 | 1,039 | 1,043 |
| **460** | 1,048 | 1,053 | 1,057 | 1,062 | 1,067 | 1,071 | 1,076 | 1,081 | 1,086 | 1,090 |
| **470** | 1,095 | 1,100 | 1,105 | 1,109 | 1,114 | 1,119 | 1,124 | 1,128 | 1,133 | 1,138 |
| **480** | 1,143 | 1,148 | 1,153 | 1,158 | 1,162 | 1,167 | 1,172 | 1,177 | 1,182 | 1,187 |
| **490** | 1,192 | 1,197 | 1,202 | 1,207 | 1,212 | 1,217 | 1,222 | 1,227 | 1,232 | 1,237 |
| **500** | 1,242 | 1,247 | 1,252 | 1,257 | 1,262 | 1,267 | 1,272 | 1,277 | 1,282 | 1,288 |
| **510** | 1,293 | 1,298 | 1,303 | 1,308 | 1,313 | 1,318 | 1,323 | 1,329 | 1,334 | 1,339 |
| **520** | 1,344 | 1,350 | 1,355 | 1,360 | 1,365 | 1,371 | 1,376 | 1,381 | 1,386 | 1,392 |
| **530** | 1,397 | 1,402 | 1,408 | 1,413 | 1,418 | 1,424 | 1,429 | 1,434 | 1,440 | 1,445 |
| **540** | 1,451 | 1,456 | 1,461 | 1,467 | 1,472 | 1,478 | 1,483 | 1,489 | 1,494 | 1,500 |
| **550** | 1,505 | 1,511 | 1,516 | 1,522 | 1,527 | 1,533 | 1,539 | 1,544 | 1,550 | 1,555 |
| **560** | 1,561 | 1,566 | 1,572 | 1,578 | 1,583 | 1,589 | 1,595 | 1,600 | 1,606 | 1,612 |
| **570** | 1,617 | 1,623 | 1,629 | 1,634 | 1,640 | 1,646 | 1,651 | 1,657 | 1,663 | 1,669 |
| **580** | 1,675 | 1,680 | 1,686 | 1,692 | 1,698 | 1,704 | 1,709 | 1,715 | 1,721 | 1,727 |
| **590** | 1,733 | 1,739 | 1,745 | 1,750 | 1,756 | 1,762 | 1,768 | 1,774 | 1,780 | 1,786 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **600** | 1,792 | 1,797 | 1,804 | 1,810 | 1,816 | 1,822 | 1,828 | 1,834 | 1,840 | 1,846 |
| **610** | 1,852 | 1,858 | 1,864 | 1,870 | 1,876 | 1,882 | 1,888 | 1,894 | 1,901 | 1,907 |
| **620** | 1,913 | 1,919 | 1,925 | 1,931 | 1,937 | 1,944 | 1,950 | 1,956 | 1,962 | 1,968 |
| **630** | 1,975 | 1,981 | 1,987 | 1,993 | 1,999 | 2,006 | 2,012 | 2,018 | 2,025 | 2,031 |
| **640** | 2,037 | 2,043 | 2,050 | 2,056 | 2,062 | 2,069 | 2,075 | 2,082 | 2,088 | 2,094 |
| **650** | 2,101 | 2,107 | 2,113 | 2,120 | 2,126 | 2,133 | 2,139 | 2,146 | 2,152 | 2,158 |
| **660** | 2,165 | 2,171 | 2,178 | 2,184 | 2,191 | 2,197 | 2,204 | 2,210 | 2,217 | 2,224 |
| **670** | 2,230 | 2,237 | 2,243 | 2,250 | 2,256 | 2,263 | 2,270 | 2,276 | 2,283 | 2,289 |
| **680** | 2,296 | 2,303 | 2,309 | 2,316 | 2,323 | 2,329 | 2,336 | 2,343 | 2,350 | 2,356 |
| **690** | 2,363 | 2,370 | 2,376 | 2,383 | 2,390 | 2,397 | 2,403 | 2,410 | 2,417 | 2,424 |
| **700** | 2,431 | 2,437 | 2,444 | 2,451 | 2,458 | 2,465 | 2,472 | 2,479 | 2,485 | 2,492 |
| **710** | 2,499 | 2,506 | 2,513 | 2,520 | 2,527 | 2,534 | 2,541 | 2,548 | 2,555 | 2,562 |
| **720** | 2,569 | 2,576 | 2,583 | 2,590 | 2,597 | 2,604 | 2,611 | 2,618 | 2,625 | 2,632 |
| **730** | 2,639 | 2,646 | 2,653 | 2,660 | 2,667 | 2,674 | 2,681 | 2,688 | 2,696 | 2,703 |
| **740** | 2,710 | 2,717 | 2,724 | 2,731 | 2,738 | 2,746 | 2,753 | 2,760 | 2,767 | 2,775 |
| **750** | 2,782 | 2,789 | 2,796 | 2,803 | 2,811 | 2,818 | 2,825 | 2,833 | 2,840 | 2,847 |
| **760** | 2,854 | 2,862 | 2,869 | 2,876 | 2,884 | 2,891 | 2,898 | 2,906 | 2,913 | 2,921 |
| **770** | 2,928 | 2,935 | 2,943 | 2,950 | 2,958 | 2,965 | 2,973 | 2,980 | 2,987 | 2,995 |
| **780** | 3,002 | 3,010 | 3,017 | 3,025 | 3,032 | 3,040 | 3,047 | 3,055 | 3,062 | 3,070 |
| **790** | 3,078 | 3,085 | 3,093 | 3,100 | 3,108 | 3,116 | 3,123 | 3,131 | 3,138 | 3,146 |
| **800** | 3,154 | 3,161 | 3,169 | 3,177 | 3,184 | 3,192 | 3,200 | 3,207 | 3,215 | 3,223 |
| **810** | 3,230 | 3,238 | 3,246 | 3,254 | 3,261 | 3,269 | 3,277 | 3,285 | 3,292 | 3,300 |
| **820** | 3,308 | 3,316 | 3,324 | 3,331 | 3,339 | 3,347 | 3,355 | 3,363 | 3,371 | 3,379 |
| **830** | 3,386 | 3,394 | 3,402 | 3,410 | 3,418 | 3,426 | 3,434 | 3,442 | 3,450 | 3,458 |
| **840** | 3,466 | 3,474 | 3,482 | 3,490 | 3,498 | 3,506 | 3,514 | 3,522 | 3,530 | 3,558 |
| **850** | 3,546 | 3,554 | 3,562 | 3,570 | 3,578 | 3,586 | 3,594 | 3,602 | 3,610 | 3,618 |
| **860** | 3,626 | 3,634 | 3,643 | 3,651 | 3,659 | 3,667 | 3,675 | 3,683 | 3,692 | 3,700 |
| **870** | 3,708 | 3,716 | 3,724 | 3,732 | 3,741 | 3,749 | 3,757 | 3,765 | 3,774 | 3,782 |
| **880** | 3,790 | 3,798 | 3,807 | 3,815 | 3,823 | 3,832 | 3,840 | 3,848 | 3,857 | 3,865 |
| **890** | 3,873 | 3,882 | 3,890 | 3,898 | 3,907 | 3,915 | 3,923 | 3,932 | 3,940 | 3,949 |
| **900** | 3,957 | 3,965 | 3,974 | 3,982 | 3,991 | 3,999 | 4,008 | 4,016 | 4,024 | 4,033 |
| **910** | 4,041 | 4,050 | 4,058 | 4,067 | 4,075 | 4,084 | 4,093 | 4,101 | 4,110 | 4,118 |
| **920** | 4,127 | 4,135 | 4,144 | 4,152 | 4,161 | 4,170 | 4,178 | 4,187 | 4,195 | 4,204 |
| **930** | 4,213 | 4,221 | 4,230 | 4,239 | 4,247 | 4,256 | 4,265 | 4,273 | 4,282 | 4,291 |
| **940** | 4,299 | 4,308 | 4,317 | 4,326 | 4,334 | 4,343 | 4,352 | 4,360 | 4,369 | 4,377 |
| **950** | 4,387 | 4,396 | 4,404 | 4,413 | 4,422 | 4,431 | 4,440 | 4,448 | 4,457 | 4,466 |
| **960** | 4,475 | 4,484 | 4,493 | 4,501 | 4,510 | 4,519 | 4,528 | 4,537 | 4,546 | 4,553 |
| **970** | 4,564 | 4,573 | 4,582 | 4,591 | 4,599 | 4,608 | 4,617 | 4,626 | 4,635 | 4,643 |
| **980** | 4,653 | 4,662 | 4,671 | 4,680 | 4,689 | 4,698 | 4,707 | 4,716 | 4,725 | 4,733 |
| **990** | 4,743 | 4,753 | 4,762 | 4,771 | 4,780 | 4,789 | 4,798 | 4,807 | 4,816 | 4,825 |
| **1000** | 4,834 | 4,843 | 4,853 | 4,862 | 4,871 | 4,880 | 4,889 | 4,898 | 4,908 | 4,917 |
| **1010** | 4,926 | 4,935 | 4,944 | 4,954 | 4,963 | 4,972 | 4,981 | 4,990 | 5,000 | 5,009 |
| **1020** | 5,018 | 5,027 | 5,037 | 5,046 | 5,055 | 5,065 | 5,074 | 5,083 | 5,092 | 5,102 |
| **1030** | 5,111 | 5,120 | 5,130 | 5,139 | 5,148 | 5,158 | 5,167 | 5,176 | 5,186 | 5,195 |
| **1040** | 5,205 | 5,214 | 5,223 | 5,233 | 5,242 | 5,252 | 5,261 | 5,270 | 5,280 | 5,289 |
| **1050** | 5,299 | 5,308 | 5,318 | 5,327 | 5,337 | 5,346 | 5,356 | 5,365 | 5,375 | 5,384 |
| **1060** | 5,394 | 5,403 | 5,413 | 5,422 | 5,432 | 5,441 | 5,451 | 5,460 | 5,470 | 5,480 |
| **1070** | 5,489 | 5,499 | 5,508 | 5,518 | 5,528 | 5,537 | 5,547 | 5,556 | 5,566 | 5,576 |
| **1080** | 5,585 | 5,595 | 5,605 | 5,614 | 5,624 | 5,634 | 5,643 | 5,653 | 5,663 | 5,672 |
| **1090** | 5,682 | 5,692 | 5,702 | 5,711 | 5,721 | 5,731 | 5,740 | 5,750 | 5,760 | 5,770 |
| **1100** | 5,780 | 5,789 | 5,799 | 5,809 | 5,819 | 5,828 | 5,838 | 5,848 | 5,858 | 5,868 |
| **1110** | 5,878 | 5,887 | 5,897 | 5,907 | 5,917 | 5,927 | 5,937 | 5,947 | 5,956 | 5,966 |
| **1120** | 5,976 | 5,986 | 5,996 | 6,006 | 6,016 | 6,026 | 6,036 | 6,046 | 6,055 | 6,065 |
| **1130** | 6,075 | 6,085 | 6,095 | 6,105 | 6,115 | 6,125 | 6,135 | 6,145 | 6,155 | 6,165 |
| **1140** | 6,175 | 6,185 | 6,195 | 6,205 | 6,215 | 6,225 | 6,235 | 6,245 | 6,256 | 6,266 |
| **1150** | 6,276 | 6,286 | 6,296 | 6,306 | 6,316 | 6,326 | 6,336 | 6,346 | 6,356 | 6,367 |
| **1160** | 6,377 | 6,387 | 6,397 | 6,407 | 6,417 | 6,427 | 6,438 | 6,448 | 6,458 | 6,468 |
| **1170** | 6,478 | 6,488 | 6,499 | 6,509 | 6,519 | 6,529 | 6,539 | 6,550 | 6,560 | 6,570 |
| **1180** | 6,580 | 6,591 | 6,601 | 6,611 | 6,621 | 6,632 | 6,642 | 6,652 | 6,663 | 6,673 |
| **1190** | 6,683 | 6,693 | 6,704 | 6,714 | 6,724 | 6,735 | 6,745 | 6,755 | 6,766 | 6,776 |

| °C in steps of 10 ⇩ | °C ascending in step of one ⇨ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| °C | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1200 | 6,786 | 6,797 | 6,807 | 6,818 | 6,828 | 6,838 | 6,849 | 6,859 | 6,869 | 6,880 |
| 1210 | 6,890 | 6,901 | 6,911 | 6,922 | 6,932 | 6,942 | 6,953 | 6,963 | 6,974 | 6,984 |
| 1220 | 6,995 | 7,005 | 7,016 | 7,026 | 7,037 | 7,047 | 7,058 | 7,068 | 7,079 | 7,089 |
| 1230 | 7,100 | 7,110 | 7,121 | 7,131 | 7,142 | 7,152 | 7,163 | 7,173 | 7,184 | 7,194 |
| 1240 | 7,205 | 7,216 | 7,226 | 7,237 | 7,247 | 7,258 | 7,269 | 7,279 | 7,290 | 7,300 |
| 1250 | 7,311 | 7,322 | 7,332 | 7,343 | 7,353 | 7,364 | 7,375 | 7,385 | 7,396 | 7,407 |
| 1260 | 7,417 | 7,428 | 7,439 | 7,449 | 7,460 | 7,471 | 7,482 | 7,492 | 7,503 | 7,514 |
| 1270 | 7,524 | 7,535 | 7,546 | 7,557 | 7,567 | 7,578 | 7,589 | 7,600 | 7,610 | 7,621 |
| 1280 | 7,632 | 7,643 | 7,653 | 7,664 | 7,675 | 7,686 | 7,697 | 7,707 | 7,718 | 7,729 |
| 1290 | 7,740 | 7,751 | 7,761 | 7,772 | 7,783 | 7,794 | 7,805 | 7,816 | 7,827 | 7,837 |
| 1300 | 7,848 | 7,859 | 7,870 | 7,881 | 7,892 | 7,903 | 7,914 | 7,924 | 7,935 | 7,946 |
| 1310 | 7,957 | 7,968 | 7,979 | 7,990 | 8,001 | 8,012 | 8,023 | 8,034 | 8,045 | 8,056 |
| 1320 | 8,066 | 8,077 | 8,088 | 8,099 | 8,110 | 8,121 | 8,132 | 8,143 | 8,154 | 8,165 |
| 1330 | 8,176 | 8,187 | 8,198 | 8,209 | 8,220 | 8,231 | 8,242 | 8,253 | 8,264 | 8,275 |
| 1340 | 8,286 | 8,298 | 8,309 | 8,320 | 8,331 | 8,342 | 8,353 | 8,364 | 8,375 | 8,386 |
| 1350 | 8,397 | 8,408 | 8,419 | 8,430 | 8,441 | 8,453 | 8,464 | 8,475 | 8,486 | 8,497 |
| 1360 | 8,508 | 8,519 | 8,530 | 8,542 | 8,553 | 8,564 | 8,575 | 8,586 | 8,597 | 8,608 |
| 1370 | 8,620 | 8,631 | 8,642 | 8,653 | 8,664 | 8,675 | 8,687 | 8,698 | 8,709 | 8,720 |
| 1380 | 8,731 | 8,743 | 8,754 | 8,765 | 8,776 | 8,787 | 8,799 | 8,810 | 8,821 | 8,832 |
| 1390 | 8,844 | 8,855 | 8,866 | 8,877 | 8,889 | 8,900 | 8,911 | 8,922 | 8,934 | 8,945 |
| 1400 | 8,956 | 8,967 | 8,979 | 8,990 | 9,001 | 9,013 | 9,024 | 9,035 | 9,047 | 9,058 |
| 1410 | 9,069 | 9,080 | 9,092 | 9,103 | 9,114 | 9,126 | 9,137 | 9,148 | 9,160 | 9,171 |
| 1420 | 9,182 | 9,194 | 9,205 | 9,216 | 9,228 | 9,239 | 9,251 | 9,262 | 9,273 | 9,285 |
| 1430 | 9,296 | 9,307 | 9,319 | 9,330 | 9,342 | 9,353 | 9,364 | 9,376 | 9,387 | 9,398 |
| 1440 | 9,410 | 9,421 | 9,433 | 9,444 | 9,456 | 9,467 | 9,478 | 9,490 | 9,501 | 9,513 |
| 1450 | 9,524 | 9,536 | 9,547 | 9,558 | 9,570 | 9,581 | 9,593 | 9,604 | 9,616 | 9,627 |
| 1460 | 9,639 | 9,650 | 9,662 | 9,673 | 9,684 | 9,696 | 9,707 | 9,719 | 9,730 | 9,742 |
| 1470 | 9,753 | 9,765 | 9,776 | 9,788 | 9,799 | 9,811 | 9,822 | 9,834 | 9,845 | 9,857 |
| 1480 | 9,868 | 9,880 | 9,891 | 9,903 | 9,914 | 9,926 | 9,937 | 9,949 | 9,961 | 9,972 |
| 1490 | 9,984 | 9,995 | 10,007 | 10,018 | 10,030 | 10,041 | 10,053 | 10,064 | 10,076 | 10,088 |
| 1500 | 10,099 | 10,111 | 10,122 | 10,134 | 10,145 | 10,157 | 10,168 | 10,180 | 10,192 | 10,203 |
| 1510 | 10,215 | 10,226 | 10,238 | 10,249 | 10,261 | 10,273 | 10,284 | 10,296 | 10,307 | 10,319 |
| 1520 | 10,331 | 10,342 | 10,354 | 10,365 | 10,377 | 10,389 | 10,400 | 10,412 | 10,423 | 10,435 |
| 1530 | 10,447 | 10,458 | 10,470 | 10,482 | 10,493 | 10,505 | 10,516 | 10,528 | 10,540 | 10,551 |
| 1540 | 10,563 | 10,575 | 10,586 | 10,598 | 10,609 | 10,621 | 10,633 | 10,644 | 10,656 | 10,668 |
| 1550 | 10,679 | 10,691 | 10,703 | 10,714 | 10,726 | 10,738 | 10,749 | 10,761 | 10,773 | 10,784 |
| 1560 | 10,796 | 10,808 | 10,819 | 10,831 | 10,843 | 10,854 | 10,866 | 10,877 | 10,889 | 10,901 |
| 1570 | 10,913 | 10,924 | 10,936 | 10,948 | 10,959 | 10,971 | 10,983 | 10,994 | 11,006 | 11,018 |
| 1580 | 11,029 | 11,041 | 11,053 | 11,064 | 11,076 | 11,088 | 11,099 | 11,111 | 11,123 | 11,134 |
| 1590 | 11,146 | 11,158 | 11,169 | 11,181 | 11,193 | 11,205 | 11,216 | 11,228 | 11,240 | 11,251 |
| 1600 | 11,263 | 11,275 | 11,286 | 11,298 | 11,310 | 11,321 | 11,333 | 11,345 | 11,357 | 11,368 |
| 1610 | 11,380 | 11,392 | 11,403 | 11,415 | 11,427 | 11,438 | 11,450 | 11,462 | 11,474 | 11,485 |
| 1620 | 11,497 | 11,509 | 11,520 | 11,532 | 11,544 | 11,555 | 11,567 | 11,579 | 11,591 | 11,602 |
| 1630 | 11,614 | 11,626 | 11,637 | 11,649 | 11,661 | 11,673 | 11,684 | 11,696 | 11,708 | 11,719 |
| 1640 | 11,731 | 11,743 | 11,754 | 11,766 | 11,778 | 11,790 | 11,801 | 11,813 | 11,825 | 11,836 |
| 1650 | 11,848 | 11,860 | 11,871 | 11,883 | 11,895 | 11,907 | 11,918 | 11,930 | 11,942 | 11,953 |
| 1660 | 11,965 | 11,977 | 11,988 | 12,000 | 12,012 | 12,024 | 12,035 | 12,047 | 12,059 | 12,070 |
| 1670 | 12,082 | 12,094 | 12,105 | 12,117 | 12,129 | 12,141 | 12,152 | 12,164 | 12,176 | 12,187 |
| 1680 | 12,199 | 12,211 | 12,222 | 12,234 | 12,246 | 12,257 | 12,269 | 12,281 | 12,292 | 12,304 |
| 1690 | 12,316 | 12,327 | 12,339 | 12,351 | 12,363 | 12,374 | 12,386 | 12,398 | 12,409 | 12,421 |
| 1700 | 12,433 | 12,444 | 12,456 | 12,468 | 12,479 | 12,491 | 12,503 | 12,514 | 12,526 | 15,538 |
| 1710 | 12,549 | 12,561 | 12,572 | 12,584 | 12,596 | 12,607 | 12,619 | 12,631 | 12,642 | 12,651 |
| 1720 | 12,666 | 12,677 | 12,689 | 12,701 | 12,712 | 12,724 | 12,736 | 12,747 | 12,759 | 12,770 |
| 1730 | 12,782 | 12,794 | 12,805 | 12,817 | 12,829 | 12,840 | 12,852 | 12,863 | 12,875 | 12,887 |
| 1740 | 12,898 | 12,910 | 12,921 | 12,933 | 12,945 | 12,956 | 12,968 | 12,980 | 12,991 | 13,003 |
| 1750 | 13,014 | 13,026 | 13,037 | 13,049 | 13,061 | 13,072 | 13,084 | 13,095 | 13,107 | 13,119 |
| 1760 | 13,130 | 13,142 | 13,153 | 13,165 | 13,176 | 13,188 | 13,200 | 13,211 | 13,223 | 13,234 |
| 1770 | 13,246 | 13,257 | 13,269 | 13,280 | 13,292 | 13,304 | 13,315 | 13,327 | 13,338 | 13,350 |
| 1780 | 13,361 | 13,373 | 13,384 | 13,396 | 13,407 | 13,419 | 13,430 | 13,442 | 13,453 | 13,465 |
| 1790 | 13,476 | 13,488 | 13,499 | 13,511 | 13,522 | 13,534 | 13,545 | 13,557 | 13,568 | 13,580 |
| 1800 | 13,591 | 13,603 | 13,614 | 13,626 | 13,637 | 13,649 | 13,660 | 13,672 | 13,683 | 13,694 |
| 1810 | 13,706 | 13,717 | 13,729 | 13,740 | 13,752 | 13,763 | 13,775 | 13,786 | 13,797 | 13,809 |
| 1820 | 13,820 | | | | | | | | | |

## *11.1.12 TC Typ E*

### *Temperature range -90°C....+780°C*

### *All resistance value in mV*

| °C in steps of 10 ↓ | °C tended to zero in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-90** | -4,777 | -4,731 | -4,684 | -4,636 | -4,589 | -4,542 | -4,494 | -4,446 | -4,398 | -4,350 |
| **-80** | -4,360 | -4,254 | -4,205 | -4,156 | -4,107 | -4,058 | -4,009 | -3,960 | -3,911 | -3,861 |
| **-70** | -3,811 | -3,761 | -3,711 | -3,661 | -3,611 | -3,561 | -3,510 | -3,459 | -3,408 | -3,357 |
| **-60** | -3,306 | -3,255 | -3,204 | -3,152 | -3,100 | -3,048 | -2,996 | -2,944 | -2,892 | -2,840 |
| **-50** | -2,787 | -2,735 | -2,682 | -2,629 | -2,576 | -2,523 | -2,469 | -2,416 | -2,362 | -2,309 |
| **-40** | -2,255 | -2,201 | -2,147 | -2,093 | -2,038 | -1,984 | -1,929 | -1,874 | -1,820 | -1,765 |
| **-30** | -1,709 | -1,654 | -1,599 | -1,543 | -1,488 | -1,432 | -1,376 | -1,320 | -1,264 | -1,208 |
| **-20** | -1,152 | -1,095 | -1,039 | -0,982 | -0,925 | -0,868 | -0,811 | -0,754 | -0,697 | -0,639 |
| **-10** | -0,582 | -0,524 | -0,466 | -0,408 | -0,350 | -0,292 | -0,234 | -0,176 | -0,117 | -0,059 |

| °C in steps of 10 ↓ | °C ascending in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,059 | 0,118 | 0,176 | 0,235 | 0,294 | 0,354 | 0,413 | 0,472 | 0,532 |
| **10** | 0,591 | 0,651 | 0,711 | 0,770 | 0,830 | 0,890 | 0,950 | 1,010 | 1,071 | 1,131 |
| **20** | 1,192 | 1,252 | 1,313 | 1,373 | 1,434 | 1,495 | 1,556 | 1,617 | 1,678 | 1,740 |
| **30** | 1,801 | 1,862 | 1,924 | 1,986 | 2,047 | 2,109 | 2,171 | 2,233 | 2,295 | 2,357 |
| **40** | 2,420 | 2,482 | 2,545 | 2,607 | 2,670 | 2,733 | 2,795 | 2,858 | 2,921 | 2,984 |
| **50** | 3,048 | 3,111 | 3,174 | 3,238 | 3,301 | 3,365 | 3,429 | 3,492 | 3,556 | 3,620 |
| **60** | 3,685 | 3,749 | 3,813 | 3,877 | 3,942 | 4,006 | 4,071 | 4,136 | 4,200 | 4,265 |
| **70** | 4,330 | 4,395 | 4,460 | 4,526 | 4,591 | 4,656 | 4,722 | 4,788 | 4,853 | 4,919 |
| **80** | 4,985 | 5,051 | 5,117 | 5,183 | 5,249 | 5,315 | 5,382 | 5,448 | 5,514 | 5,581 |
| **90** | 5,648 | 5,714 | 5,781 | 5,848 | 5,915 | 5,982 | 6,049 | 6,117 | 6,184 | 6,251 |
| **100** | 6,319 | 6,386 | 6,454 | 6,522 | 6,590 | 6,658 | 6,725 | 6,794 | 6,862 | 6,930 |
| **110** | 6,998 | 7,066 | 7,135 | 7,203 | 7,272 | 7,341 | 7,409 | 7,478 | 7,547 | 7,616 |
| **120** | 7,685 | 7,754 | 7,823 | 7,892 | 7,962 | 8,031 | 8,101 | 8,170 | 8,240 | 8,309 |
| **130** | 8,379 | 8,449 | 8,519 | 8,589 | 8,659 | 8,729 | 8,799 | 8,869 | 8,940 | 9,010 |
| **140** | 9,081 | 9,151 | 9,222 | 9,292 | 9,363 | 9,434 | 9,505 | 9,576 | 9,647 | 9,718 |
| **150** | 9,789 | 9,860 | 9,931 | 10,003 | 10,074 | 10,145 | 10,217 | 10,288 | 10,360 | 10,432 |
| **160** | 10,503 | 10,575 | 10,647 | 10,719 | 10,791 | 10,863 | 10,935 | 11,007 | 11,080 | 11,152 |
| **170** | 11,224 | 11,297 | 11,369 | 11,442 | 11,514 | 11,587 | 11,660 | 11,733 | 11,805 | 11,878 |
| **180** | 11,951 | 12,024 | 12,097 | 12,170 | 12,243 | 12,317 | 12,390 | 12,463 | 12,537 | 12,610 |
| **190** | 12,684 | 12,757 | 12,831 | 12,904 | 12,978 | 13,052 | 13,126 | 13,199 | 13,273 | 13,347 |
| **200** | 13,421 | 13,495 | 13,569 | 13,644 | 13,718 | 13,792 | 13,866 | 13,941 | 14,015 | 14,090 |
| **210** | 14,164 | 14,239 | 14,313 | 14,388 | 14,463 | 14,537 | 14,612 | 14,687 | 14,762 | 14,837 |
| **220** | 14,912 | 14,987 | 15,062 | 15,137 | 15,212 | 15,287 | 15,362 | 15,438 | 15,513 | 15,588 |
| **230** | 15,664 | 15,739 | 15,815 | 15,890 | 15,966 | 16,041 | 16,117 | 16,193 | 16,269 | 16,344 |
| **240** | 16,420 | 16,496 | 16,572 | 16,648 | 16,724 | 16,800 | 16,876 | 16,952 | 17,028 | 17,104 |
| **250** | 17,181 | 17,257 | 17,333 | 17,409 | 17,486 | 17,562 | 17,639 | 17,715 | 17,792 | 17,868 |
| **260** | 17,945 | 18,021 | 18,098 | 18,175 | 18,252 | 18,328 | 18,405 | 18,482 | 18,559 | 18,636 |
| **270** | 18,713 | 18,790 | 18,867 | 18,944 | 19,021 | 19,098 | 19,175 | 19,252 | 19,330 | 19,407 |
| **280** | 19,484 | 19,561 | 19,639 | 19,716 | 19,794 | 19,871 | 19,948 | 20,026 | 20,103 | 20,181 |
| **290** | 20,259 | 20,336 | 20,414 | 20,492 | 20,569 | 20,647 | 20,725 | 20,803 | 20,880 | 20,958 |
| **300** | 21,036 | 21,114 | 21,192 | 21,270 | 21,348 | 21,426 | 21,504 | 21,582 | 21,660 | 21,739 |
| **310** | 21,817 | 21,895 | 21,973 | 22,051 | 22,130 | 22,208 | 22,286 | 22,365 | 22,443 | 22,522 |
| **320** | 22,600 | 22,678 | 22,757 | 22,835 | 22,914 | 22,993 | 23,071 | 23,150 | 23,228 | 23,307 |
| **330** | 23,386 | 23,464 | 23,543 | 23,622 | 23,701 | 23,780 | 23,858 | 23,937 | 24,016 | 24,095 |
| **340** | 24,174 | 24,253 | 24,332 | 24,411 | 24,490 | 24,569 | 24,648 | 24,727 | 24,806 | 24,885 |

| °C in steps of 10 | °C ascending in step of on | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **350** | 24,964 | 25,044 | 25,123 | 25,202 | 25,281 | 25,360 | 25,440 | 25,519 | 25,598 | 25,678 |
| **360** | 25,757 | 25,836 | 25,916 | 25,995 | 26,075 | 26,154 | 26,233 | 26,313 | 26,392 | 26,472 |
| **370** | 26,552 | 26,631 | 26,711 | 26,790 | 26,870 | 26,950 | 27,029 | 27,109 | 27,189 | 27,268 |
| **380** | 27,348 | 27,428 | 27,507 | 27,587 | 27,667 | 27,747 | 27,827 | 27,907 | 27,986 | 28,066 |
| **390** | 28,146 | 28,226 | 28,306 | 28,386 | 28,466 | 28,546 | 28,626 | 28,706 | 28,786 | 28,866 |
| **400** | 28,946 | 29,026 | 29,106 | 29,186 | 29,266 | 29,346 | 29,427 | 29,507 | 29,587 | 29,667 |
| **410** | 29,748 | 29,827 | 29,908 | 29,988 | 30,068 | 30,148 | 30,229 | 30,309 | 30,389 | 30,470 |
| **420** | 30,550 | 30,630 | 30,711 | 30,791 | 30,871 | 30,952 | 31,032 | 31,112 | 31,193 | 31,273 |
| **430** | 31,354 | 31,434 | 31,515 | 31,595 | 31,676 | 31,756 | 31,837 | 31,917 | 31,998 | 32,078 |
| **440** | 32,159 | 32,239 | 32,320 | 32,400 | 32,481 | 32,562 | 32,642 | 32,723 | 32,803 | 32,884 |
| **450** | 32,965 | 33,045 | 33,126 | 33,207 | 33,287 | 33,368 | 33,449 | 33,529 | 33,610 | 33,691 |
| **460** | 33,772 | 33,852 | 33,933 | 34,014 | 34,095 | 34,175 | 34,256 | 34,337 | 34,418 | 34,498 |
| **470** | 34,579 | 34,660 | 34,741 | 34,822 | 34,902 | 34,983 | 35,064 | 35,145 | 35,226 | 35,307 |
| **480** | 35,387 | 35,468 | 35,549 | 35,630 | 35,711 | 35,792 | 35,873 | 35,954 | 36,034 | 36,115 |
| **490** | 36,196 | 36,277 | 36,358 | 36,439 | 36,520 | 36,601 | 36,682 | 36,763 | 36,846 | 36,925 |
| **500** | 37,005 | 37,086 | 37,167 | 37,248 | 37,329 | 37,410 | 37,491 | 37,572 | 37,653 | 37,734 |
| **510** | 37,815 | 37,896 | 37,977 | 38,058 | 38,139 | 38,220 | 38,300 | 38,381 | 38,462 | 38,534 |
| **520** | 38,624 | 38,705 | 38,786 | 38,867 | 38,948 | 39,029 | 39,110 | 39,191 | 39,272 | 39,353 |
| **530** | 39,434 | 39,515 | 39,596 | 39,677 | 39,758 | 39,839 | 39,920 | 40,001 | 40,082 | 40,163 |
| **540** | 40,243 | 40,324 | 40,405 | 40,486 | 40,567 | 40,648 | 40,729 | 40,810 | 40,891 | 40,972 |
| **550** | 41,053 | 41,134 | 41,215 | 41,296 | 41,377 | 41,457 | 41,538 | 41,619 | 41,700 | 41,781 |
| **560** | 41,862 | 41,943 | 42,024 | 42,105 | 42,185 | 42,266 | 42,347 | 42,428 | 42,509 | 42,590 |
| **570** | 42,671 | 42,751 | 42,832 | 42,913 | 42,994 | 43,075 | 43,156 | 43,236 | 43,317 | 43,398 |
| **580** | 43,479 | 43,560 | 43,640 | 43,721 | 43,802 | 43,883 | 43,963 | 44,044 | 44,125 | 44,206 |
| **590** | 44,286 | 44,367 | 44,448 | 44,529 | 44,609 | 44,690 | 44,771 | 44,851 | 44,932 | 45,013 |
| **600** | 45,093 | 45,174 | 45,255 | 45,335 | 45,416 | 45,497 | 45,577 | 45,658 | 45,738 | 45,819 |
| **610** | 45,900 | 45,980 | 46,061 | 46,141 | 46,222 | 46,302 | 46,383 | 46,463 | 46,544 | 46,624 |
| **620** | 46,705 | 46,785 | 46,866 | 46,946 | 47,027 | 47,107 | 47,188 | 47,268 | 47,349 | 47,429 |
| **630** | 47,509 | 47,590 | 47,670 | 47,751 | 47,831 | 47,911 | 47,992 | 48,072 | 48,152 | 48,233 |
| **640** | 48,313 | 48,393 | 48,474 | 48,554 | 48,634 | 48,715 | 48,795 | 48,875 | 48,955 | 49,035 |
| **650** | 49,116 | 49,196 | 49,276 | 49,356 | 49,436 | 49,517 | 49,597 | 49,677 | 49,757 | 49,837 |
| **660** | 49,917 | 49,997 | 50,077 | 50,157 | 50,238 | 50,318 | 50,398 | 50,478 | 50,558 | 50,638 |
| **670** | 50,718 | 50,798 | 50,878 | 50,958 | 51,038 | 51,118 | 51,197 | 51,277 | 51,357 | 51,437 |
| **680** | 51,517 | 51,597 | 51,677 | 51,757 | 51,837 | 51,916 | 51,996 | 52,076 | 52,156 | 52,236 |
| **690** | 52,315 | 52,395 | 52,475 | 52,555 | 52,634 | 52,714 | 52,794 | 52,873 | 52,953 | 53,033 |
| **700** | 53,112 | 53,192 | 53,272 | 53,351 | 53,431 | 53,510 | 53,590 | 53,670 | 53,749 | 53,829 |
| **710** | 53,908 | 53,988 | 54,067 | 54,147 | 54,226 | 54,306 | 54,385 | 54,465 | 54,544 | 54,624 |
| **720** | 54,703 | 54,782 | 54,862 | 54,941 | 55,021 | 55,100 | 55,179 | 55,259 | 55,338 | 55,417 |
| **730** | 55,497 | 55,576 | 55,655 | 55,734 | 55,814 | 55,893 | 55,972 | 56,051 | 56,131 | 56,210 |
| **740** | 56,289 | 56,368 | 56,447 | 56,526 | 56,606 | 56,685 | 56,764 | 56,843 | 56,922 | 57,001 |
| **750** | 57,080 | 57,159 | 57,238 | 57,317 | 57,396 | 57,475 | 57,554 | 57,633 | 57,712 | 57,791 |
| **760** | 57,870 | 57,949 | 58,028 | 58,107 | 58,186 | 58,265 | 58,343 | 58,422 | 58,501 | 58,580 |
| **770** | 58,659 | 58,738 | 58,816 | 58,895 | 58,974 | 59,053 | 59,131 | 59,210 | 59,289 | 59,367 |
| **780** | 59,446 | | | | | | | | | |

## *11.1.13* TC Typ J

Temperature range -100°C....+1020°C

*All resistance value in mV*

| °C in steps of 10 ↓ | °C tended to zero in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-100** | -4,633 | -4,591 | -4,550 | -4,509 | -4,467 | -4,425 | -4,384 | -4,342 | -4,300 | -4,257 |
| **-90** | -4,215 | -4,173 | -4,130 | -4,088 | -4,045 | -4,002 | -3,959 | 3,916 | -3,872 | -3,829 |
| **-80** | -3,786 | -3,742 | -3,698 | -3,654 | -3,610 | -3,566 | -3,522 | -3,478 | -3,434 | -3,389 |
| **-70** | -3,344 | -3,300 | -3,255 | -3,210 | -3,165 | -3,120 | -3,075 | -3,089 | -2,984 | -2,938 |
| **-60** | -2,893 | -2,847 | -2,801 | -2,755 | -2,709 | -2,663 | -2,617 | -2,571 | -2,524 | -2,478 |
| **-50** | -2,431 | -1,865 | -1,818 | -1,770 | -1,722 | -1,674 | -1,626 | -1,578 | -2,055 | -2,008 |
| **-40** | -1,961 | -1,913 | -1,865 | -1,818 | -1,770 | -1,722 | -1,674 | -1,626 | -1,578 | -1,530 |
| **-30** | -1,482 | -1,433 | -1,385 | -1,336 | -1,288 | -1,239 | -1,190 | -1,142 | -1,093 | -1,044 |
| **-20** | -0,995 | -0,946 | -0,896 | -0,847 | -0,798 | -0,749 | -0,699 | -0,650 | -0,600 | -0,550 |
| **-10** | -0,501 | -0,451 | -0,401 | -0,351 | -0,301 | -0,251 | -0,201 | -0,151 | -0,101 | -0,050 |
| **0** | 0,000 | 0,050 | 0,101 | 0,151 | 0,202 | 0,253 | 0,303 | 0,354 | 0,405 | 0,456 |

| °C in steps of 10 ↓ | °C ascending in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,050 | 0,101 | 0,151 | 0,202 | 0,253 | 0,303 | 0,354 | 0,405 | 0,456 |
| **10** | 0,507 | 0,558 | 0,609 | 0,660 | 0,711 | 0,762 | 0,814 | 0,865 | 0,916 | 0,968 |
| **20** | 1,019 | 1,071 | 1,122 | 1,174 | 1,226 | 1,277 | 1,329 | 1,381 | 1,433 | 1,485 |
| **30** | 1,537 | 1,589 | 1,641 | 1,693 | 1,745 | 1,797 | 1,849 | 1,902 | 1,954 | 2,006 |
| **40** | 2,059 | 2,111 | 2,164 | 2,216 | 2,269 | 2,322 | 2,374 | 2,427 | 2,480 | 2,532 |
| **50** | 2,585 | 2,638 | 2,691 | 2,744 | 2,797 | 2,850 | 2,903 | 2,956 | 3,009 | 3,062 |
| **60** | 3,116 | 3,169 | 3,222 | 3,275 | 3,329 | 3,382 | 3,436 | 3,489 | 3,543 | 3,596 |
| **70** | 3,650 | 3,703 | 3,757 | 3,810 | 3,864 | 3,918 | 3,971 | 4,025 | 4,079 | 4,133 |
| **80** | 4,187 | 4,240 | 4,294 | 4,348 | 4,402 | 4,456 | 4,510 | 4,564 | 4,618 | 4,672 |
| **90** | 4,726 | 4,781 | 4,835 | 4,889 | 4,943 | 4,997 | 5,052 | 5,106 | 5,160 | 5,215 |
| **100** | 5,269 | 5,323 | 5,378 | 5,432 | 5,487 | 5,541 | 5,595 | 5,650 | 5,705 | 5,759 |
| **110** | 5,814 | 5,868 | 5,923 | 5,977 | 6,032 | 6,087 | 6,141 | 6,196 | 6,251 | 6,306 |
| **120** | 6,360 | 6,415 | 6,470 | 6,525 | 6,579 | 6,634 | 6,689 | 6,744 | 6,799 | 6,854 |
| **130** | 6,909 | 6,964 | 7,019 | 7,074 | 7,129 | 7,184 | 7,239 | 7,294 | 7,349 | 7,404 |
| **140** | 7,459 | 7,514 | 7,569 | 7,624 | 7,679 | 7,734 | 7,789 | 7,844 | 7,900 | 7,955 |
| **150** | 8,010 | 8,065 | 8,120 | 8,175 | 8,231 | 8,286 | 8,341 | 8,396 | 8,452 | 8,507 |
| **160** | 8,562 | 8,618 | 8,673 | 8,728 | 8,783 | 8,839 | 8,894 | 8,949 | 9,005 | 9,060 |
| **170** | 9,115 | 9,171 | 9,226 | 9,282 | 9,337 | 9,392 | 9,448 | 9,503 | 9,559 | 9,614 |
| **180** | 9,669 | 9,725 | 9,780 | 9,836 | 9,891 | 9,947 | 10,002 | 10,057 | 10,113 | 10,168 |
| **190** | 10,224 | 10,279 | 10,335 | 10,390 | 10,446 | 10,501 | 10,557 | 10,612 | 10,668 | 10,723 |
| **200** | 10,779 | 10,834 | 10,890 | 10,945 | 11,001 | 11,056 | 11,112 | 11,167 | 11,223 | 11,278 |
| **210** | 11,334 | 11,389 | 11,445 | 11,501 | 11,556 | 11,612 | 11,667 | 11,723 | 11,778 | 11,834 |
| **220** | 11,889 | 11,945 | 12,000 | 12,056 | 12,111 | 12,167 | 12,222 | 12,278 | 12,334 | 12,389 |
| **230** | 12,445 | 12,500 | 12,556 | 12,611 | 12,667 | 12,722 | 12,778 | 12,833 | 12,889 | 12,944 |
| **240** | 13,000 | 13,056 | 13,111 | 13,167 | 13,222 | 13,278 | 13,333 | 13,389 | 13,444 | 13,500 |
| **250** | 13,555 | 13,611 | 13,666 | 13,722 | 13,777 | 13,833 | 13,888 | 13,944 | 13,999 | 14,055 |
| **260** | 14,110 | 14,166 | 14,221 | 14,277 | 14,332 | 14,388 | 14,443 | 14,499 | 14,554 | 14,609 |
| **270** | 14,665 | 14,720 | 14,776 | 14,831 | 14,887 | 14,942 | 14,998 | 15,053 | 15,109 | 15,164 |
| **280** | 15,219 | 15,275 | 15,330 | 15,386 | 15,441 | 15,496 | 15,552 | 15,607 | 15,663 | 15,718 |
| **290** | 15,773 | 15,829 | 15,884 | 15,940 | 15,995 | 16,050 | 16,106 | 16,161 | 16,216 | 16,272 |
| **300** | 16,327 | 16,383 | 16,438 | 16,493 | 16,549 | 16,604 | 16,659 | 16,715 | 16,770 | 16,825 |
| **310** | 16,881 | 16,936 | 16,991 | 17,046 | 17,102 | 17,157 | 17,212 | 17,268 | 17,323 | 17,378 |
| **320** | 17,434 | 17,489 | 17,544 | 17,599 | 17,655 | 17,710 | 17,765 | 17,820 | 17,876 | 17,931 |
| **330** | 17,986 | 18,041 | 18,097 | 18,152 | 18,207 | 18,262 | 18,318 | 18,373 | 18,428 | 18,483 |
| **340** | 18,538 | 18,594 | 18,649 | 18,704 | 18,759 | 18,814 | 18,870 | 18,925 | 18,980 | 19,035 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 350 | 19,090 | 19,146 | 19,201 | 19,256 | 19,311 | 19,366 | 19,422 | 19,477 | 19,532 | 19,587 |
| 360 | 19,642 | 19,697 | 19,753 | 19,808 | 19,863 | 19,918 | 19,973 | 20,028 | 20,083 | 20,139 |
| 370 | 20,194 | 20,249 | 20,304 | 20,359 | 20,414 | 20,469 | 20,525 | 20,580 | 20,635 | 20,690 |
| 380 | 20,745 | 20,800 | 20,855 | 20,911 | 20,966 | 21,021 | 21,076 | 21,131 | 21,186 | 21,241 |
| 390 | 21,297 | 21,352 | 21,407 | 21,462 | 21,517 | 21,572 | 21,627 | 21,683 | 21,738 | 21,793 |
| 400 | 21,848 | 21,903 | 21,958 | 22,014 | 22,069 | 22,124 | 22,179 | 22,234 | 22,289 | 22,345 |
| 410 | 22,400 | 22,455 | 22,510 | 22,565 | 22,620 | 22,676 | 22,731 | 22,786 | 22,841 | 22,896 |
| 420 | 22,952 | 23,007 | 23,062 | 23,117 | 23,172 | 23,228 | 23,283 | 23,338 | 23,393 | 23,449 |
| 430 | 23,504 | 23,559 | 23,614 | 23,670 | 23,725 | 23,780 | 23,835 | 23,891 | 23,946 | 24,001 |
| 440 | 24,057 | 24,112 | 24,167 | 24,223 | 24,278 | 24,333 | 24,389 | 24,444 | 24,499 | 24,555 |
| 450 | 24,610 | 24,665 | 24,721 | 24,776 | 24,832 | 24,887 | 24,943 | 24,998 | 25,053 | 25,109 |
| 460 | 25,164 | 25,220 | 25,275 | 25,331 | 25,386 | 25,442 | 25,497 | 25,553 | 25,608 | 25,664 |
| 470 | 25,720 | 25,775 | 25,831 | 25,886 | 25,942 | 25,998 | 26,053 | 26,109 | 26,165 | 26,220 |
| 480 | 26,276 | 26,332 | 26,387 | 26,443 | 26,499 | 26,555 | 26,610 | 26,666 | 26,722 | 26,778 |
| 490 | 26,834 | 26,889 | 26,945 | 27,001 | 27,057 | 27,113 | 27,169 | 27,225 | 27,281 | 27,337 |
| 500 | 27,393 | 27,449 | 27,505 | 27,561 | 27,617 | 27,673 | 27,729 | 27,785 | 27,841 | 27,897 |
| 510 | 27,953 | 28,010 | 28,066 | 28,122 | 28,178 | 28,234 | 28,291 | 28,347 | 28,403 | 28,460 |
| 520 | 28,516 | 28,572 | 28,629 | 28,685 | 28,741 | 28,798 | 28,854 | 28,911 | 28,967 | 29,024 |
| 530 | 29,080 | 29,137 | 29,194 | 29,250 | 29,307 | 29,363 | 29,420 | 29,477 | 29,534 | 29,590 |
| 540 | 29,647 | 29,704 | 29,761 | 29,818 | 29,874 | 29,931 | 29,988 | 30,045 | 30,102 | 30,159 |
| 550 | 30,216 | 30,273 | 30,330 | 30,387 | 30,444 | 30,502 | 30,559 | 30,616 | 30,673 | 30,730 |
| 560 | 30,788 | 30,845 | 30,902 | 30,960 | 31,017 | 31,074 | 31,132 | 31,189 | 31,247 | 31,304 |
| 570 | 31,362 | 31,419 | 31,477 | 31,535 | 31,592 | 31,650 | 31,708 | 31,766 | 31,823 | 31,881 |
| 580 | 31,939 | 31,997 | 32,055 | 32,113 | 32,171 | 32,229 | 32,287 | 32,345 | 32,403 | 32,461 |
| 590 | 32,519 | 32,577 | 32,636 | 32,694 | 32,752 | 32,810 | 32,869 | 32,927 | 32,985 | 33,044 |
| 600 | 33,102 | 33,161 | 33,219 | 33,278 | 33,337 | 33,395 | 33,454 | 33,513 | 33,571 | 33,630 |
| 610 | 33,689 | 33,748 | 33,807 | 33,866 | 33,925 | 33,984 | 34,043 | 34,102 | 34,161 | 34,220 |
| 620 | 34,279 | 34,338 | 34,397 | 34,457 | 34,516 | 34,575 | 34,635 | 34,694 | 34,754 | 34,813 |
| 630 | 34,873 | 34,932 | 34,992 | 35,051 | 35,111 | 35,171 | 35,230 | 35,290 | 35,350 | 35,410 |
| 640 | 35,470 | 35,530 | 35,590 | 35,650 | 35,710 | 35,770 | 35,830 | 35,890 | 35,950 | 36,010 |
| 650 | 36,071 | 36,131 | 36,191 | 36,252 | 36,312 | 36,373 | 36,433 | 36,494 | 36,554 | 36,615 |
| 660 | 36,675 | 36,736 | 36,797 | 36,858 | 36,918 | 36,979 | 37,040 | 37,101 | 37,162 | 37,223 |
| 670 | 37,284 | 37,345 | 37,406 | 37,467 | 37,528 | 37,590 | 37,651 | 37,712 | 37,773 | 37,835 |
| 680 | 37,896 | 37,958 | 38,019 | 38,081 | 38,142 | 38,204 | 38,265 | 38,327 | 38,389 | 38,450 |
| 690 | 38,512 | 38,574 | 38,636 | 38,698 | 38,760 | 38,822 | 38,884 | 38,946 | 39,008 | 39,070 |
| 700 | 39,132 | 39,194 | 39,256 | 39,318 | 39,381 | 39,443 | 39,505 | 39,568 | 39,630 | 39,693 |
| 710 | 39,755 | 39,818 | 39,880 | 39,943 | 40,005 | 40,068 | 40,131 | 40,193 | 40,256 | 40,319 |
| 720 | 40,382 | 40,445 | 40,508 | 40,570 | 40,633 | 40,696 | 40,759 | 40,822 | 40,886 | 40,949 |
| 730 | 41,012 | 41,075 | 41,138 | 41,201 | 41,265 | 41,328 | 41,391 | 41,455 | 41,518 | 41,581 |
| 740 | 41,645 | 41,708 | 41,772 | 41,835 | 41,899 | 41,962 | 42,026 | 42,090 | 42,153 | 42,217 |
| 750 | 42,281 | 42,344 | 42,408 | 42,472 | 42,536 | 42,599 | 42,663 | 42,727 | 42,791 | 42,855 |
| 760 | 42,919 | 42,983 | 43,047 | 43,111 | 43,175 | 43,239 | 43,303 | 43,367 | 43,431 | 43,495 |
| 770 | 43,559 | 43,624 | 43,688 | 43,752 | 43,817 | 43,881 | 43,945 | 44,010 | 44,074 | 44,139 |
| 780 | 44,203 | 44,267 | 44,332 | 44,396 | 44,461 | 44,525 | 44,590 | 44,655 | 44,719 | 44,784 |
| 790 | 44,848 | 44,913 | 44,977 | 45,042 | 45,107 | 45,171 | 45,236 | 45,301 | 45,365 | 45,430 |
| 800 | 45,494 | 45,559 | 45,624 | 45,688 | 45,753 | 45,818 | 45,882 | 45,947 | 46,011 | 46,076 |
| 810 | 46,141 | 46,205 | 46,270 | 46,334 | 46,399 | 46,464 | 46,528 | 46,593 | 46,657 | 46,722 |
| 820 | 46,786 | 46,851 | 46,915 | 46,980 | 47,044 | 47,109 | 47,173 | 47,238 | 47,302 | 47,367 |
| 830 | 47,431 | 47,495 | 47,560 | 47,624 | 47,688 | 47,753 | 47,817 | 47,881 | 47,946 | 48,010 |
| 840 | 48,074 | 48,138 | 48,202 | 48,267 | 48,331 | 48,395 | 48,459 | 48,523 | 48,587 | 48,651 |
| 850 | 48,715 | 48,779 | 48,843 | 48,907 | 48,971 | 49,034 | 49,098 | 49,162 | 49,226 | 49,290 |
| 860 | 49,353 | 49,417 | 49,481 | 49,544 | 49,608 | 49,672 | 49,735 | 49,799 | 49,862 | 49,926 |
| 870 | 49,989 | 50,052 | 50,116 | 50,179 | 50,243 | 50,306 | 50,369 | 50,432 | 50,495 | 50,559 |
| 880 | 50,622 | 50,685 | 50,748 | 50,811 | 50,874 | 50,937 | 51,000 | 51,063 | 51,126 | 51,188 |
| 890 | 51,251 | 51,314 | 51,377 | 51,439 | 51,502 | 51,565 | 51,627 | 51,690 | 51,752 | 51,815 |
| 900 | 51,877 | 51,940 | 52,002 | 52,064 | 52,127 | 52,189 | 52,251 | 52,314 | 52,376 | 52,438 |
| 910 | 52,500 | 52,562 | 52,624 | 52,686 | 52,748 | 52,810 | 52,872 | 52,934 | 52,996 | 53,057 |
| 920 | 53,119 | 53,181 | 53,243 | 53,304 | 53,366 | 53,427 | 53,489 | 53,550 | 53,612 | 53,673 |
| 930 | 53,735 | 53,796 | 53,857 | 53,919 | 63,980 | 54,041 | 54,102 | 54,164 | 54,225 | 54,286 |
| 940 | 54,347 | 54,408 | 54,469 | 54,530 | 54,591 | 54,652 | 54,713 | 54,773 | 54,834 | 54,895 |
| 950 | 54,956 | 55,016 | 55,077 | 55,138 | 55,198 | 55,259 | 55,319 | 55,380 | 55,440 | 55,501 |
| 960 | 55,561 | 55,622 | 55,682 | 55,742 | 55,803 | 55,863 | 55,923 | 55,983 | 56,043 | 56,104 |
| 970 | 56,164 | 56,224 | 56,284 | 56,344 | 56,404 | 56,464 | 56,524 | 56,584 | 56,643 | 56,703 |
| 980 | 56,763 | 56,823 | 56,883 | 56,942 | 57,002 | 57,062 | 57,121 | 57,181 | 57,240 | 57,300 |
| 990 | 57,360 | 57,419 | 57,479 | 57,538 | 57,597 | 57,657 | 57,716 | 57,776 | 57,835 | 57,894 |
| 1000 | 57,953 | 58,013 | 58,072 | 58,131 | 58,190 | 58,249 | 58,309 | 58,368 | 58,427 | 58,486 |
| 1010 | 58,545 | 58,604 | 58,663 | 58,722 | 58,781 | 58,840 | 58,899 | 58,957 | 59,016 | 59,075 |
| 1020 | 59,134 | | | | | | | | | |

## *11.1.14 TC Typ K (Ni-CrNi)*

*Temperature range -150°C....+1370°C*

*All resistance value in mV*

| °C in steps of 10 ↓ | °C tended to zero in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-150** | -4,912 | -4,889 | -4,865 | -4,841 | -4,817 | -4,792 | -4,768 | -4,743 | -4,719 | -4,694 |
| **-140** | -4,669 | -4,644 | -4,618 | -4,593 | -4,567 | -4,541 | -4,515 | -4,489 | -4,463 | -4,437 |
| **-130** | -4,410 | -4,384 | -4,357 | -4,330 | -4,303 | -4,276 | -4,248 | -4,221 | -4,193 | -4,166 |
| **-120** | -4,138 | -4,110 | -4,082 | -4,053 | -4,025 | -3,997 | -3,968 | -3,939 | -3,910 | -3,881 |
| **-110** | -3,852 | -3,823 | -3,793 | -3,764 | -3,734 | -3,704 | -3,674 | -3,644 | -3,614 | -3,584 |
| **-100** | -3,553 | -3,523 | -3,492 | -3,461 | -3,430 | -3,399 | -3,368 | -3,337 | -3,305 | -3,274 |
| **-90** | -3,242 | -3,211 | -3,179 | -3,147 | -3,115 | -3,082 | -3,050 | -3,018 | -2,985 | -2,953 |
| **-80** | 2,920 | -2,887 | -2,854 | -2,821 | -2,788 | -2,754 | -2,721 | -2,687 | -2,654 | -2,620 |
| **-70** | -2,586 | -2,552 | -2,518 | -2,484 | -2,450 | -2,416 | -2,381 | -2,347 | -2,312 | -2,277 |
| **-60** | -2,243 | -2,208 | -2,173 | 2,137 | -2,102 | -2,067 | -2,032 | -1,966 | -1,961 | -1,925 |
| **-50** | -1,889 | -1,853 | -1,817 | -1,781 | -1,745 | -1,709 | -1,673 | -1,636 | -1,600 | -1,563 |
| **-40** | -1,527 | -1,490 | -1,453 | -1,416 | -1,379 | -1,342 | -1,305 | -1,268 | -1,231 | -1,193 |
| **-30** | -1,156 | -1,118 | -1,081 | -1,043 | -1,005 | -0,968 | -0,930 | -0,892 | -0,854 | 0,816 |
| **-20** | -0,777 | -0,739 | -0,701 | -0,662 | -0,362 | -0,585 | 0,547 | -0,508 | -0,469 | -0,431 |
| **-10** | -0,392 | -0,353 | -0,314 | -0,275 | -0,236 | -0,197 | -0,157 | -0,118 | -0,079 | -0,039 |

| °C in steps of 10 ↓ | °C ascending in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,039 | 0,079 | 0,119 | 0,158 | 0,198 | 0,238 | 0,277 | 0,317 | 0,357 |
| **10** | 0,397 | 0,437 | 0,477 | 0,517 | 0,557 | 0,597 | 0,637 | 0,677 | 0,718 | 0,758 |
| **20** | 0,798 | 0,838 | 0,879 | 0,919 | 0,960 | 1,000 | 1,041 | 1,081 | 1,122 | 1,162 |
| **30** | 1,203 | 1,244 | 1,285 | 1,325 | 1,366 | 1,407 | 1,448 | 1,489 | 1,529 | 1,570 |
| **40** | 1,611 | 1,652 | 1,693 | 1,734 | 1,776 | 1,817 | 1,858 | 1,899 | 1,940 | 1,981 |
| **50** | 2,022 | 2,064 | 2,105 | 2,146 | 2,188 | 2,229 | 2,270 | 2,312 | 2,353 | 2,394 |
| **60** | 2,436 | 2,477 | 2,519 | 2,560 | 2,601 | 2,643 | 2,684 | 2,726 | 2,767 | 2,809 |
| **70** | 2,850 | 2,892 | 2,933 | 2,975 | 3,016 | 3,058 | 3,100 | 3,141 | 3,183 | 3,224 |
| **80** | 3,266 | 3,307 | 3,349 | 3,390 | 3,432 | 3,473 | 3,515 | 3,556 | 3,598 | 3,639 |
| **90** | 3,681 | 3,722 | 3,764 | 3,805 | 3,847 | 3,888 | 3,930 | 3,971 | 4,012 | 4,054 |
| **100** | 4,095 | 4,137 | 4,178 | 4,219 | 4,261 | 4,302 | 4,343 | 4,384 | 4,426 | 4,467 |
| **110** | 4,508 | 4,549 | 4,590 | 4,632 | 4,673 | 4,714 | 4,755 | 4,796 | 4,837 | 4,878 |
| **120** | 4,919 | 4,960 | 5,001 | 5,042 | 5,083 | 5,124 | 5,164 | 5,205 | 5,246 | 5,287 |
| **130** | 5,327 | 5,368 | 5,409 | 5,450 | 5,490 | 5,531 | 5,571 | 5,612 | 5,652 | 5,693 |
| **140** | 5,733 | 5,774 | 5,814 | 5,855 | 5,895 | 5,936 | 5,976 | 6,016 | 6,057 | 6,097 |
| **150** | 6,137 | 6,177 | 6,218 | 6,258 | 6,298 | 6,338 | 6,378 | 6,419 | 6,459 | 6,499 |
| **160** | 6,539 | 6,579 | 6,619 | 6,659 | 6,699 | 6,739 | 6,779 | 6,819 | 6,859 | 6,899 |
| **170** | 6,939 | 6,979 | 7,019 | 7,059 | 7,099 | 7,139 | 7,179 | 7,219 | 7,259 | 7,299 |
| **180** | 7,338 | 7,378 | 7,418 | 7,458 | 7,498 | 7,538 | 7,578 | 7,618 | 7,658 | 7,697 |
| **190** | 7,737 | 7,777 | 7,817 | 7,859 | 7,897 | 7,937 | 7,977 | 8,017 | 8,057 | 8,097 |
| **200** | 8,137 | 8,177 | 8,216 | 8,256 | 8,296 | 8,336 | 8,376 | 8,416 | 8,456 | 8,497 |
| **210** | 5,537 | 8,577 | 8,617 | 8,657 | 8,697 | 8,737 | 8,777 | 8,817 | 8,857 | 8,898 |
| **220** | 8,938 | 8,978 | 9,018 | 9,058 | 9,099 | 9,139 | 9,179 | 9,220 | 9,260 | 9,300 |
| **230** | 9,341 | 9,381 | 9,421 | 9,462 | 9,502 | 9,543 | 9,583 | 9,624 | 9,664 | 9,705 |
| **240** | 9,745 | 9,786 | 9,826 | 9,867 | 9,907 | 9,948 | 9,989 | 10,029 | 10,070 | 10,111 |
| **250** | 10,151 | 10,192 | 10,233 | 10,274 | 10,315 | 10,355 | 10,396 | 10,437 | 10,478 | 10,519 |
| **260** | 10,560 | 10,600 | 10,641 | 10,682 | 10,723 | 10,764 | 10,805 | 10,846 | 10,887 | 10,928 |
| **270** | 10,969 | 11,010 | 11,051 | 11,093 | 11,134 | 11,175 | 11,216 | 11,257 | 11,298 | 11,339 |
| **280** | 11,381 | 11,422 | 11,463 | 11,504 | 11,546 | 11,587 | 11,628 | 11,669 | 11,711 | 11,752 |
| **290** | 11,793 | 11,835 | 11,876 | 11,918 | 11,959 | 12,000 | 12,042 | 12,083 | 12,125 | 12,166 |
| **300** | 12,207 | 12,249 | 12,290 | 12,332 | 12,373 | 12,415 | 12,456 | 12,498 | 12,539 | 12,581 |
| **310** | 12,623 | 12,664 | 12,706 | 12,747 | 12,789 | 122,831 | 12,872 | 12,914 | 12,955 | 12,997 |
| **320** | 13,039 | 13,080 | 13,122 | 13,164 | 13,205 | 13,247 | 13,289 | 13,331 | 13,372 | 13,414 |
| **330** | 13,456 | 13,497 | 13,539 | 13,581 | 13,623 | 13,665 | 13,706 | 13,748 | 13,790 | 13,832 |
| **340** | 13,874 | 13,915 | 13,957 | 13,999 | 14,041 | 14,083 | 14,125 | 14,167 | 14,208 | 14,250 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **350** | 14,292 | 14,334 | 14,376 | 14,418 | 14,460 | 14,502 | 14,544 | 14,586 | 14,628 | 14,670 |
| **360** | 14,712 | 14,754 | 14,796 | 14,838 | 14,880 | 14,922 | 14,964 | 15,006 | 15,048 | 15,090 |
| **370** | 15,132 | 14,174 | 15,216 | 15,258 | 15,300 | 15,342 | 15,384 | 15,426 | 15,468 | 15,510 |
| **380** | 15,552 | 15,594 | 15,636 | 15,679 | 15,721 | 15,763 | 15,805 | 153,847 | 15,889 | 15,931 |
| **390** | 15,974 | 16,016 | 16,058 | 16,100 | 16,142 | 16,184 | 16,227 | 16,269 | 16,311 | 16,353 |
| **400** | 16,395 | 16,438 | 16,480 | 16,522 | 16,564 | 16,607 | 16,649 | 16,691 | 16,733 | 16,776 |
| **410** | 16,818 | 16,86 | 16,902 | 16,945 | 16,987 | 17,029 | 17,072 | 17,114 | 17,156 | 17,199 |
| **420** | 17,241 | 17,283 | 17,326 | 17,368 | 17,41 | 17,453 | 17,495 | 17,537 | 17,580 | 17,622 |
| **430** | 17,664 | 17,707 | 17,749 | 17,792 | 17,834 | 17,876 | 17,919 | 17,961 | 18,004 | 18,046 |
| **440** | 18,088 | 18,131 | 18,173 | 18,216 | 18,258 | 18,301 | 18,343 | 18,385 | 18,428 | 18,47 |
| **450** | 18,513 | 18,555 | 18,598 | 18,640 | 18,683 | 18,725 | 18,768 | 18,810 | 18,853 | 18,895 |
| **460** | 18,938 | 18,980 | 19,023 | 19,065 | 19,108 | 19,150 | 19,193 | 19,235 | 19,278 | 19,320 |
| **470** | 193,363 | 19,405 | 19,448 | 196,490 | 19,533 | 196,576 | 19,618 | 19,661 | 19,703 | 17,746 |
| **480** | 19,788 | 19,831 | 19,873 | 19,916 | 19,959 | 20,001 | 20,044 | 20,086 | 20,129 | 20,172 |
| **490** | 20,214 | 20,257 | 20,299 | 20,342 | 20,385 | 20,427 | 20,470 | 20,512 | 20,555 | 20,598 |
| **500** | 20,640 | 20,683 | 20,725 | 20,768 | 20,811 | 20,853 | 20,896 | 20,938 | 20,981 | 21,024 |
| **510** | 21,066 | 21,109 | 21,152 | 21,194 | 21,237 | 21,28 | 21,322 | 21,365 | 21,407 | 21,450 |
| **520** | 21,493 | 21,535 | 21,578 | 21,621 | 21,663 | 21,706 | 21,749 | 21,791 | 21,834 | 21,876 |
| **530** | 21,919 | 21,962 | 22,004 | 22,047 | 22,090 | 22,132 | 22,175 | 22,218 | 22,260 | 22,303 |
| **540** | 22,346 | 22,388 | 22,431 | 22,473 | 22,516 | 22,559 | 22,601 | 22,644 | 22,687 | 22,729 |
| **550** | 22,772 | 22,815 | 22,857 | 22,900 | 22,942 | 22,985 | 23,028 | 23,070 | 23,117 | 23,156 |
| **560** | 23,198 | 23,241 | 23,284 | 23,326 | 23,369 | 23,411 | 23,454 | 23,497 | 23,539 | 23,582 |
| **570** | 23,624 | 23,667 | 23,710 | 23,752 | 23,795 | 23,837 | 23,880 | 23,923 | 23,965 | 24,008 |
| **580** | 24,050 | 24,093 | 24,136 | 24,178 | 24,221 | 24,263 | 24,306 | 24,348 | 24,391 | 24,434 |
| **590** | 24,476 | 24,519 | 24,561 | 24,604 | 24,646 | 24,689 | 24,731 | 24,774 | 24,817 | 24,859 |
| **600** | 24,902 | 24,944 | 24,987 | 25,029 | 25,072 | 25,114 | 25,157 | 25,199 | 25,242 | 25,284 |
| **610** | 25,327 | 25,369 | 25,412 | 25,454 | 25,497 | 25,539 | 25,582 | 25,624 | 25,666 | 25,709 |
| **620** | 25,751 | 25,794 | 25,836 | 25,879 | 25,921 | 25,964 | 26,006 | 26,048 | 26,091 | 26,133 |
| **630** | 26,176 | 26,218 | 26,260 | 26,303 | 26,345 | 26,387 | 26,430 | 26,472 | 26,515 | 26,557 |
| **640** | 26,599 | 26,642 | 26,684 | 26,726 | 26,769 | 26,811 | 26,853 | 26,896 | 26,938 | 26,980 |
| **650** | 27,022 | 27,065 | 27,107 | 27,149 | 27,192 | 27,234 | 27,276 | 27,318 | 27,361 | 27,403 |
| **660** | 27,445 | 27,487 | 27,529 | 27,572 | 27,614 | 27,656 | 27,698 | 27,740 | 27,783 | 27,825 |
| **670** | 27,867 | 27,909 | 27,951 | 27,993 | 28,035 | 28,078 | 28,120 | 28,162 | 28,204 | 28,246 |
| **680** | 28,288 | 28,330 | 28,372 | 28,414 | 28,456 | 28,498 | 28,540 | 28,593 | 28,625 | 28,667 |
| **690** | 28,709 | 28,751 | 28,793 | 28,835 | 28,877 | 28,919 | 28,961 | 29,002 | 29,044 | 29,086 |
| **700** | 29,128 | 29,170 | 29,212 | 29,254 | 29,296 | 29,338 | 29,380 | 29,422 | 29,464 | 29,505 |
| **710** | 29,547 | 29,589 | 29,631 | 29,673 | 29,715 | 29,756 | 29,798 | 29,840 | 29,882 | 29,924 |
| **720** | 29,965 | 30,007 | 30,049 | 30,091 | 30,132 | 30,174 | 30,216 | 30,257 | 30,299 | 30,341 |
| **730** | 30,383 | 30,427 | 30,466 | 30,508 | 30,549 | 30,591 | 30,632 | 30,674 | 30,716 | 30,757 |
| **740** | 30,799 | 30,840 | 30,882 | 30,924 | 30,965 | 31,007 | 31,048 | 31,090 | 31,131 | 31,173 |
| **750** | 31,214 | 31,256 | 31,297 | 31,339 | 31,380 | 31,422 | 31,463 | 31,504 | 31,546 | 31,587 |
| **760** | 31,629 | 31,670 | 31,712 | 31,753 | 31,794 | 31,856 | 31,877 | 31,918 | 31,960 | 32,001 |
| **770** | 32,042 | 32,084 | 32,125 | 32,166 | 32,207 | 32,249 | 32,290 | 32,331 | 32,372 | 32,414 |
| **780** | 32,455 | 32,496 | 32,537 | 32,578 | 32,619 | 32,661 | 32,702 | 32,743 | 32,784 | 32,825 |
| **790** | 32,866 | 32,907 | 32,948 | 32,990 | 33,031 | 33,072 | 33,113 | 33,154 | 33,195 | 33,236 |
| **800** | 33,277 | 33,318 | 33,359 | 33,400 | 33,441 | 33,482 | 33,523 | 33,564 | 33,604 | 33,645 |
| **810** | 33,686 | 33,727 | 33,768 | 33,809 | 33,850 | 33,891 | 33,931 | 33,972 | 34,013 | 34,054 |
| **820** | 34,095 | 34,136 | 34,176 | 34,217 | 34,258 | 34,299 | 34,339 | 34,380 | 34,421 | 34,461 |
| **830** | 34,502 | 34,543 | 34,583 | 34,624 | 34,665 | 34,705 | 34,746 | 34,787 | 34,827 | 34,868 |
| **840** | 34,909 | 34,949 | 34,990 | 35,030 | 35,071 | 35,111 | 35,152 | 35,192 | 35,233 | 35,273 |
| **850** | 35,314 | 35,354 | 35,395 | 35,435 | 35,476 | 35,516 | 35,557 | 35,597 | 35,637 | 35,678 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **860** | 35,718 | 35,758 | 35,799 | 35,839 | 35,880 | 35,920 | 35,960 | 36,000 | 36,041 | 36,081 |
| **870** | 36,121 | 36,162 | 36,202 | 36,242 | 36,282 | 36,323 | 36,363 | 36,403 | 36,443 | 36,483 |
| **880** | 36,524 | 36,564 | 36,604 | 36,644 | 36,684 | 36,724 | 36,764 | 36,804 | 36,844 | 36,885 |
| **890** | 36,925 | 36,965 | 37,005 | 37,045 | 37,085 | 37,125 | 37,165 | 37,205 | 37,245 | 37,285 |
| **900** | 37,325 | 37,365 | 37,405 | 37,445 | 37,484 | 37,524 | 37,564 | 37,604 | 37,644 | 37,684 |
| **910** | 37,724 | 37,764 | 37,803 | 37,843 | 37,883 | 37,923 | 37,963 | 38,002 | 38,042 | 38,082 |
| **920** | 38,122 | 38,162 | 38,201 | 38,241 | 38,281 | 38,320 | 38,360 | 38,400 | 38,439 | 38,479 |
| **930** | 38,519 | 38,558 | 38,598 | 38,638 | 38,677 | 38,717 | 38,756 | 38,796 | 38,836 | 38,875 |
| **940** | 38,915 | 38,954 | 38,994 | 39,033 | 39,073 | 39,112 | 39,152 | 39,191 | 39,231 | 39,270 |
| **950** | 39,310 | 39,349 | 39,388 | 39,428 | 39,467 | 39,507 | 39,546 | 39,585 | 39,625 | 39,664 |
| **960** | 39,703 | 39,743 | 39,782 | 39,821 | 39,861 | 39,900 | 39,939 | 39,979 | 40,018 | 40,057 |
| **970** | 40,096 | 40,136 | 40,175 | 40,214 | 40,253 | 40,262 | 40,332 | 40,710 | 40,410 | 40,449 |
| **980** | 40,488 | 40,527 | 40,566 | 40,605 | 40,645 | 40,684 | 40,723 | 40,762 | 40,801 | 40,840 |
| **990** | 40,879 | 40,918 | 40,957 | 40,996 | 41,035 | 41,074 | 41,113 | 41,115 | 41,191 | 41,230 |
| **1000** | 41,269 | 41,308 | 41,347 | 41,385 | 41,424 | 41,463 | 41,502 | 41,541 | 41,580 | 41,619 |
| **1010** | 41,657 | 41,696 | 41,735 | 41,774 | 41,813 | 41,851 | 41,890 | 41,929 | 41,968 | 42,006 |
| **1020** | 42,045 | 42,084 | 42,123 | 42,161 | 42,200 | 42,239 | 42,277 | 42,316 | 42,355 | 42,393 |
| **1030** | 42,432 | 42,470 | 42,506 | 42,548 | 42,586 | 42,625 | 42,663 | 42,702 | 42,740 | 42,779 |
| **1040** | 42,817 | 42,856 | 42,894 | 42,933 | 42,971 | 43,010 | 43,048 | 43,087 | 43,125 | 43,164 |
| **1050** | 43,202 | 43,240 | 43,279 | 43,317 | 43,356 | 43,394 | 43,432 | 43,471 | 43,509 | 43,547 |
| **1060** | 43,585 | 43,624 | 43,662 | 43,700 | 43,739 | 43,777 | 43,815 | 43,853 | 43,891 | 43,930 |
| **1070** | 43,968 | 44,006 | 44,044 | 44,082 | 44,121 | 44,159 | 44,197 | 44,235 | 44,273 | 44,311 |
| **1080** | 44,349 | 44,387 | 44,425 | 44,463 | 44,501 | 44,539 | 44,577 | 44,615 | 44,653 | 44,691 |
| **1090** | 44,729 | 44,767 | 44,805 | 44,843 | 44,881 | 44,919 | 44,957 | 44,995 | 45,033 | 45,070 |
| **1100** | 45,108 | 45,146 | 45,184 | 45,222 | 45,260 | 45,297 | 45,335 | 45,373 | 45,411 | 45,448 |
| **1110** | 45,486 | 45,524 | 45,561 | 45,599 | 45,637 | 45,675 | 45,712 | 45,750 | 45,787 | 45,825 |
| **1120** | 45,863 | 45,900 | 45,938 | 45,975 | 46,013 | 46,051 | 46,088 | 46,126 | 46,163 | 46,201 |
| **1130** | 46,238 | 46,275 | 46,313 | 46,350 | 46,388 | 46,425 | 46,463 | 46,500 | 46,537 | 46,575 |
| **1140** | 46,612 | 46,649 | 46,687 | 46,724 | 46,761 | 46,799 | 46,836 | 46,873 | 46,910 | 46,948 |
| **1150** | 46,985 | 47,022 | 47,059 | 47,096 | 47,134 | 47,141 | 47,208 | 47,245 | 47,282 | 47,319 |
| **1160** | 47,356 | 47,393 | 47,430 | 47,468 | 47,505 | 47,542 | 47,579 | 47,616 | 47,653 | 47,689 |
| **1170** | 47,726 | 47,763 | 47,800 | 47,837 | 47,874 | 47,911 | 47,948 | 47,985 | 48,021 | 48,058 |
| **1180** | 48,095 | 48,132 | 48,169 | 48,205 | 48,242 | 48,279 | 48,316 | 48,352 | 48,389 | 48,426 |
| **1190** | 48,462 | 48,499 | 48,536 | 48,572 | 48,609 | 48,645 | 48,682 | 48,718 | 48,755 | 48,792 |
| **1200** | 48,828 | 48,865 | 48,901 | 48,937 | 48,974 | 49,010 | 49,047 | 49,083 | 49,120 | 49,156 |
| **1210** | 49,192 | 49,229 | 49,265 | 49,301 | 49,338 | 49,374 | 49,410 | 49,446 | 49,483 | 49,519 |
| **1220** | 49,555 | 49,591 | 49,627 | 49,663 | 49,700 | 49,736 | 49,772 | 49,808 | 49,844 | 49,880 |
| **1230** | 49,916 | 49,952 | 49,988 | 50,024 | 50,060 | 50,096 | 50,132 | 50,168 | 50,204 | 50,240 |
| **1240** | 50,276 | 50,311 | 50,347 | 50,383 | 50,419 | 50,455 | 50,491 | 50,526 | 50,562 | 50,598 |
| **1250** | 50,633 | 50,669 | 50,705 | 50,741 | 50,776 | 50,812 | 50,847 | 50,883 | 50,919 | 50,954 |
| **1260** | 50,990 | 51,025 | 51,061 | 51,096 | 51,132 | 51,167 | 51,203 | 51,238 | 51,274 | 51,309 |
| **1270** | 51,344 | 51,380 | 51,415 | 51,450 | 51,486 | 51,521 | 51,556 | 51,592 | 51,627 | 51,662 |
| **1280** | 51,697 | 51,733 | 51,768 | 51,803 | 51,838 | 51,873 | 51,908 | 51,943 | 51,979 | 52,014 |
| **1290** | 52,049 | 52,084 | 52,119 | 52,154 | 52,189 | 52,224 | 52,259 | 52,294 | 52,329 | 52,364 |
| **1300** | 52,398 | 52,433 | 52,468 | 52,503 | 52,538 | 52,573 | 52,608 | 52,642 | 52,677 | 52,712 |
| **1310** | 52,747 | 52,781 | 52,816 | 52,851 | 52,886 | 52,920 | 52,955 | 52,989 | 53,024 | 53,059 |
| **1320** | 53,093 | 53,128 | 53,162 | 53,197 | 53,232 | 53,266 | 53,301 | 53,335 | 53,370 | 53,404 |
| **1330** | 53,439 | 53,473 | 53,507 | 53,542 | 53,576 | 53,611 | 53,645 | 53,679 | 53,714 | 53,748 |
| **1340** | 53,782 | 53,817 | 53,851 | 53,885 | 53,920 | 53,954 | 53,988 | 54,022 | 54,057 | 54,091 |
| **1350** | 54,125 | 54,159 | 54,193 | 54,228 | 54,262 | 54,296 | 54,330 | 54,364 | 54,398 | 54,432 |
| **1360** | 54,466 | 54,501 | 54,535 | 54,569 | 54,603 | 54,637 | 54,671 | 54,705 | 54,739 | 54,773 |
| **1370** | 54,807 | | | | | | | | | |

## *11.1.15 TC Typ L (Fe-CuNi)*

*Temperature range -105°C....+900°C*

*All resistance value in mV*

| °C in steps of 10 ↓ | °C tended to zero in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-110** | | | | | | -4,950 | -4,910 | -4,870 | -4,830 | -4,790 |
| **-100** | -4,750 | -4,710 | -4,660 | -4,620 | -4,580 | -4,540 | -4,500 | -4,450 | -4,410 | -4,370 |
| **-90** | -4,330 | -4,280 | -4,240 | -4,200 | -4,150 | -4,110 | -4,060 | -4,020 | -3,980 | -3,930 |
| **-80** | -3,890 | -3,840 | -3,800 | -3,750 | -3,710 | -3,660 | -3,620 | -3,570 | -3,530 | -3,480 |
| **-70** | -3,440 | -3,390 | -3,350 | -3,300 | -3,250 | -3,210 | -3,160 | -3,120 | -3,070 | -3,020 |
| **-60** | -2,980 | -2,930 | -2,880 | -2,840 | -2,790 | -2,740 | -2,700 | -2,650 | -2,600 | -2,560 |
| **-50** | -2,510 | -2,460 | -2,410 | -2,360 | -2,320 | -2,270 | -2,220 | -2,170 | -2,120 | -2,080 |
| **-40** | -2,030 | -1,980 | -1,930 | -1,880 | -1,830 | -1,780 | -1,730 | -1,680 | -1,630 | -1,580 |
| **-30** | -1,530 | -1,480 | -1,430 | -1,380 | -1,320 | -1,270 | -1,220 | -1,170 | -1,120 | -1,070 |
| **-20** | -1,020 | -0,970 | -0,920 | -0,870 | -0,810 | -0,760 | -0,710 | -0,660 | -0,610 | -0,560 |
| **-10** | -0,510 | -0,460 | -0,410 | -0,360 | -0,310 | -0,250 | -0,200 | -0,150 | -0,100 | -0,050 |

| °C in steps of 10 ↓ | °C ascending in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,050 | 0,100 | 0,160 | 0,210 | 0,260 | 0,310 | 0,360 | 0,420 | 0,470 |
| **10** | 0,520 | 0,570 | 0,630 | 0,680 | 0,730 | 0,780 | 0,840 | 0,890 | 0,940 | 1,000 |
| **20** | 1,050 | 1,100 | 1,160 | 1,210 | 1,260 | 1,310 | 1,370 | 1,420 | 1,470 | 1,530 |
| **30** | 1,580 | 1,630 | 1,690 | 1,740 | 1,790 | 1,840 | 1,900 | 1,950 | 2,000 | 2,060 |
| **40** | 2,110 | 2,160 | 2,220 | 2,270 | 2,330 | 2,380 | 2,430 | 2,490 | 2,540 | 2,600 |
| **50** | 2,650 | 2,700 | 2,760 | 2,810 | 2,870 | 2,920 | 2,970 | 3,030 | 3,080 | 3,140 |
| **60** | 3,190 | 3,240 | 3,300 | 3,350 | 3,410 | 3,460 | 3,510 | 3,570 | 3,620 | 3,680 |
| **70** | 3,730 | 3,780 | 3,840 | 3,890 | 3,950 | 4,000 | 4,050 | 4,110 | 4,160 | 4,220 |
| **80** | 4,270 | 4,320 | 4,380 | 4,430 | 4,490 | 4,540 | 4,600 | 4,650 | 4,710 | 4,770 |
| **90** | 4,820 | 4,870 | 4,930 | 4,980 | 5,040 | 5,090 | 5,150 | 5,200 | 5,260 | 5,320 |
| **100** | 5,370 | 5,420 | 5,480 | 5,530 | 5,590 | 5,640 | 5,700 | 5,750 | 5,810 | 5,870 |
| **110** | 5,920 | 5,970 | 6,030 | 6,080 | 6,140 | 6,190 | 6,250 | 6,300 | 6,360 | 6,420 |
| **120** | 6,470 | 6,530 | 6,580 | 6,640 | 6,690 | 6,750 | 6,810 | 6,860 | 6,920 | 6,970 |
| **130** | 7,030 | 7,090 | 7,140 | 7,200 | 7,250 | 7,310 | 7,370 | 7,420 | 7,480 | 7,530 |
| **140** | 7,590 | 7,650 | 7,700 | 7,760 | 7,810 | 7,870 | 7,930 | 7,980 | 8,040 | 8,090 |
| **150** | 8,150 | 8,210 | 8,260 | 8,320 | 8,370 | 8,430 | 8,490 | 8,540 | 8,600 | 8,650 |
| **160** | 8,710 | 8,770 | 8,820 | 8,880 | 8,930 | 8,990 | 9,050 | 9,100 | 9,160 | 9,210 |
| **170** | 9,270 | 9,330 | 9,380 | 9,440 | 9,490 | 9,550 | 9,610 | 9,660 | 9,720 | 9,770 |
| **180** | 9,830 | 9,890 | 9,940 | 10,000 | 10,050 | 10,110 | 10,170 | 10,220 | 10,280 | 10,330 |
| **190** | 10,390 | 10,450 | 10,500 | 10,560 | 10,631 | 10,670 | 10,730 | 10,780 | 10,840 | 10,890 |
| **200** | 10,950 | 11,010 | 11,060 | 11,120 | 11,170 | 11,230 | 11,290 | 11,340 | 11,400 | 11,450 |
| **210** | 11,510 | 11,570 | 11,620 | 11,680 | 11,730 | 11,790 | 11,850 | 11,900 | 11,960 | 12,010 |
| **220** | 12,070 | 12,130 | 12,180 | 12,240 | 12,290 | 12,350 | 12,410 | 12,460 | 12,520 | 12,570 |
| **230** | 12,630 | 12,690 | 12,740 | 12,800 | 12,850 | 12,910 | 12,970 | 13,020 | 13,080 | 13,130 |
| **240** | 13,190 | 13,250 | 13,300 | 13,360 | 13,410 | 13,470 | 13,530 | 13,580 | 13,640 | 13,690 |
| **250** | 13,750 | 13,810 | 13,860 | 13,920 | 13,970 | 14,030 | 14,090 | 14,140 | 14,200 | 14,250 |
| **260** | 14,310 | 14,370 | 14,420 | 14,480 | 14,540 | 14,590 | 14,650 | 14,710 | 14,760 | 14,820 |
| **270** | 14,880 | 14,940 | 14,990 | 15,050 | 15,100 | 15,160 | 15,220 | 15,270 | 15,330 | 15,380 |
| **280** | 15,440 | 15,500 | 15,550 | 15,610 | 15,660 | 15,720 | 15,780 | 15,830 | 15,890 | 15,940 |
| **290** | 16,000 | 16,060 | 16,110 | 16,170 | 16,220 | 16,280 | 16,340 | 16,390 | 16,450 | 16,500 |
| **300** | 16,560 | 16,620 | 16,670 | 16,730 | 16,780 | 16,840 | 16,900 | 16,950 | 17,010 | 17,060 |
| **310** | 17,120 | 17,180 | 17,230 | 17,290 | 17,340 | 17,400 | 17,460 | 17,510 | 17,570 | 17,620 |
| **320** | 17,680 | 17,740 | 17,790 | 17,850 | 17,900 | 17,960 | 18,020 | 18,070 | 18,130 | 18,180 |
| **330** | 18,240 | 18,300 | 18,350 | 18,410 | 18,460 | 18,520 | 18,580 | 18,630 | 18,690 | 18,740 |
| **340** | 18,800 | 18,860 | 18,910 | 18,970 | 19,020 | 19,085 | 19,140 | 19,190 | 19,250 | 19,300 |
| **350** | 19,360 | 19,420 | 19,470 | 19,530 | 19,580 | 19,640 | 19,700 | 19,750 | 19,810 | 19,850 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **360** | 19,920 | 19,980 | 20,030 | 20,090 | 20,140 | 20,200 | 20,260 | 20,310 | 20,370 | 20,420 |
| **370** | 20,480 | 20,540 | 20,590 | 20,650 | 20,700 | 20,760 | 20,820 | 20,870 | 20,930 | 20,980 |
| **380** | 21,040 | 21,100 | 21,150 | 21,210 | 21,260 | 21,320 | 21,380 | 21,430 | 21,490 | 21,540 |
| **390** | 21,600 | 21,660 | 21,710 | 21,770 | 21,820 | 21,880 | 21,940 | 21,990 | 22,050 | 22,100 |
| **400** | 22,160 | 22,220 | 22,270 | 22,330 | 22,380 | 22,440 | 22,500 | 22,550 | 22,610 | 22,660 |
| **410** | 22,720 | 22,780 | 22,830 | 22,890 | 22,950 | 23,000 | 23,060 | 23,120 | 23,180 | 23,230 |
| **420** | 23,290 | 23,350 | 23,400 | 23,460 | 23,520 | 23,570 | 23,630 | 23,690 | 23,740 | 23,800 |
| **430** | 23,860 | 23,920 | 23,970 | 24,030 | 24,090 | 24,140 | 24,200 | 24,260 | 24,320 | 24,370 |
| **440** | 24,430 | 24,490 | 24,540 | 24,600 | 24,660 | 24,710 | 24,770 | 24,830 | 24,890 | 24,940 |
| **450** | 25,000 | 25,060 | 25,110 | 25,170 | 25,230 | 25,280 | 25,340 | 25,400 | 25,460 | 25,510 |
| **460** | 25,570 | 25,630 | 25,680 | 25,740 | 25,800 | 25,850 | 25,910 | 25,970 | 26,030 | 26,080 |
| **470** | 26,170 | 26,200 | 26,250 | 26,310 | 26,370 | 26,420 | 26,480 | 26,540 | 26,600 | 26,650 |
| **480** | 26,710 | 26,770 | 26,820 | 26,880 | 26,940 | 26,990 | 27,050 | 27,110 | 27,170 | 27,220 |
| **490** | 27,280 | 27,340 | 27,390 | 27,450 | 27,510 | 27,560 | 27,620 | 27,680 | 27,740 | 27,790 |
| **500** | 27,850 | 27,910 | 27,970 | 28,020 | 28,080 | 28,140 | 28,200 | 28,260 | 28,310 | 28,370 |
| **510** | 28,430 | 28,490 | 28,550 | 28,600 | 28,660 | 28,720 | 28,780 | 28,840 | 28,890 | 28,950 |
| **520** | 29,010 | 29,070 | 29,130 | 29,180 | 29,240 | 29,300 | 29,360 | 29,420 | 29,470 | 29,530 |
| **530** | 29,590 | 29,650 | 29,710 | 29,760 | 29,820 | 29,880 | 29,940 | 30,000 | 30,050 | 30,110 |
| **540** | 30,170 | 30,230 | 30,290 | 30,340 | 30,400 | 30,460 | 30,520 | 30,580 | 30,630 | 30,690 |
| **550** | 30,750 | 30,810 | 30,870 | 30,920 | 30,980 | 31,040 | 31,100 | 31,160 | 31,210 | 31,270 |
| **560** | 31,330 | 31,390 | 31,450 | 31,500 | 31,560 | 31,620 | 31,680 | 31,740 | 31,790 | 31,850 |
| **570** | 31,910 | 31,970 | 32,030 | 32,080 | 32,140 | 32,200 | 32,260 | 32,320 | 32,370 | 32,430 |
| **580** | 32,490 | 32,550 | 32,610 | 32,660 | 32,720 | 32,780 | 32,840 | 32,900 | 32,960 | 33,020 |
| **590** | 33,080 | 33,140 | 33,200 | 33,260 | 33,320 | 33,380 | 33,430 | 33,490 | 33,550 | 33,610 |
| **600** | 33,670 | 33,730 | 33,790 | 33,850 | 33,910 | 33,970 | 34,020 | 34,080 | 34,140 | 34,200 |
| **610** | 34,260 | 34,320 | 34,380 | 34,440 | 34,500 | 34,560 | 34,610 | 34,670 | 37,730 | 34,790 |
| **620** | 34,850 | 34,910 | 34,970 | 35,030 | 35,090 | 35,150 | 35,200 | 35,260 | 35,320 | 35,380 |
| **630** | 35,440 | 35,500 | 35,560 | 35,620 | 35,680 | 35,740 | 35,800 | 35,860 | 35,920 | 35,980 |
| **640** | 36,040 | 36,100 | 36,160 | 36,220 | 36,280 | 36,340 | 36,400 | 36,460 | 36,520 | 36,580 |
| **650** | 36,640 | 36,700 | 36,760 | 36,820 | 36,880 | 36,950 | 37,010 | 37,070 | 37,130 | 37,190 |
| **660** | 37,250 | 37,300 | 37,360 | 37,420 | 37,480 | 37,550 | 37,610 | 37,670 | 37,730 | 37,790 |
| **670** | 37,850 | 37,910 | 37,970 | 38,040 | 38,100 | 38,160 | 38,220 | 38,280 | 38,350 | 38,410 |
| **680** | 38,470 | 38,530 | 38,590 | 38,660 | 38,720 | 38,780 | 38,840 | 38,900 | 38,970 | 39,030 |
| **690** | 39,090 | 39,150 | 39,220 | 39,280 | 39,340 | 39,410 | 39,470 | 39,530 | 39,590 | 39,660 |
| **700** | 39,720 | 39,780 | 39,850 | 39,910 | 39,970 | 40,040 | 40,100 | 40,160 | 40,220 | 40,290 |
| **710** | 40,350 | 40,410 | 40,480 | 40,540 | 40,600 | 40,670 | 40,730 | 40,800 | 40,860 | 40,930 |
| **720** | 40,980 | 41,040 | 41,110 | 41,170 | 41,230 | 41,300 | 41,360 | 41,430 | 41,490 | 41,560 |
| **730** | 41,620 | 41,690 | 41,750 | 41,820 | 41,880 | 41,950 | 42,010 | 42,080 | 42,140 | 42,210 |
| **740** | 42,270 | 42,340 | 42,400 | 42,470 | 42,530 | 42,600 | 42,660 | 42,730 | 42,790 | 42,860 |
| **750** | 42,920 | 42,990 | 43,050 | 43,120 | 43,180 | 43,250 | 43,310 | 43,380 | 43,440 | 43,510 |
| **760** | 43,570 | 43,640 | 43,700 | 43,770 | 43,830 | 43,900 | 43,970 | 44,030 | 44,100 | 44,160 |
| **770** | 44,230 | 44,300 | 44,360 | 44,430 | 44,490 | 44,560 | 44,630 | 44,690 | 44,760 | 44,820 |
| **780** | 44,890 | 44,960 | 45,020 | 45,090 | 45,150 | 45,220 | 45,290 | 45,350 | 45,420 | 45,480 |
| **790** | 45,550 | 45,620 | 45,680 | 45,750 | 45,820 | 45,890 | 45,950 | 46,020 | 46,090 | 46,150 |
| **800** | 46,220 | 46,290 | 46,350 | 46,420 | 46,490 | 46,560 | 46,620 | 46,690 | 46,760 | 46,820 |
| **810** | 46,890 | 46,960 | 47,030 | 47,090 | 47,160 | 47,230 | 47,300 | 47,370 | 47,430 | 47,500 |
| **820** | 47,570 | 47,640 | 47,710 | 47,770 | 47,840 | 47,910 | 47,980 | 48,050 | 48,110 | 48,180 |
| **830** | 48,250 | 48,320 | 48,390 | 48,460 | 48,530 | 48,600 | 48,660 | 48,730 | 48,800 | 48,870 |
| **840** | 48,940 | 49,010 | 49,080 | 49,150 | 49,220 | 49,290 | 49,350 | 49,420 | 49,490 | 49,560 |
| **850** | 49,630 | 49,700 | 49,770 | 49,840 | 49,910 | 49,980 | 50,040 | 50,110 | 50,180 | 50,250 |
| **860** | 50,320 | 50,390 | 50,460 | 50,530 | 50,600 | 50,670 | 50,740 | 50,810 | 50,880 | 50,950 |
| **870** | 51,020 | 51,090 | 51,160 | 51,230 | 51,300 | 51,370 | 51,440 | 51,510 | 51,580 | 51,650 |
| **880** | 51,720 | 51,790 | 51,860 | 51,930 | 52,000 | 52,080 | 52,150 | 52,220 | 52,290 | 52,360 |
| **890** | 52,430 | 52,500 | 52,570 | 52,640 | 52,710 | 52,790 | 52,860 | 52,930 | 53,000 | 53,070 |
| **900** | 53,140 | | | | | | | | | |

## *11.1.16 TC Typ N*

*Temperature range -270°C....+1300°C*

*All resistance value in mV*

| °C in steps of 10 ↓ | °C tended to zero in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-270** | -4,345 | -4,345 | -4,344 | -4,344 | -4,343 | -4,342 | -4,341 | -4,340 | -4,339 | -4,337 |
| **-260** | -4,336 | -4,334 | -4,332 | -4,330 | -4,328 | -4,326 | -4,324 | -4,321 | -4,319 | -4,316 |
| **-250** | -4,313 | -4,310 | -4,307 | -4,304 | -4,300 | -4,297 | -4,293 | -4,289 | -4,285 | -4,281 |
| **-240** | -4,277 | -4,273 | -4,268 | -4,263 | -4,259 | -4,254 | -4,248 | -4,243 | -4,238 | -4,232 |
| **-230** | -4,227 | -4,221 | -4,215 | -4,209 | -4,202 | -4,196 | -4,189 | -4,183 | -4,176 | -4,169 |
| **-220** | -4,162 | -4,155 | -4,147 | -4,140 | -4,132 | -4,124 | -4,116 | -4,108 | -4,100 | -4,091 |
| **-210** | -4,083 | -4,074 | -4,066 | -4,057 | -4,048 | -4,038 | -4,029 | -4,020 | -4,010 | -4,000 |
| **-200** | -3,990 | -3,980 | -3,970 | -3,960 | -3,950 | -3,929 | -3,928 | -3,918 | -3,907 | -3,896 |
| **-190** | -3,884 | -3,873 | -3,862 | -3,850 | -3,838 | -3,827 | -3,815 | -3,803 | -3,790 | -3,778 |
| **-180** | -3,766 | -3,753 | -3,740 | -3,727 | -3,715 | -3,701 | -3,688 | -3,675 | -3,661 | -3,648 |
| **-170** | -3,634 | -3,620 | -3,607 | -3,592 | -3,578 | -3,564 | -3,550 | -3,535 | -3,521 | -3,506 |
| **-160** | -3,494 | -3,476 | -3,461 | -3,446 | -3,430 | -3,415 | -3,399 | -3,384 | -3,368 | -3,352 |
| **-150** | -3,336 | -3,320 | -3,304 | -3,288 | -3,271 | -3,255 | -3,238 | -3,221 | -3,204 | -3,187 |
| **-140** | -3,170 | -3,153 | -3,136 | -3,118 | -3,101 | -3,083 | -3,066 | -3,048 | -3,030 | -3,012 |
| **-130** | -2,994 | -2,976 | -2,957 | -2,939 | -2,921 | -2,902 | -2,883 | -2,864 | -2,846 | -2,827 |
| **-120** | -2,807 | -2,788 | -2,769 | -2,750 | -2,730 | -2,711 | -2,691 | -2,671 | -2,651 | -2,632 |
| **-110** | -2,612 | -2,591 | -2,571 | -2,551 | -2,531 | -2,510 | -2,490 | -2,469 | -2,448 | -2,427 |
| **-100** | -2,407 | -2,386 | -2,365 | -2,343 | -2,322 | -2,301 | -2,280 | -2,258 | -2,237 | -2,215 |
| **-90** | -2,193 | -2,171 | -2,150 | -2,128 | -2,106 | -2,084 | -2,061 | -2,039 | -2,017 | -1,995 |
| **-80** | -1,972 | -1,950 | -1,927 | -1,904 | -1,882 | -1,859 | -1,836 | -1,813 | -1,790 | -1,767 |
| **-70** | -1,744 | -1,721 | -1,697 | -1,674 | -1,651 | -1,627 | -1,604 | -1,580 | -1,556 | -1,533 |
| **-60** | -1,509 | -1,485 | -1,461 | -1,437 | -1,413 | -1,389 | -1,365 | -1,341 | -1,317 | -1,293 |
| **-50** | -1,268 | -1,244 | -1,220 | -1,195 | -1,171 | -1,146 | -1,121 | -1,097 | -1,072 | -1,047 |
| **-40** | -1,023 | -0,998 | -0,973 | -0,948 | -0,923 | -0,898 | -0,873 | -0,848 | -0,823 | -0,797 |
| **-30** | -0,772 | -0,747 | -0,722 | -0,696 | -0,671 | -0,646 | -0,620 | -0,595 | -0,569 | -0,544 |
| **-20** | -0,518 | -0,492 | -0,467 | -0,441 | -0,415 | -0,390 | -0,364 | -0,338 | -0,312 | -0,286 |
| **-10** | -0,260 | -0,234 | -0,208 | -0,183 | -0,157 | -0,130 | -0,104 | -0,078 | -0,052 | -0,026 |

| °C in steps of 10 ↓ | °C ascending in step of one → | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,026 | 0,052 | 0,078 | 0,104 | 0,130 | 0,156 | 0,182 | 0,208 | 0,235 |
| **10** | 0,261 | 0,287 | 0,313 | 0,340 | 0,366 | 0,393 | 0,419 | 0,446 | 0,472 | 0,499 |
| **20** | 0,525 | 0,552 | 0,578 | 0,605 | 0,632 | 0,659 | 0,685 | 0,712 | 0,739 | 0,766 |
| **30** | 0,793 | 0,820 | 0,847 | 0,874 | 0,901 | 0,928 | 0,955 | 0,983 | 1,010 | 1,037 |
| **40** | 1,065 | 1,092 | 1,119 | 1,147 | 1,174 | 1,202 | 1,229 | 1,257 | 1,284 | 1,312 |
| **50** | 1,340 | 1,368 | 1,395 | 1,423 | 1,451 | 1,479 | 1,507 | 1,535 | 1,563 | 1,591 |
| **60** | 1,619 | 1,647 | 1,675 | 1,703 | 1,732 | 1,760 | 1,788 | 1,817 | 1,845 | 1,873 |
| **70** | 1,902 | 1,930 | 1,959 | 1,988 | 2,016 | 2,045 | 2,074 | 2,102 | 2,131 | 2,160 |
| **80** | 2,189 | 2,218 | 2,247 | 2,276 | 2,305 | 2,334 | 2,363 | 2,392 | 2,421 | 2,450 |
| **90** | 2,480 | 2,509 | 2,538 | 2,568 | 2,597 | 2,626 | 2,656 | 2,685 | 2,715 | 2,744 |
| **100** | 2,774 | 2,804 | 2,833 | 2,863 | 2,893 | 2,923 | 2,953 | 2,983 | 3,012 | 3,042 |
| **110** | 3,072 | 3,102 | 3,133 | 3,163 | 3,193 | 3,223 | 3,253 | 3,283 | 3,314 | 3,344 |
| **120** | 3,374 | 3,405 | 3,435 | 3,466 | 3,496 | 3,527 | 3,557 | 3,588 | 3,619 | 3,649 |
| **130** | 3,680 | 3,711 | 3,742 | 3,772 | 3,803 | 3,834 | 3,865 | 3,896 | 3,927 | 3,958 |
| **140** | 3,989 | 4,020 | 4,051 | 4,083 | 4,114 | 4,145 | 4,176 | 4,208 | 4,239 | 4,270 |
| **150** | 4,302 | 4,333 | 4,365 | 4,396 | 4,428 | 4,459 | 4,491 | 4,523 | 4,554 | 4,586 |
| **160** | 4,618 | 4,650 | 4,681 | 4,713 | 4,745 | 4,777 | 4,809 | 4,841 | 4,873 | 4,905 |
| **170** | 4,937 | 4,969 | 5,001 | 5,033 | 5,066 | 5,098 | 5,130 | 5,162 | 5,195 | 5,227 |
| **180** | 5,259 | 5,292 | 5,324 | 5,357 | 5,389 | 5,422 | 5,454 | 5,487 | 5,520 | 5,552 |
| **190** | 5,585 | 5,618 | 5,650 | 5,683 | 5,716 | 5,749 | 5,782 | 5,815 | 5,847 | 5,880 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **200** | 5,913 | 5,946 | 5,979 | 6,013 | 6,046 | 6,079 | 6,112 | 6,145 | 6,178 | 6,211 |
| **210** | 6,245 | 6,278 | 6,311 | 6,345 | 6,378 | 6,411 | 6,445 | 6,478 | 6,512 | 6,545 |
| **220** | 6,579 | 6,612 | 6,646 | 6,680 | 6,713 | 6,747 | 6,781 | 6,814 | 6,848 | 6,882 |
| **230** | 6,916 | 6,949 | 6,983 | 7,017 | 7,051 | 7,085 | 7,119 | 7,153 | 7,187 | 7,221 |
| **240** | 7,255 | 7,289 | 7,323 | 7,357 | 7,392 | 7,426 | 7,460 | 7,494 | 7,528 | 7,563 |
| **250** | 7,597 | 7,631 | 7,666 | 7,700 | 7,734 | 7,769 | 7,803 | 7,838 | 7,872 | 7,907 |
| **260** | 7,941 | 7,976 | 8,010 | 8,045 | 8,080 | 8,114 | 8,149 | 8,184 | 8,218 | 8,253 |
| **270** | 8,288 | 8,323 | 8,358 | 8,392 | 8,427 | 8,462 | 8,497 | 8,532 | 8,567 | 8,602 |
| **280** | 8,637 | 8,672 | 8,707 | 8,742 | 8,777 | 8,812 | 8,847 | 8,882 | 8,918 | 8,953 |
| **290** | 8,988 | 9,023 | 9,058 | 9,094 | 9,129 | 9,164 | 9,200 | 9,235 | 9,270 | 9,306 |
| **300** | 9,341 | 9,377 | 9,412 | 9,448 | 9,483 | 9,519 | 9,554 | 9,590 | 9,625 | 9,661 |
| **310** | 9,696 | 9,732 | 9,768 | 9,803 | 9,839 | 9,875 | 9,910 | 9,946 | 9,982 | 10,018 |
| **320** | 10,054 | 10,089 | 10,125 | 10,161 | 10,197 | 10,233 | 10,269 | 10,305 | 10,341 | 10,377 |
| **330** | 10,413 | 10,449 | 10,485 | 10,521 | 10,557 | 10,593 | 10,629 | 10,665 | 10,701 | 10,737 |
| **340** | 10,774 | 10,810 | 10,846 | 10,882 | 10,918 | 10,955 | 10,991 | 11,027 | 11,064 | 11,100 |
| **350** | 11,136 | 11,173 | 11,209 | 11,245 | 11,282 | 11,318 | 11,355 | 11,391 | 11,428 | 11,464 |
| **360** | 11,501 | 11,537 | 11,574 | 11,610 | 11,647 | 11,683 | 11,720 | 11,757 | 11,793 | 11,830 |
| **370** | 11,867 | 11,903 | 11,940 | 11,977 | 12,013 | 12,050 | 12,087 | 12,124 | 12,160 | 12,197 |
| **380** | 12,234 | 12,271 | 12,308 | 12,345 | 12,382 | 12,418 | 12,455 | 12,492 | 12,529 | 12,566 |
| **390** | 12,603 | 12,640 | 12,677 | 12,714 | 12,751 | 12,788 | 12,825 | 12,862 | 12,899 | 12,937 |
| **400** | 12,974 | 13,011 | 13,048 | 13,085 | 13,122 | 13,159 | 13,197 | 13,234 | 13,271 | 13,308 |
| **410** | 13,346 | 13,383 | 13,420 | 13,457 | 13,495 | 13,532 | 13,569 | 13,607 | 13,644 | 13,682 |
| **420** | 13,719 | 13,756 | 13,794 | 13,831 | 13,869 | 13,906 | 13,944 | 13,981 | 14,019 | 14,056 |
| **430** | 14,094 | 14,131 | 14,169 | 14,206 | 14,244 | 14,281 | 14,319 | 14,356 | 14,394 | 14,432 |
| **440** | 14,469 | 14,507 | 14,545 | 14,582 | 14,620 | 14,658 | 14,695 | 14,733 | 14,771 | 14,809 |
| **450** | 14,846 | 14,884 | 14,922 | 14,960 | 14,998 | 15,035 | 15,073 | 15,111 | 15,149 | 15,187 |
| **460** | 15,225 | 15,262 | 15,300 | 15,338 | 15,376 | 15,414 | 15,452 | 15,490 | 15,528 | 15,566 |
| **470** | 15,604 | 15,642 | 15,680 | 15,718 | 15,756 | 15,794 | 15,832 | 15,870 | 15,908 | 15,946 |
| **480** | 15,984 | 16,022 | 16,060 | 16,099 | 16,137 | 16,175 | 16,213 | 16,251 | 16,289 | 16,327 |
| **490** | 16,366 | 16,404 | 16,442 | 16,480 | 16,518 | 16,557 | 16,595 | 16,633 | 16,671 | 16,710 |
| **500** | 16,748 | 16,786 | 16,824 | 16,863 | 16,901 | 16,939 | 16,978 | 17,016 | 17,054 | 17,093 |
| **510** | 17,131 | 17,169 | 17,208 | 17,246 | 17,285 | 17,323 | 17,361 | 17,400 | 17,438 | 17,477 |
| **520** | 17,515 | 17,554 | 17,592 | 17,630 | 17,669 | 17,707 | 17,746 | 17,784 | 17,823 | 17,861 |
| **530** | 17,900 | 17,938 | 17,977 | 18,016 | 18,054 | 18,093 | 18,131 | 18,170 | 18,208 | 18,247 |
| **540** | 18,286 | 18,324 | 18,363 | 18,401 | 18,440 | 18,479 | 18,517 | 18,556 | 18,595 | 18,633 |
| **550** | 18,672 | 18,711 | 18,749 | 18,788 | 18,827 | 18,865 | 18,904 | 18,943 | 18,982 | 19,020 |
| **560** | 19,059 | 19,098 | 19,136 | 19,175 | 19,214 | 19,253 | 19,292 | 19,330 | 19,369 | 19,408 |
| **570** | 19,447 | 19,485 | 19,524 | 19,563 | 19,602 | 19,641 | 19,680 | 19,718 | 19,757 | 19,796 |
| **580** | 19,835 | 19,874 | 19,913 | 19,952 | 19,990 | 20,029 | 20,068 | 20,107 | 20,146 | 20,185 |
| **590** | 20,224 | 20,263 | 20,302 | 20,341 | 20,379 | 20,418 | 20,457 | 20,496 | 20,535 | 20,574 |
| **600** | 20,613 | 20,652 | 20,691 | 20,730 | 20,769 | 20,808 | 20,847 | 20,886 | 20,925 | 20,964 |
| **610** | 21,003 | 21,042 | 21,081 | 21,120 | 21,159 | 21,198 | 21,237 | 21,276 | 21,315 | 21,354 |
| **620** | 21,393 | 21,432 | 21,471 | 21,510 | 21,549 | 21,588 | 21,628 | 21,667 | 21,706 | 21,745 |
| **630** | 21,784 | 21,823 | 21,862 | 21,901 | 21,940 | 21,979 | 22,018 | 22,058 | 22,097 | 22,136 |
| **640** | 22,175 | 22,214 | 22,253 | 22,292 | 22,331 | 22,370 | 22,410 | 22,449 | 22,488 | 22,527 |
| **650** | 22,566 | 22,605 | 22,644 | 22,684 | 22,723 | 22,762 | 22,801 | 22,840 | 22,879 | 22,919 |
| **660** | 22,958 | 22,997 | 23,036 | 23,075 | 23,115 | 23,154 | 23,193 | 23,232 | 23,271 | 23,311 |
| **670** | 23,350 | 23,389 | 23,428 | 23,467 | 23,507 | 23,546 | 23,585 | 23,624 | 23,663 | 23,703 |
| **680** | 23,742 | 23,781 | 23,820 | 23,860 | 23,899 | 23,938 | 23,977 | 24,016 | 24,056 | 24,095 |
| **690** | 24,134 | 24,173 | 24,213 | 24,252 | 24,291 | 24,330 | 24,370 | 24,409 | 24,448 | 24,487 |
| **700** | 24,527 | 24,566 | 24,605 | 24,644 | 24,684 | 24,723 | 24,762 | 24,801 | 24,841 | 24,880 |
| **710** | 24,919 | 24,959 | 24,998 | 25,037 | 25,076 | 25,116 | 25,155 | 25,194 | 25,233 | 25,273 |
| **720** | 25,312 | 25,351 | 25,391 | 25,430 | 25,469 | 25,508 | 25,548 | 25,587 | 25,626 | 25,666 |
| **730** | 25,705 | 25,744 | 25,783 | 25,823 | 25,862 | 25,901 | 25,941 | 25,980 | 26,019 | 26,058 |
| **740** | 26,098 | 26,137 | 26,176 | 26,216 | 26,255 | 26,294 | 26,333 | 26,373 | 26,412 | 26,451 |
| **750** | 26,491 | 26,530 | 26,569 | 26,608 | 26,648 | 26,687 | 26,726 | 26,766 | 26,805 | 26,844 |
| **760** | 26,883 | 26,923 | 26,962 | 27,001 | 27,041 | 27,080 | 27,119 | 27,158 | 27,198 | 27,237 |
| **770** | 27,276 | 27,316 | 27,355 | 27,394 | 27,433 | 27,473 | 27,512 | 27,551 | 27,591 | 27,630 |
| **780** | 27,669 | 27,708 | 27,748 | 27,787 | 27,826 | 27,866 | 27,905 | 27,944 | 27,983 | 28,023 |
| **790** | 28,062 | 28,101 | 28,140 | 28,180 | 28,219 | 28,258 | 28,297 | 28,337 | 28,376 | 28,415 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **800** | 28,455 | 28,494 | 28,533 | 28,572 | 28,612 | 28,651 | 28,690 | 28,729 | 28,769 | 28,808 |
| **810** | 28,847 | 28,886 | 28,926 | 28,965 | 29,004 | 29,043 | 29,083 | 29,122 | 29,161 | 29,200 |
| **820** | 29,239 | 29,279 | 29,318 | 29,357 | 29,396 | 29,436 | 29,475 | 29,514 | 29,553 | 29,592 |
| **830** | 29,632 | 29,671 | 29,710 | 29,749 | 29,789 | 29,828 | 29,867 | 29,906 | 29,945 | 29,985 |
| **840** | 30,024 | 30,063 | 30,102 | 30,141 | 30,181 | 30,220 | 30,259 | 30,298 | 30,337 | 30,376 |
| **850** | 30,416 | 30,455 | 30,494 | 30,533 | 30,572 | 30,611 | 30,651 | 30,690 | 30,729 | 30,768 |
| **860** | 30,807 | 30,846 | 30,886 | 30,925 | 30,964 | 31,003 | 31,042 | 31,081 | 31,120 | 31,160 |
| **870** | 31,199 | 31,238 | 31,277 | 31,316 | 31,355 | 31,394 | 31,433 | 31,473 | 31,512 | 31,551 |
| **880** | 31,590 | 31,629 | 31,668 | 31,707 | 31,746 | 31,785 | 31,824 | 31,863 | 31,903 | 31,942 |
| **890** | 31,981 | 32,020 | 32,059 | 32,098 | 32,137 | 32,176 | 32,215 | 32,254 | 32,293 | 32,332 |
| **900** | 32,371 | 32,410 | 32,449 | 32,488 | 32,527 | 32,566 | 32,605 | 32,644 | 32,683 | 32,722 |
| **910** | 32,760 | 32,799 | 32,838 | 32,877 | 32,916 | 32,955 | 32,993 | 33,032 | 33,071 | 33,110 |
| **920** | 33,149 | 33,188 | 33,227 | 33,266 | 33,305 | 33,344 | 33,382 | 33,421 | 33,460 | 33,499 |
| **930** | 33,538 | 33,577 | 33,616 | 33,655 | 33,693 | 33,732 | 33,771 | 33,810 | 33,849 | 33,888 |
| **940** | 33,926 | 33,965 | 34,004 | 34,043 | 34,082 | 34,121 | 34,159 | 34,198 | 34,237 | 34,276 |
| **950** | 34,315 | 34,353 | 34,392 | 34,431 | 34,470 | 34,508 | 34,547 | 34,586 | 34,625 | 34,663 |
| **960** | 34,702 | 34,741 | 34,780 | 34,818 | 34,857 | 34,896 | 34,935 | 34,973 | 35,012 | 35,051 |
| **970** | 35,089 | 35,128 | 35,167 | 35,205 | 35,244 | 35,283 | 35,321 | 35,360 | 35,390 | 35,437 |
| **980** | 35,476 | 35,515 | 35,553 | 35,592 | 35,631 | 36,669 | 35,708 | 35,747 | 35,785 | 35,824 |
| **990** | 35,862 | 35,901 | 35,940 | 35,978 | 36,017 | 36,055 | 36,094 | 36,132 | 36,171 | 36,210 |
| **1000** | 36,248 | 36,287 | 36,325 | 36,364 | 36,402 | 36,441 | 36,479 | 36,518 | 36,556 | 36,595 |
| **1010** | 36,633 | 36,672 | 36,710 | 36,749 | 36,787 | 36,826 | 36,864 | 36,903 | 36,941 | 36,980 |
| **1020** | 37,018 | 37,057 | 37,095 | 37,134 | 37,172 | 37,210 | 37,249 | 37,287 | 37,326 | 37,364 |
| **1030** | 37,402 | 37,441 | 37,479 | 37,518 | 37,556 | 37,594 | 37,633 | 37,671 | 37,710 | 37,748 |
| **1040** | 37,786 | 37,825 | 37,863 | 37,901 | 37,940 | 37,978 | 38,016 | 38,055 | 38,093 | 38,131 |
| **1050** | 38,169 | 38,208 | 38,246 | 38,284 | 38,323 | 38,361 | 38,399 | 38,437 | 38,476 | 38,514 |
| **1060** | 38,552 | 38,590 | 38,628 | 38,667 | 38,705 | 38,743 | 38,781 | 38,819 | 38,858 | 38,896 |
| **1070** | 38,934 | 38,972 | 39,010 | 39,049 | 39,087 | 39,125 | 39,163 | 39,201 | 39,239 | 39,277 |
| **1080** | 39,315 | 39,354 | 39,392 | 39,430 | 39,468 | 39,506 | 39,544 | 39,582 | 39,620 | 39,658 |
| **1090** | 39,696 | 39,734 | 39,772 | 39,810 | 39,848 | 39,886 | 39,924 | 39,962 | 40,000 | 40,038 |
| **1100** | 40,076 | 40,114 | 40,152 | 40,190 | 40,228 | 40,266 | 40,304 | 40,342 | 40,380 | 40,418 |
| **1110** | 40,456 | 40,494 | 40,532 | 40,570 | 40,607 | 40,645 | 40,683 | 40,721 | 40,759 | 40,797 |
| **1120** | 40,835 | 40,872 | 40,910 | 40,948 | 40,986 | 41,024 | 41,062 | 41,099 | 41,137 | 41,175 |
| **1130** | 41,213 | 41,250 | 41,288 | 41,326 | 41,364 | 41,401 | 41,439 | 41,477 | 41,515 | 41,552 |
| **1140** | 41,590 | 41,628 | 41,665 | 41,703 | 41,741 | 41,778 | 41,816 | 41,854 | 41,891 | 41,929 |
| **1150** | 41,966 | 42,004 | 42,042 | 42,079 | 42,117 | 42,154 | 42,192 | 42,229 | 42,267 | 42,305 |
| **1160** | 42,342 | 42,380 | 42,417 | 42,455 | 42,492 | 42,530 | 42,567 | 42,605 | 42,642 | 42,680 |
| **1170** | 42,717 | 42,754 | 42,792 | 42,829 | 42,867 | 42,904 | 42,941 | 42,979 | 43,016 | 43,054 |
| **1180** | 43,091 | 43,128 | 43,166 | 43,203 | 43,240 | 43,278 | 43,315 | 43,352 | 43,389 | 43,427 |
| **1190** | 43,464 | 43,501 | 43,538 | 43,576 | 43,613 | 43,650 | 43,687 | 43,725 | 43,762 | 43,799 |
| **1200** | 43,836 | 43,873 | 43,910 | 43,948 | 43,985 | 44,022 | 44,059 | 44,096 | 44,133 | 44,170 |
| **1210** | 44,207 | 44,244 | 44,281 | 44,318 | 44,355 | 44,393 | 44,430 | 44,467 | 44,504 | 44,541 |
| **1220** | 44,577 | 44,614 | 44,651 | 44,688 | 44,725 | 44,762 | 44,799 | 44,836 | 44,873 | 44,910 |
| **1230** | 44,947 | 44,984 | 45,020 | 45,057 | 45,094 | 45,131 | 45,168 | 45,204 | 45,241 | 45,278 |
| **1240** | 45,315 | 45,352 | 45,388 | 45,425 | 45,462 | 45,498 | 45,535 | 45,572 | 45,609 | 45,645 |
| **1250** | 45,682 | 45,719 | 45,755 | 45,792 | 45,828 | 45,865 | 45,902 | 45,938 | 45,975 | 46,011 |
| **1260** | 46,048 | 46,085 | 46,121 | 46,158 | 46,194 | 46,231 | 46,670 | 46,304 | 46,340 | 46,377 |
| **1270** | 46,413 | 46,449 | 46,486 | 46,522 | 46,559 | 46,595 | 46,631 | 46,668 | 46,704 | 46,741 |
| **1280** | 46,777 | 46,813 | 46,850 | 46,886 | 46,922 | 46,959 | 46,995 | 47,031 | 47,067 | 47,104 |
| **1290** | 47,140 | 47,176 | 47,212 | 47,249 | 47,285 | 47,321 | 47,357 | 47,393 | 47,430 | 47,466 |
| **1300** | 47,502 | | | | | | | | | |

## *11.1.17 TC Typ R*

*Temperature range 0°C....+1760°C*

*All resistance value in mV*

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,005 | 0,011 | 0,016 | 0,021 | 0,027 | 0,032 | 0,038 | 0,043 | 0,049 |
| **10** | 0,054 | 0,060 | 0,065 | 0,071 | 0,077 | 0,082 | 0,088 | 0,094 | 0,100 | 0,105 |
| **20** | 0,111 | 0,117 | 0,123 | 0,129 | 0,135 | 0,141 | 0,147 | 0,153 | 0,159 | 0,165 |
| **30** | 0,171 | 0,177 | 0,183 | 0,189 | 0,195 | 0,201 | 0,207 | 0,214 | 0,220 | 0,226 |
| **40** | 0,232 | 0,239 | 0,245 | 0,251 | 0,258 | 0,264 | 0,271 | 0,277 | 0,284 | 0,290 |
| **50** | 0,296 | 0,303 | 0,310 | 0,316 | 0,323 | 0,329 | 0,336 | 0,343 | 0,349 | 0,356 |
| **60** | 0,363 | 0,369 | 0,376 | 0,383 | 0,390 | 0,397 | 0,403 | 0,410 | 0,417 | 0,424 |
| **70** | 0,431 | 0,438 | 0,445 | 0,452 | 0,459 | 0,466 | 0,473 | 0,480 | 0,487 | 0,494 |
| **80** | 0,501 | 0,508 | 0,516 | 0,523 | 0,530 | 0,537 | 0,544 | 0,552 | 0,559 | 0,566 |
| **90** | 0,573 | 0,581 | 0,588 | 0,595 | 0,603 | 0,610 | 0,618 | 0,625 | 0,632 | 0,640 |
| **100** | 0,647 | 0,655 | 0,662 | 0,670 | 0,677 | 0,685 | 0,693 | 0,700 | 0,708 | 0,715 |
| **110** | 0,723 | 0,731 | 0,738 | 0,746 | 0,754 | 0,761 | 0,769 | 0,777 | 0,785 | 0,792 |
| **120** | 0,800 | 0,808 | 0,816 | 0,824 | 0,832 | 0,839 | 0,847 | 0,855 | 0,863 | 0,871 |
| **130** | 0,879 | 0,887 | 0,895 | 0,903 | 0,911 | 0,919 | 0,927 | 0,935 | 0,943 | 0,951 |
| **140** | 0,959 | 0,967 | 0,976 | 0,984 | 0,992 | 1,000 | 1,008 | 1,016 | 1,025 | 1,033 |
| **150** | 1,041 | 1,049 | 1,058 | 1,066 | 1,074 | 1,082 | 1,091 | 1,099 | 1,107 | 1,116 |
| **160** | 1,124 | 1,132 | 1,141 | 1,149 | 1,158 | 1,166 | 1,175 | 1,183 | 1,191 | 1,200 |
| **170** | 1,208 | 1,217 | 1,225 | 1,234 | 1,242 | 1,251 | 1,260 | 1,268 | 1,277 | 1,285 |
| **180** | 1,294 | 1,303 | 1,311 | 1,320 | 1,329 | 1,337 | 1,346 | 1,355 | 1,363 | 1,372 |
| **190** | 1,381 | 1,389 | 1,398 | 1,407 | 1,416 | 1,425 | 1,433 | 1,442 | 1,451 | 1,460 |
| **200** | 1,469 | 1,477 | 1,486 | 1,495 | 1,504 | 1,513 | 1,522 | 1,531 | 1,540 | 1,549 |
| **210** | 1,558 | 1,567 | 1,575 | 1,584 | 1,593 | 1,602 | 1,611 | 1,620 | 1,629 | 1,639 |
| **220** | 1,648 | 1,657 | 1,666 | 1,675 | 1,684 | 1,693 | 1,702 | 1,711 | 1,720 | 1,729 |
| **230** | 1,739 | 1,748 | 1,757 | 1,766 | 1,775 | 1,784 | 1,794 | 1,803 | 1,812 | 1,821 |
| **240** | 1,831 | 1,840 | 1,849 | 1,858 | 1,868 | 1,877 | 1,886 | 1,895 | 1,905 | 1,914 |
| **250** | 1,923 | 1,933 | 1,942 | 1,951 | 1,961 | 1,970 | 1,980 | 1,989 | 1,998 | 2,008 |
| **260** | 2,017 | 2,027 | 2,036 | 2,046 | 2,055 | 2,064 | 2,074 | 2,083 | 2,093 | 2,102 |
| **270** | 2,112 | 2,121 | 2,131 | 2,140 | 2,150 | 2,159 | 2,169 | 2,179 | 2,188 | 2,198 |
| **280** | 2,207 | 2,217 | 2,226 | 2,236 | 2,246 | 2,255 | 2,265 | 2,275 | 2,284 | 2,294 |
| **290** | 2,304 | 2,313 | 2,323 | 2,333 | 2,342 | 2,352 | 2,362 | 2,371 | 2,381 | 2,391 |
| **300** | 2,401 | 2,410 | 2,420 | 2,430 | 2,440 | 2,449 | 2,459 | 2,469 | 2,479 | 2,488 |
| **310** | 2,498 | 2,508 | 2,518 | 2,528 | 2,538 | 2,547 | 2,557 | 2,567 | 2,577 | 2,587 |
| **320** | 2,597 | 2,607 | 2,617 | 2,626 | 2,636 | 2,646 | 2,656 | 2,666 | 2,676 | 2,686 |
| **330** | 2,696 | 2,706 | 2,716 | 2,726 | 2,736 | 2,746 | 2,756 | 2,766 | 2,776 | 2,786 |
| **340** | 2,796 | 2,806 | 2,816 | 2,826 | 2,836 | 2,846 | 2,856 | 2,866 | 2,876 | 2,886 |
| **350** | 2,896 | 2,906 | 2,916 | 2,926 | 2,937 | 2,947 | 2,957 | 2,967 | 2,977 | 2,987 |
| **360** | 2,997 | 3,007 | 3,018 | 3,028 | 3,038 | 3,048 | 3,058 | 3,068 | 3,079 | 3,089 |
| **370** | 3,099 | 3,109 | 3,119 | 3,130 | 3,140 | 3,150 | 3,160 | 3,171 | 3,181 | 3,191 |
| **380** | 3,201 | 3,212 | 3,222 | 3,232 | 3,242 | 3,253 | 3,263 | 3,273 | 3,284 | 3,294 |
| **390** | 3,304 | 3,315 | 3,325 | 3,335 | 3,346 | 3,356 | 3,366 | 3,377 | 3,387 | 3,397 |
| **400** | 3,408 | 3,418 | 3,428 | 3,439 | 3,449 | 3,460 | 3,470 | 3,480 | 3,491 | 3,501 |
| **410** | 3,512 | 3,522 | 3,533 | 3,543 | 3,553 | 3,564 | 3,574 | 3,585 | 3,595 | 3,606 |
| **420** | 3,616 | 3,627 | 3,637 | 3,648 | 3,658 | 3,669 | 3,679 | 3,690 | 3,700 | 3,711 |
| **430** | 3,721 | 3,732 | 3,742 | 3,753 | 3,764 | 3,774 | 3,785 | 3,795 | 3,806 | 3,816 |
| **440** | 3,827 | 3,838 | 3,848 | 3,859 | 3,869 | 3,880 | 3,891 | 3,901 | 3,912 | 3,922 |
| **450** | 3,933 | 3,944 | 3,954 | 3,965 | 3,976 | 3,986 | 3,997 | 4,008 | 4,018 | 4,029 |
| **460** | 4,040 | 4,050 | 4,061 | 4,072 | 4,083 | 4,093 | 4,104 | 4,115 | 4,125 | 4,136 |
| **470** | 4,147 | 4,158 | 4,168 | 4,179 | 4,190 | 4,201 | 4,211 | 4,222 | 4,233 | 4,244 |
| **480** | 4,255 | 4,265 | 4,276 | 4,287 | 4,298 | 4,309 | 4,319 | 4,330 | 4,341 | 4,352 |
| **490** | 4,363 | 4,373 | 4,384 | 4,395 | 4,406 | 4,417 | 4,428 | 4,439 | 4,449 | 4,460 |
| **500** | 4,471 | 4,482 | 4,493 | 4,504 | 4,515 | 4,526 | 4,537 | 4,548 | 4,558 | 4,569 |
| **510** | 4,580 | 4,591 | 4,602 | 4,613 | 4,624 | 4,635 | 4,646 | 4,657 | 4,668 | 4,679 |
| **520** | 4,690 | 4,701 | 4,712 | 4,723 | 4,734 | 4,745 | 4,756 | 4,767 | 4,778 | 4,789 |
| **530** | 4,800 | 4,811 | 4,822 | 4,833 | 4,844 | 4,855 | 4,866 | 4,877 | 4,888 | 4,899 |
| **540** | 4,910 | 4,922 | 4,933 | 4,944 | 4,955 | 4,966 | 4,977 | 4,988 | 4,999 | 5,010 |
| **550** | 5,021 | 5,033 | 5,044 | 5,055 | 5,066 | 5,077 | 5,088 | 5,099 | 5,111 | 5,122 |
| **560** | 5,133 | 5,144 | 5,155 | 5,166 | 5,178 | 5,189 | 5,200 | 5,211 | 5,222 | 5,234 |
| **570** | 5,245 | 5,256 | 5,267 | 5,279 | 5,290 | 5,301 | 5,312 | 5,323 | 5,335 | 5,346 |
| **580** | 5,357 | 5,369 | 5,380 | 5,391 | 5,402 | 5,414 | 5,425 | 5,436 | 5,448 | 5,459 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **600** | 5,583 | 5,595 | 5,606 | 5,618 | 5,629 | 5,640 | 5,652 | 5,663 | 5,674 | 5,686 |
| **610** | 5,697 | 5,709 | 5,720 | 5,731 | 5,743 | 5,754 | 5,766 | 5,777 | 5,789 | 5,800 |
| **620** | 5,812 | 5,823 | 5,834 | 5,846 | 5,857 | 5,869 | 5,880 | 5,892 | 5,903 | 5,915 |
| **630** | 5,926 | 5,938 | 5,949 | 5,961 | 5,972 | 5,984 | 5,995 | 6,007 | 6,018 | 6,030 |
| **640** | 6,041 | 6,053 | 6,065 | 6,076 | 6,088 | 6,099 | 6,111 | 6,122 | 6,134 | 6,146 |
| **650** | 6,157 | 6,169 | 6,180 | 6,192 | 6,204 | 6,215 | 6,227 | 6,238 | 6,250 | 6,262 |
| **660** | 6,273 | 6,285 | 6,297 | 6,308 | 6,320 | 6,332 | 6,343 | 6,355 | 6,367 | 6,378 |
| **670** | 6,390 | 6,402 | 6,413 | 6,425 | 6,437 | 6,448 | 6,460 | 6,472 | 6,484 | 6,495 |
| **680** | 6,507 | 6,519 | 6,531 | 6,542 | 6,554 | 6,566 | 6,578 | 6,589 | 6,601 | 6,613 |
| **690** | 6,625 | 6,636 | 6,648 | 6,660 | 6,672 | 6,684 | 6,695 | 6,707 | 6,719 | 6,731 |
| **700** | 6,743 | 6,755 | 6,766 | 6,778 | 6,790 | 6,802 | 6,814 | 6,826 | 6,838 | 6,849 |
| **710** | 6,861 | 6,873 | 6,885 | 6,897 | 6,909 | 6,921 | 6,933 | 6,945 | 6,956 | 6,968 |
| **720** | 6,980 | 6,992 | 7,004 | 7,016 | 7,028 | 7,040 | 7,052 | 7,064 | 7,076 | 7,088 |
| **730** | 7,100 | 7,112 | 7,124 | 7,136 | 7,148 | 7,160 | 7,172 | 7,184 | 7,196 | 7,208 |
| **740** | 7,220 | 7,232 | 7,244 | 7,256 | 7,268 | 7,280 | 7,292 | 7,304 | 7,316 | 7,328 |
| **750** | 7,340 | 7,352 | 7,364 | 7,376 | 7,389 | 7,401 | 7,413 | 7,425 | 7,437 | 7,449 |
| **760** | 7,461 | 7,473 | 7,485 | 7,498 | 7,510 | 7,522 | 7,534 | 7,546 | 7,558 | 7,570 |
| **770** | 7,583 | 7,595 | 7,607 | 7,619 | 7,631 | 7,644 | 7,656 | 7,668 | 7,680 | 7,692 |
| **780** | 7,705 | 7,717 | 7,729 | 7,741 | 7,753 | 7,766 | 7,778 | 7,790 | 7,802 | 7,815 |
| **790** | 7,827 | 7,839 | 7,851 | 7,864 | 7,876 | 7,888 | 7,901 | 7,913 | 7,925 | 7,938 |
| **800** | 7,950 | 7,962 | 7,974 | 7,987 | 7,999 | 8,011 | 8,024 | 8,036 | 8,048 | 8,061 |
| **810** | 8,073 | 8,086 | 8,098 | 8,110 | 8,123 | 8,135 | 8,147 | 8,160 | 8,172 | 8,185 |
| **820** | 8,197 | 8,209 | 8,222 | 8,234 | 8,247 | 8,259 | 8,272 | 8,284 | 8,296 | 8,309 |
| **830** | 8,321 | 8,334 | 8,346 | 8,359 | 8,371 | 8,384 | 8,396 | 8,409 | 8,421 | 8,434 |
| **840** | 8,446 | 8,459 | 8,471 | 8,484 | 8,496 | 8,509 | 8,521 | 8,534 | 8,546 | 8,559 |
| **850** | 8,571 | 8,584 | 8,597 | 8,609 | 8,622 | 8,634 | 8,647 | 8,659 | 8,672 | 8,685 |
| **860** | 8,697 | 8,710 | 8,722 | 8,735 | 8,748 | 8,760 | 8,773 | 8,785 | 8,798 | 8,811 |
| **870** | 8,823 | 8,836 | 8,849 | 8,861 | 8,874 | 8,887 | 8,899 | 8,912 | 8,925 | 8,937 |
| **880** | 8,950 | 8,963 | 8,975 | 8,988 | 9,001 | 9,014 | 9,026 | 9,039 | 9,052 | 9,065 |
| **890** | 9,077 | 9,090 | 9,103 | 9,115 | 9,128 | 9,141 | 9,154 | 9,167 | 9,179 | 9,192 |
| **900** | 9,205 | 9,218 | 9,230 | 9,243 | 9,256 | 9,269 | 9,282 | 9,294 | 9,307 | 9,320 |
| **910** | 9,333 | 9,346 | 9,359 | 9,371 | 9,384 | 9,397 | 9,410 | 9,423 | 9,436 | 9,449 |
| **920** | 9,461 | 9,474 | 9,487 | 9,500 | 9,513 | 9,526 | 9,539 | 9,552 | 9,565 | 9,578 |
| **930** | 9,590 | 9,603 | 9,616 | 9,629 | 9,642 | 9,655 | 9,668 | 9,681 | 9,694 | 9,707 |
| **940** | 9,720 | 9,733 | 9,746 | 9,759 | 9,772 | 9,785 | 9,798 | 9,811 | 9,824 | 9,837 |
| **950** | 9,850 | 9,863 | 9,876 | 9,889 | 9,902 | 9,915 | 9,928 | 9,941 | 9,954 | 9,967 |
| **960** | 9,980 | 9,993 | 10,006 | 10,019 | 10,032 | 10,046 | 10,059 | 10,072 | 10,085 | 10,098 |
| **970** | 10,111 | 10,124 | 10,137 | 10,150 | 10,163 | 10,177 | 10,190 | 10,203 | 10,216 | 10,229 |
| **980** | 10,242 | 10,255 | 10,268 | 10,282 | 10,295 | 10,308 | 10,321 | 10,334 | 10,347 | 10,361 |
| **990** | 10,374 | 10,387 | 10,400 | 10,413 | 10,427 | 10,440 | 10,453 | 10,466 | 10,480 | 10,493 |
| **1000** | 10,506 | 10,519 | 10,532 | 10,546 | 10,559 | 10,572 | 10,585 | 10,599 | 10,612 | 10,625 |
| **1010** | 10,638 | 10,652 | 10,665 | 10,678 | 10,692 | 10,705 | 10,718 | 10,731 | 10,745 | 10,758 |
| **1020** | 10,771 | 10,785 | 10,798 | 10,811 | 10,825 | 10,838 | 10,851 | 10,865 | 10,878 | 10,891 |
| **1030** | 10,905 | 10,918 | 10,932 | 10,945 | 10,958 | 10,972 | 10,985 | 10,998 | 11,012 | 11,025 |
| **1040** | 11,039 | 11,052 | 11,065 | 11,079 | 11,092 | 11,106 | 11,119 | 11,132 | 11,146 | 11,159 |
| **1050** | 11,173 | 11,186 | 11,200 | 11,213 | 11,227 | 11,240 | 11,253 | 11,267 | 11,280 | 11,294 |
| **1060** | 11,307 | 11,321 | 11,334 | 11,348 | 11,361 | 11,375 | 11,388 | 11,402 | 11,415 | 11,429 |
| **1070** | 11,442 | 11,456 | 11,469 | 11,483 | 11,496 | 11,510 | 11,524 | 11,537 | 11,551 | 11,564 |
| **1080** | 11,578 | 11,591 | 11,605 | 11,618 | 11,632 | 11,646 | 11,659 | 11,673 | 11,686 | 11,700 |
| **1090** | 11,714 | 11,727 | 11,741 | 11,754 | 11,768 | 11,782 | 11,795 | 11,809 | 11,822 | 11,836 |
| **1100** | 11,850 | 11,863 | 11,877 | 11,891 | 11,904 | 11,918 | 11,931 | 11,945 | 11,959 | 11,972 |
| **1110** | 11,986 | 12,000 | 12,013 | 12,027 | 12,041 | 12,054 | 12,068 | 12,082 | 12,096 | 12,109 |
| **1120** | 12,123 | 12,137 | 12,150 | 12,164 | 12,178 | 12,191 | 12,205 | 12,219 | 12,233 | 12,246 |
| **1130** | 12,260 | 12,274 | 12,288 | 12,301 | 12,315 | 12,329 | 12,342 | 12,356 | 12,370 | 12,384 |
| **1140** | 12,397 | 12,411 | 12,425 | 12,439 | 12,453 | 12,466 | 12,480 | 12,494 | 12,508 | 12,521 |
| **1150** | 12,535 | 12,549 | 12,563 | 12,577 | 12,590 | 12,604 | 12,618 | 12,632 | 12,646 | 12,659 |
| **1160** | 12,673 | 12,687 | 12,701 | 12,715 | 12,729 | 12,742 | 12,756 | 12,770 | 12,784 | 12,798 |
| **1170** | 12,812 | 12,825 | 12,839 | 12,853 | 12,867 | 12,881 | 12,895 | 12,909 | 12,922 | 12,936 |
| **1180** | 12,950 | 12,964 | 12,978 | 12,992 | 13,006 | 13,019 | 13,033 | 13,047 | 13,061 | 13,075 |
| **1190** | 13,089 | 13,103 | 13,117 | 13,131 | 13,145 | 13,158 | 13,172 | 13,186 | 13,200 | 13,214 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1200** | 13,228 | 13,242 | 13,256 | 13,270 | 13,284 | 13,298 | 13,311 | 13,325 | 13,339 | 13,353 |
| **1210** | 13,367 | 13,381 | 13,395 | 13,409 | 13,423 | 13,437 | 13,451 | 13,465 | 13,479 | 13,493 |
| **1220** | 13,507 | 13,521 | 13,535 | 13,549 | 13,563 | 13,577 | 13,590 | 13,604 | 13,618 | 13,632 |
| **1230** | 13,646 | 13,660 | 13,674 | 13,688 | 13,702 | 13,716 | 13,730 | 13,744 | 13,758 | 13,772 |
| **1240** | 13,786 | 13,800 | 13,814 | 13,828 | 13,842 | 13,856 | 13,870 | 13,884 | 13,898 | 13,912 |
| **1250** | 13,926 | 13,940 | 13,954 | 13,968 | 13,982 | 13,996 | 14,010 | 14,024 | 14,038 | 14,052 |
| **1260** | 14,066 | 14,081 | 14,095 | 14,109 | 14,123 | 14,137 | 14,151 | 14,165 | 14,179 | 14,193 |
| **1270** | 14,207 | 14,221 | 14,235 | 14,249 | 14,263 | 14,277 | 14,291 | 14,305 | 14,319 | 14,333 |
| **1280** | 14,347 | 14,361 | 14,375 | 14,390 | 14,404 | 14,418 | 14,432 | 14,446 | 14,460 | 14,474 |
| **1290** | 14,488 | 14,502 | 14,516 | 14,530 | 14,544 | 14,558 | 14,572 | 14,586 | 14,601 | 14,615 |
| **1300** | 14,629 | 14,643 | 14,657 | 14,671 | 14,685 | 14,699 | 14,713 | 14,727 | 14,741 | 14,755 |
| **1310** | 14,770 | 14,784 | 14,798 | 14,812 | 14,826 | 14,840 | 14,854 | 14,868 | 14,882 | 14,896 |
| **1320** | 14,911 | 14,925 | 14,939 | 14,953 | 14,967 | 14,981 | 14,995 | 15,009 | 15,023 | 15,037 |
| **1330** | 15,052 | 15,066 | 15,080 | 15,094 | 15,108 | 15,122 | 15,136 | 15,150 | 15,164 | 15,179 |
| **1340** | 15,193 | 15,207 | 15,221 | 15,235 | 15,249 | 15,263 | 15,277 | 15,291 | 15,306 | 15,320 |
| **1350** | 15,334 | 15,348 | 15,362 | 15,376 | 15,390 | 15,404 | 15,419 | 15,433 | 15,447 | 15,461 |
| **1360** | 15,475 | 15,489 | 15,503 | 15,517 | 15,531 | 15,546 | 15,560 | 15,574 | 15,588 | 15,602 |
| **1370** | 15,616 | 15,630 | 15,645 | 15,659 | 15,673 | 15,687 | 15,701 | 15,715 | 15,729 | 15,743 |
| **1380** | 15,758 | 15,772 | 15,786 | 15,800 | 15,814 | 15,828 | 15,842 | 15,856 | 15,871 | 15,885 |
| **1390** | 15,899 | 15,913 | 15,927 | 15,941 | 15,955 | 15,969 | 15,984 | 15,998 | 16,012 | 16,026 |
| **1400** | 16,040 | 16,054 | 16,068 | 16,082 | 16,097 | 16,111 | 16,125 | 16,139 | 16,153 | 16,167 |
| **1410** | 16,181 | 16,196 | 16,210 | 16,224 | 16,238 | 16,252 | 16,266 | 16,280 | 16,294 | 16,309 |
| **1420** | 16,323 | 16,337 | 16,351 | 16,365 | 16,379 | 16,393 | 16,407 | 16,422 | 16,436 | 16,450 |
| **1430** | 16,464 | 16,478 | 16,492 | 16,506 | 16,520 | 16,534 | 16,549 | 16,563 | 16,577 | 16,591 |
| **1440** | 16,605 | 16,619 | 16,633 | 16,647 | 16,662 | 16,676 | 16,690 | 16,704 | 16,718 | 16,732 |
| **1450** | 16,746 | 16,760 | 16,774 | 16,789 | 16,803 | 16,817 | 16,831 | 16,845 | 16,859 | 16,873 |
| **1460** | 16,887 | 16,901 | 16,915 | 16,930 | 16,944 | 16,958 | 16,972 | 16,986 | 17,000 | 17,014 |
| **1470** | 17,028 | 17,042 | 17,056 | 17,071 | 17,085 | 17,099 | 17,113 | 17,127 | 17,141 | 17,155 |
| **1480** | 17,169 | 17,183 | 17,197 | 17,211 | 17,225 | 17,240 | 17,254 | 17,268 | 17,282 | 17,296 |
| **1490** | 17,310 | 17,324 | 17,338 | 17,352 | 17,366 | 17,380 | 17,394 | 17,408 | 17,423 | 17,437 |
| **1500** | 17,451 | 17,465 | 17,479 | 17,493 | 17,507 | 17,521 | 17,535 | 17,549 | 17,563 | 17,577 |
| **1510** | 17,591 | 17,605 | 17,619 | 17,633 | 17,647 | 17,661 | 17,676 | 17,690 | 17,704 | 17,718 |
| **1520** | 17,732 | 17,746 | 17,760 | 17,774 | 17,788 | 17,802 | 17,816 | 17,830 | 17,844 | 17,858 |
| **1530** | 17,872 | 17,886 | 17,900 | 17,914 | 17,928 | 17,942 | 17,956 | 17,970 | 17,984 | 17,998 |
| **1540** | 18,012 | 18,026 | 18,040 | 18,054 | 18,068 | 18,082 | 18,096 | 18,110 | 18,124 | 18,138 |
| **1550** | 18,152 | 18,166 | 18,180 | 18,194 | 18,208 | 18,222 | 18,236 | 18,250 | 18,264 | 18,278 |
| **1560** | 18,292 | 18,306 | 18,320 | 18,334 | 18,348 | 18,362 | 18,376 | 18,390 | 18,404 | 18,417 |
| **1570** | 18,431 | 18,445 | 18,459 | 18,473 | 18,487 | 18,501 | 18,515 | 18,529 | 18,543 | 18,557 |
| **1580** | 18,571 | 18,585 | 18,599 | 18,613 | 18,627 | 18,640 | 18,654 | 18,668 | 18,682 | 18,696 |
| **1590** | 18,710 | 18,724 | 18,738 | 18,752 | 18,766 | 18,779 | 18,793 | 18,807 | 18,821 | 18,835 |
| **1600** | 18,849 | 18,863 | 18,877 | 18,891 | 18,904 | 18,918 | 18,932 | 18,946 | 18,960 | 18,974 |
| **1610** | 18,988 | 19,002 | 19,015 | 19,029 | 19,043 | 19,057 | 19,071 | 19,085 | 19,098 | 19,112 |
| **1620** | 19,126 | 19,140 | 19,154 | 19,168 | 19,181 | 19,195 | 19,209 | 19,223 | 19,237 | 19,250 |
| **1630** | 19,264 | 19,278 | 19,292 | 19,306 | 19,319 | 19,333 | 19,347 | 19,361 | 19,375 | 19,388 |
| **1640** | 19,402 | 19,416 | 19,430 | 19,444 | 19,457 | 19,471 | 19,485 | 19,499 | 19,512 | 19,526 |
| **1650** | 19,540 | 19,554 | 19,567 | 19,581 | 19,595 | 19,609 | 19,622 | 19,636 | 19,650 | 19,663 |
| **1660** | 19,677 | 19,691 | 19,705 | 19,718 | 19,732 | 19,746 | 19,759 | 19,773 | 19,787 | 19,800 |
| **1670** | 19,814 | 19,828 | 19,841 | 19,855 | 19,869 | 19,882 | 19,896 | 19,910 | 19,923 | 19,937 |
| **1680** | 19,951 | 19,964 | 19,978 | 19,992 | 20,005 | 20,019 | 20,032 | 20,046 | 20,060 | 20,073 |
| **1690** | 20,087 | 20,100 | 20,114 | 20,127 | 20,141 | 20,154 | 20,168 | 20,181 | 20,195 | 20,208 |
| **1700** | 20,222 | 20,235 | 20,249 | 20,262 | 20,275 | 20,289 | 20,302 | 20,316 | 20,329 | 20,342 |
| **1710** | 20,356 | 20,369 | 20,382 | 20,396 | 20,409 | 20,422 | 20,436 | 20,449 | 20,462 | 20,475 |
| **1720** | 20,488 | 20,502 | 20,515 | 20,528 | 20,541 | 20,554 | 20,567 | 20,581 | 20,594 | 20,607 |
| **1730** | 20,620 | 20,633 | 20,646 | 20,659 | 20,672 | 20,685 | 20,698 | 20,711 | 20,724 | 20,736 |
| **1740** | 20,749 | 20,762 | 20,775 | 20,788 | 20,801 | 20,813 | 20,826 | 20,839 | 20,852 | 20,864 |
| **1750** | 20,877 | 20,890 | 20,902 | 20,915 | 20,928 | 20,940 | 20,953 | 20,965 | 20,978 | 20,990 |
| **1760** | 21,003 | | | | | | | | | |

## *11.1.18 TC Typ S (Pt-RhPt)*

*Temperature range 0°C....+1760°C*

*All resistance value in mV*

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,005 | 0,011 | 0,016 | 0,022 | 0,027 | 0,033 | 0,038 | 0,044 | 0,050 |
| **10** | 0,055 | 0,061 | 0,067 | 0,072 | 0,078 | 0,084 | 0,090 | 0,095 | 0,101 | 0,107 |
| **20** | 0,113 | 0,119 | 0,125 | 0,131 | 0,137 | 0,143 | 0,149 | 0,155 | 0,161 | 0,167 |
| **30** | 0,173 | 0,179 | 0,185 | 0,191 | 0,197 | 0,204 | 0,210 | 0,216 | 0,222 | 0,229 |
| **40** | 0,235 | 0,241 | 0,248 | 0,254 | 0,260 | 0,267 | 0,273 | 0,280 | 0,286 | 0,292 |
| **50** | 0,299 | 0,305 | 0,312 | 0,319 | 0,325 | 0,332 | 0,338 | 0,345 | 0,352 | 0,358 |
| **60** | 0,365 | 0,372 | 0,378 | 0,385 | 0,392 | 0,399 | 0,405 | 0,412 | 0,419 | 0,426 |
| **70** | 0,433 | 0,440 | 0,446 | 0,453 | 0,460 | 0,467 | 0,474 | 0,481 | 0,488 | 0,495 |
| **80** | 0,502 | 0,509 | 0,516 | 0,523 | 0,530 | 0,538 | 0,545 | 0,552 | 0,559 | 0,566 |
| **90** | 0,573 | 0,580 | 0,588 | 0,595 | 0,602 | 0,609 | 0,617 | 0,624 | 0,631 | 0,639 |
| **100** | 0,646 | 0,653 | 0,661 | 0,668 | 0,675 | 0,683 | 0,690 | 0,698 | 0,705 | 0,713 |
| **110** | 0,720 | 0,727 | 0,735 | 0,743 | 0,750 | 0,758 | 0,765 | 0,773 | 0,780 | 0,788 |
| **120** | 0,795 | 0,803 | 0,811 | 0,818 | 0,826 | 0,834 | 0,841 | 0,849 | 0,857 | 0,865 |
| **130** | 0,872 | 0,880 | 0,888 | 0,896 | 0,903 | 0,911 | 0,919 | 0,927 | 0,935 | 0,942 |
| **140** | 0,950 | 0,958 | 0,966 | 0,974 | 0,982 | 0,990 | 0,998 | 1,006 | 1,013 | 1,021 |
| **150** | 1,029 | 1,037 | 1,045 | 1,053 | 1,061 | 1,069 | 1,077 | 1,085 | 1,094 | 1,102 |
| **160** | 1,110 | 1,118 | 1,126 | 1,134 | 1,142 | 1,150 | 1,158 | 1,167 | 1,175 | 1,183 |
| **170** | 1,191 | 1,199 | 1,207 | 1,216 | 1,224 | 1,232 | 1,240 | 1,249 | 1,257 | 1,265 |
| **180** | 1,273 | 1,282 | 1,290 | 1,298 | 1,307 | 1,315 | 1,323 | 1,332 | 1,340 | 1,348 |
| **190** | 1,357 | 1,365 | 1,373 | 1,382 | 1,390 | 1,399 | 1,407 | 1,415 | 1,424 | 1,432 |
| **200** | 1,441 | 1,449 | 1,458 | 1,466 | 1,475 | 1,483 | 1,492 | 1,500 | 1,509 | 1,517 |
| **210** | 1,526 | 1,534 | 1,543 | 1,551 | 1,560 | 1,569 | 1,577 | 1,586 | 1,594 | 1,603 |
| **220** | 1,612 | 1,620 | 1,629 | 1,638 | 1,646 | 1,655 | 1,663 | 1,672 | 1,681 | 1,690 |
| **230** | 1,698 | 1,707 | 1,716 | 1,724 | 1,733 | 1,742 | 1,751 | 1,759 | 1,768 | 1,777 |
| **240** | 1,786 | 1,794 | 1,803 | 1,812 | 1,821 | 1,829 | 1,838 | 1,847 | 1,856 | 1,865 |
| **250** | 1,874 | 1,882 | 1,891 | 1,900 | 1,909 | 1,918 | 1,927 | 1,936 | 1,944 | 1,953 |
| **260** | 1,962 | 1,971 | 1,980 | 1,989 | 1,998 | 2,007 | 2,016 | 2,025 | 2,034 | 2,043 |
| **270** | 2,052 | 2,061 | 2,070 | 2,078 | 2,087 | 2,096 | 2,105 | 2,114 | 2,123 | 2,132 |
| **280** | 2,141 | 2,151 | 2,160 | 2,169 | 2,178 | 2,187 | 2,196 | 2,205 | 2,214 | 2,223 |
| **290** | 2,232 | 2,241 | 2,250 | 2,259 | 2,268 | 2,277 | 2,287 | 2,296 | 2,305 | 2,314 |
| **300** | 2,323 | 2,332 | 2,341 | 2,350 | 2,360 | 2,369 | 2,378 | 2,387 | 2,396 | 2,405 |
| **310** | 2,415 | 2,424 | 2,433 | 2,442 | 2,451 | 2,461 | 2,470 | 2,479 | 2,488 | 2,497 |
| **320** | 2,507 | 2,516 | 2,525 | 2,534 | 2,544 | 2,553 | 2,562 | 2,571 | 2,581 | 2,590 |
| **330** | 2,599 | 2,609 | 2,618 | 2,627 | 2,636 | 2,646 | 2,655 | 2,664 | 2,674 | 2,683 |
| **340** | 2,692 | 2,702 | 2,711 | 2,720 | 2,730 | 2,739 | 2,748 | 2,758 | 2,767 | 2,776 |
| **350** | 2,786 | 2,795 | 2,805 | 2,814 | 2,823 | 2,833 | 2,842 | 2,851 | 2,861 | 2,870 |
| **360** | 2,880 | 2,889 | 2,899 | 2,908 | 2,917 | 2,927 | 2,936 | 2,946 | 2,955 | 2,965 |
| **370** | 2,974 | 2,983 | 2,993 | 3,002 | 3,012 | 3,021 | 3,031 | 3,040 | 3,050 | 3,059 |
| **380** | 3,069 | 3,078 | 3,088 | 3,097 | 3,107 | 3,116 | 3,126 | 3,135 | 3,145 | 3,154 |
| **390** | 3,164 | 3,173 | 3,183 | 3,192 | 3,202 | 3,212 | 3,221 | 3,231 | 3,240 | 3,250 |
| **400** | 3,259 | 3,269 | 3,279 | 3,288 | 3,298 | 3,307 | 3,317 | 3,326 | 3,336 | 3,346 |
| **410** | 3,355 | 3,365 | 3,374 | 3,384 | 3,394 | 3,403 | 3,413 | 3,423 | 3,432 | 3,442 |
| **420** | 3,451 | 3,461 | 3,471 | 3,480 | 3,490 | 3,500 | 3,509 | 3,519 | 3,529 | 3,538 |
| **430** | 3,548 | 3,558 | 3,567 | 3,577 | 3,587 | 3,596 | 3,606 | 3,616 | 3,626 | 3,635 |
| **440** | 3,645 | 3,655 | 3,664 | 3,674 | 3,684 | 3,694 | 3,703 | 3,713 | 3,723 | 3,732 |
| **450** | 3,742 | 3,752 | 3,762 | 3,771 | 3,781 | 3,791 | 3,801 | 3,810 | 3,820 | 3,830 |
| **460** | 3,840 | 3,850 | 3,859 | 3,869 | 3,879 | 3,889 | 3,898 | 3,908 | 3,918 | 3,928 |
| **470** | 3,938 | 3,947 | 3,957 | 3,967 | 3,977 | 3,987 | 3,997 | 4,006 | 4,016 | 4,026 |
| **480** | 4,036 | 4,046 | 4,056 | 4,065 | 4,075 | 4,085 | 4,095 | 4,105 | 4,115 | 4,125 |
| **490** | 4,134 | 4,144 | 4,154 | 4,164 | 4,174 | 4,184 | 4,194 | 4,204 | 4,213 | 4,223 |
| **500** | 4,233 | 4,243 | 4,253 | 4,263 | 4,273 | 4,283 | 4,293 | 4,303 | 4,313 | 4,323 |
| **510** | 4,332 | 4,342 | 4,352 | 4,362 | 4,372 | 4,382 | 4,392 | 4,402 | 4,412 | 4,422 |
| **520** | 4,432 | 4,442 | 4,452 | 4,462 | 4,472 | 4,482 | 4,492 | 4,502 | 4,512 | 4,522 |
| **530** | 4,532 | 4,542 | 4,552 | 4,562 | 4,572 | 4,582 | 4,592 | 4,602 | 4,612 | 4,622 |
| **540** | 4,632 | 4,642 | 4,652 | 4,662 | 4,672 | 4,682 | 4,692 | 4,702 | 4,712 | 4,722 |
| **550** | 4,732 | 4,742 | 4,752 | 4,762 | 4,772 | 4,782 | 4,793 | 4,803 | 4,813 | 4,823 |
| **560** | 4,833 | 4,843 | 4,853 | 4,863 | 4,873 | 4,883 | 4,893 | 4,904 | 4,914 | 4,924 |
| **570** | 4,934 | 4,944 | 4,954 | 4,964 | 4,974 | 4,984 | 4,995 | 5,005 | 5,015 | 5,025 |
| **580** | 5,035 | 5,045 | 5,055 | 5,066 | 5,076 | 5,086 | 5,096 | 5,106 | 5,116 | 5,127 |
| **590** | 5,137 | 5,147 | 5,157 | 5,167 | 5,178 | 5,188 | 5,198 | 5,208 | 5,218 | 5,228 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **600** | 5,239 | 5,249 | 5,259 | 5,269 | 5,280 | 5,290 | 5,300 | 5,310 | 5,320 | 5,331 |
| **610** | 5,341 | 5,351 | 5,361 | 5,372 | 5,382 | 5,392 | 5,402 | 5,413 | 5,423 | 5,433 |
| **620** | 5,443 | 5,454 | 5,464 | 5,474 | 5,485 | 5,495 | 5,505 | 5,515 | 5,526 | 5,536 |
| **630** | 5,546 | 5,557 | 5,567 | 5,577 | 5,588 | 5,598 | 5,608 | 5,618 | 5,629 | 5,639 |
| **640** | 5,649 | 5,660 | 5,670 | 5,680 | 5,691 | 5,701 | 5,712 | 5,722 | 5,732 | 5,743 |
| **650** | 5,753 | 5,763 | 5,774 | 5,784 | 5,794 | 5,805 | 5,815 | 5,826 | 5,836 | 5,846 |
| **660** | 5,857 | 5,867 | 5,878 | 5,888 | 5,898 | 5,909 | 5,919 | 5,930 | 5,940 | 5,950 |
| **670** | 5,961 | 5,971 | 5,982 | 5,992 | 6,003 | 6,013 | 6,024 | 6,034 | 6,044 | 6,055 |
| **680** | 6,065 | 6,076 | 6,086 | 6,097 | 6,107 | 6,118 | 6,128 | 6,139 | 6,149 | 6,160 |
| **690** | 6,170 | 6,181 | 6,191 | 6,202 | 6,212 | 6,223 | 6,233 | 6,244 | 6,254 | 6,265 |
| **700** | 6,275 | 6,286 | 6,296 | 6,307 | 6,317 | 6,328 | 6,338 | 6,349 | 6,360 | 6,370 |
| **710** | 6,381 | 6,391 | 6,402 | 6,412 | 6,423 | 6,434 | 6,444 | 6,455 | 6,465 | 6,476 |
| **720** | 6,486 | 6,497 | 6,508 | 6,518 | 6,529 | 6,539 | 6,550 | 6,561 | 6,571 | 6,582 |
| **730** | 6,593 | 6,603 | 6,614 | 6,624 | 6,635 | 6,646 | 6,656 | 6,667 | 6,678 | 6,688 |
| **740** | 6,699 | 6,710 | 6,720 | 6,731 | 6,742 | 6,752 | 6,763 | 6,774 | 6,784 | 6,795 |
| **750** | 6,806 | 6,817 | 6,827 | 6,838 | 6,849 | 6,859 | 6,870 | 6,881 | 6,892 | 6,902 |
| **760** | 6,913 | 6,924 | 6,934 | 6,945 | 6,956 | 6,967 | 6,977 | 6,988 | 6,999 | 7,010 |
| **770** | 7,020 | 7,031 | 7,042 | 7,053 | 7,064 | 7,074 | 7,085 | 7,096 | 7,107 | 7,117 |
| **780** | 7,128 | 7,139 | 7,150 | 7,161 | 7,172 | 7,182 | 7,193 | 7,204 | 7,215 | 7,226 |
| **790** | 7,236 | 7,247 | 7,258 | 7,269 | 7,280 | 7,291 | 7,302 | 7,312 | 7,323 | 7,334 |
| **800** | 7,345 | 7,356 | 7,367 | 7,378 | 7,388 | 7,399 | 7,410 | 7,421 | 7,432 | 7,443 |
| **810** | 7,454 | 7,465 | 7,476 | 7,487 | 7,497 | 7,508 | 7,519 | 7,530 | 7,541 | 7,552 |
| **820** | 7,563 | 7,574 | 7,585 | 7,596 | 7,607 | 7,618 | 7,629 | 7,640 | 7,651 | 7,662 |
| **830** | 7,673 | 7,684 | 7,695 | 7,706 | 7,717 | 7,728 | 7,739 | 7,750 | 7,761 | 7,772 |
| **840** | 7,783 | 7,794 | 7,805 | 7,816 | 7,827 | 7,838 | 7,849 | 7,860 | 7,871 | 7,882 |
| **850** | 7,893 | 7,904 | 7,915 | 7,926 | 7,937 | 7,948 | 7,959 | 7,970 | 7,981 | 7,992 |
| **860** | 8,003 | 8,014 | 8,026 | 8,037 | 8,048 | 8,059 | 8,070 | 8,081 | 8,092 | 8,103 |
| **870** | 8,114 | 8,125 | 8,137 | 8,148 | 8,159 | 8,170 | 8,181 | 8,192 | 8,203 | 8,214 |
| **880** | 8,226 | 8,237 | 8,248 | 8,259 | 8,270 | 8,281 | 8,293 | 8,304 | 8,315 | 8,326 |
| **890** | 8,337 | 8,348 | 8,360 | 8,371 | 8,382 | 8,393 | 8,404 | 8,416 | 8,427 | 8,438 |
| **900** | 8,449 | 8,460 | 8,472 | 8,483 | 8,494 | 8,505 | 8,517 | 8,528 | 8,539 | 8,550 |
| **910** | 8,562 | 8,573 | 8,584 | 8,595 | 8,607 | 8,618 | 8,629 | 8,640 | 8,652 | 8,663 |
| **920** | 8,674 | 8,685 | 8,697 | 8,708 | 8,719 | 8,731 | 8,742 | 8,753 | 8,765 | 8,776 |
| **930** | 8,787 | 8,798 | 8,810 | 8,821 | 8,832 | 8,844 | 8,855 | 8,866 | 8,878 | 8,889 |
| **940** | 8,900 | 8,912 | 8,923 | 8,935 | 8,946 | 8,957 | 8,969 | 8,980 | 8,991 | 9,003 |
| **950** | 9,014 | 9,025 | 9,037 | 9,048 | 9,060 | 9,071 | 9,082 | 9,094 | 9,105 | 9,117 |
| **960** | 9,128 | 9,139 | 9,151 | 9,162 | 9,174 | 9,185 | 9,197 | 9,208 | 9,219 | 9,231 |
| **970** | 9,242 | 9,254 | 9,265 | 9,277 | 9,288 | 9,300 | 9,311 | 9,323 | 9,334 | 9,345 |
| **980** | 9,357 | 9,368 | 9,380 | 9,391 | 9,403 | 9,414 | 9,426 | 9,437 | 9,449 | 9,460 |
| **990** | 9,472 | 9,483 | 9,495 | 9,506 | 9,518 | 9,529 | 9,541 | 9,552 | 9,564 | 9,576 |
| **1000** | 9,587 | 9,599 | 9,610 | 9,622 | 9,633 | 9,645 | 9,656 | 9,668 | 9,680 | 9,691 |
| **1010** | 9,703 | 9,714 | 9,726 | 9,737 | 9,749 | 9,761 | 9,772 | 9,784 | 9,795 | 9,807 |
| **1020** | 9,819 | 9,830 | 9,842 | 9,853 | 9,865 | 9,877 | 9,888 | 9,900 | 9,911 | 9,923 |
| **1030** | 9,935 | 9,946 | 9,958 | 9,970 | 9,981 | 9,993 | 10,005 | 10,016 | 10,028 | 10,040 |
| **1040** | 10,051 | 10,063 | 10,075 | 10,086 | 10,098 | 10,110 | 10,121 | 10,133 | 10,145 | 10,156 |
| **1050** | 10,168 | 10,180 | 10,191 | 10,203 | 10,215 | 10,227 | 10,238 | 10,250 | 10,262 | 10,273 |
| **1060** | 10,285 | 10,297 | 10,309 | 10,320 | 10,332 | 10,344 | 10,356 | 10,367 | 10,379 | 10,391 |
| **1070** | 10,403 | 10,414 | 10,426 | 10,438 | 10,450 | 10,461 | 10,473 | 10,485 | 10,497 | 10,509 |
| **1080** | 10,520 | 10,532 | 10,544 | 10,556 | 10,567 | 10,579 | 10,591 | 10,603 | 10,615 | 10,626 |
| **1090** | 10,638 | 10,650 | 10,662 | 10,674 | 10,686 | 10,697 | 10,709 | 10,721 | 10,733 | 10,745 |
| **1100** | 10,757 | 10,768 | 10,780 | 10,792 | 10,804 | 10,816 | 10,828 | 10,839 | 10,851 | 10,863 |
| **1110** | 10,875 | 10,887 | 10,899 | 10,911 | 10,922 | 10,934 | 10,946 | 10,958 | 10,970 | 10,982 |
| **1120** | 10,994 | 11,006 | 11,017 | 11,029 | 11,041 | 11,053 | 11,065 | 11,077 | 11,089 | 11,101 |
| **1130** | 11,113 | 11,125 | 11,136 | 11,148 | 11,160 | 11,172 | 11,184 | 11,196 | 11,208 | 11,220 |
| **1140** | 11,232 | 11,244 | 11,256 | 11,268 | 11,280 | 11,291 | 11,303 | 11,315 | 11,327 | 11,339 |
| **1150** | 11,351 | 11,363 | 11,375 | 11,387 | 11,399 | 11,411 | 11,423 | 11,435 | 11,447 | 11,459 |
| **1160** | 11,471 | 11,483 | 11,495 | 11,507 | 11,519 | 11,531 | 11,542 | 11,554 | 11,566 | 11,578 |
| **1170** | 11,590 | 11,602 | 11,614 | 11,626 | 11,638 | 11,650 | 11,662 | 11,674 | 11,686 | 11,698 |
| **1180** | 11,710 | 11,722 | 11,734 | 11,746 | 11,758 | 11,770 | 11,782 | 11,794 | 11,806 | 11,818 |
| **1190** | 11,830 | 11,842 | 11,854 | 11,866 | 11,878 | 11,890 | 11,902 | 11,914 | 11,926 | 11,939 |
| **1200** | 11,951 | 11,963 | 11,975 | 11,987 | 11,999 | 12,011 | 12,023 | 12,035 | 12,047 | 12,059 |
| **1210** | 12,071 | 12,083 | 12,095 | 12,107 | 12,119 | 12,131 | 12,143 | 12,155 | 12,167 | 12,179 |
| **1220** | 12,191 | 12,203 | 12,216 | 12,228 | 12,240 | 12,252 | 12,264 | 12,276 | 12,288 | 12,300 |
| **1230** | 12,312 | 12,324 | 12,336 | 12,348 | 12,360 | 12,372 | 12,384 | 12,397 | 12,409 | 12,421 |
| **1240** | 12,433 | 12,445 | 12,457 | 12,469 | 12,481 | 12,493 | 12,505 | 12,517 | 12,529 | 12,542 |
| **1250** | 12,554 | 12,566 | 12,578 | 12,590 | 12,602 | 12,614 | 12,626 | 12,638 | 12,650 | 12,662 |
| **1260** | 12,675 | 12,687 | 12,699 | 12,711 | 12,723 | 12,735 | 12,747 | 12,759 | 12,771 | 12,783 |
| **1270** | 12,796 | 12,808 | 12,820 | 12,832 | 12,844 | 12,856 | 12,868 | 12,880 | 12,892 | 12,905 |
| **1280** | 12,917 | 12,929 | 12,941 | 12,953 | 12,965 | 12,977 | 12,989 | 13,001 | 13,014 | 13,026 |
| **1290** | 13,038 | 13,050 | 13,062 | 13,074 | 13,086 | 13,098 | 13,111 | 13,123 | 13,135 | 13,147 |

| °C in steps of 10 | °C ascending in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1300** | 13,159 | 13,171 | 13,183 | 13,195 | 13,208 | 13,220 | 13,232 | 13,244 | 13,256 | 13,268 |
| **1310** | 13,280 | 13,292 | 13,305 | 13,317 | 13,329 | 13,341 | 13,353 | 13,365 | 13,377 | 13,390 |
| **1320** | 13,402 | 13,414 | 13,426 | 13,438 | 13,450 | 13,462 | 13,474 | 13,487 | 13,499 | 13,511 |
| **1330** | 13,523 | 13,535 | 13,547 | 13,559 | 13,572 | 13,584 | 13,596 | 13,608 | 13,620 | 13,632 |
| **1340** | 13,644 | 13,657 | 13,669 | 13,681 | 13,693 | 13,705 | 13,717 | 13,729 | 13,742 | 13,754 |
| **1350** | 13,766 | 13,778 | 13,790 | 13,802 | 13,814 | 13,826 | 13,839 | 13,851 | 13,863 | 13,875 |
| **1360** | 13,887 | 13,899 | 13,911 | 13,924 | 13,936 | 13,948 | 13,960 | 13,972 | 13,984 | 13,996 |
| **1370** | 14,009 | 14,021 | 14,033 | 14,045 | 14,057 | 14,069 | 14,081 | 14,094 | 14,106 | 14,118 |
| **1380** | 14,130 | 14,142 | 14,154 | 14,166 | 14,178 | 14,191 | 14,203 | 14,215 | 14,227 | 14,239 |
| **1390** | 14,251 | 14,263 | 14,276 | 14,288 | 14,300 | 14,312 | 14,324 | 14,336 | 14,348 | 14,360 |
| **1400** | 14,373 | 14,385 | 14,397 | 14,409 | 14,421 | 14,433 | 14,445 | 14,457 | 14,470 | 14,482 |
| **1410** | 14,494 | 14,506 | 14,518 | 14,530 | 14,542 | 14,554 | 14,567 | 14,579 | 14,591 | 14,603 |
| **1420** | 14,615 | 14,627 | 14,639 | 14,651 | 14,664 | 14,676 | 14,688 | 14,700 | 14,712 | 14,724 |
| **1430** | 14,736 | 14,748 | 14,760 | 14,773 | 14,785 | 14,797 | 14,809 | 14,821 | 14,833 | 14,845 |
| **1440** | 14,857 | 14,869 | 14,881 | 14,894 | 14,906 | 14,918 | 14,930 | 14,942 | 14,954 | 14,966 |
| **1450** | 14,978 | 14,990 | 15,002 | 15,015 | 15,027 | 15,039 | 15,051 | 15,063 | 15,075 | 15,087 |
| **1460** | 15,099 | 15,111 | 15,123 | 15,135 | 15,148 | 15,160 | 15,172 | 15,184 | 15,196 | 15,208 |
| **1470** | 15,220 | 15,232 | 15,244 | 15,256 | 15,268 | 15,280 | 15,292 | 15,304 | 15,317 | 15,329 |
| **1480** | 15,341 | 15,353 | 15,365 | 15,377 | 15,389 | 15,401 | 15,413 | 15,425 | 15,437 | 15,449 |
| **1490** | 15,461 | 15,473 | 15,485 | 15,497 | 15,509 | 15,521 | 15,534 | 15,546 | 15,558 | 15,570 |
| **1500** | 15,582 | 15,594 | 15,606 | 15,618 | 15,630 | 15,642 | 15,654 | 15,666 | 15,678 | 15,690 |
| **1510** | 15,702 | 15,714 | 15,726 | 15,738 | 15,750 | 15,762 | 15,774 | 15,786 | 15,798 | 15,810 |
| **1520** | 15,822 | 15,834 | 15,846 | 15,858 | 15,870 | 15,882 | 15,894 | 15,906 | 15,918 | 15,930 |
| **1530** | 15,942 | 15,954 | 15,966 | 15,978 | 15,990 | 16,002 | 16,014 | 16,026 | 16,038 | 16,050 |
| **1540** | 16,062 | 16,074 | 16,086 | 16,098 | 16,110 | 16,122 | 16,134 | 16,146 | 16,158 | 16,170 |
| **1550** | 16,182 | 16,194 | 16,205 | 16,217 | 16,229 | 16,241 | 16,253 | 16,265 | 16,277 | 16,289 |
| **1560** | 16,301 | 16,313 | 16,325 | 16,337 | 16,349 | 16,361 | 16,373 | 16,385 | 16,396 | 16,408 |
| **1570** | 16,420 | 16,432 | 16,444 | 16,456 | 16,468 | 16,480 | 16,492 | 16,504 | 16,516 | 16,527 |
| **1580** | 16,539 | 16,551 | 16,563 | 16,575 | 16,587 | 16,599 | 16,611 | 16,623 | 16,634 | 16,646 |
| **1590** | 16,658 | 16,670 | 16,682 | 16,694 | 16,706 | 16,718 | 16,729 | 16,741 | 16,753 | 16,765 |
| **1600** | 16,777 | 16,789 | 16,801 | 16,812 | 16,824 | 16,836 | 16,848 | 16,860 | 16,872 | 16,883 |
| **1610** | 16,895 | 16,907 | 16,919 | 16,931 | 16,943 | 16,954 | 16,966 | 16,978 | 16,990 | 17,002 |
| **1620** | 17,013 | 17,025 | 17,037 | 17,049 | 17,061 | 17,072 | 17,084 | 17,096 | 17,108 | 17,120 |
| **1630** | 17,131 | 17,143 | 17,155 | 17,167 | 17,178 | 17,190 | 17,202 | 17,214 | 17,225 | 17,237 |
| **1640** | 17,249 | 17,261 | 17,272 | 17,284 | 17,296 | 17,308 | 17,319 | 17,331 | 17,343 | 17,355 |
| **1650** | 17,366 | 17,378 | 17,390 | 17,401 | 17,413 | 17,425 | 17,437 | 17,448 | 17,460 | 17,472 |
| **1660** | 17,483 | 17,495 | 17,507 | 17,518 | 17,530 | 17,542 | 17,553 | 17,565 | 17,577 | 17,588 |
| **1670** | 17,600 | 17,612 | 17,623 | 17,635 | 17,647 | 17,658 | 17,670 | 17,682 | 17,693 | 17,705 |
| **1680** | 17,717 | 17,728 | 17,740 | 17,751 | 17,763 | 17,775 | 17,786 | 17,798 | 17,809 | 17,821 |
| **1690** | 17,832 | 17,844 | 17,855 | 17,867 | 17,878 | 17,890 | 17,901 | 17,913 | 17,924 | 17,936 |
| **1700** | 17,947 | 17,959 | 17,970 | 17,982 | 17,993 | 18,004 | 18,016 | 18,027 | 18,039 | 18,050 |
| **1710** | 18,061 | 18,073 | 18,084 | 18,095 | 18,107 | 18,118 | 18,129 | 18,140 | 18,152 | 18,163 |
| **1720** | 18,174 | 18,185 | 18,196 | 18,208 | 18,219 | 18,230 | 18,241 | 18,252 | 18,263 | 18,274 |
| **1730** | 18,285 | 18,297 | 18,308 | 18,319 | 18,330 | 18,341 | 18,352 | 18,362 | 18,373 | 18,384 |
| **1740** | 18,395 | 18,406 | 18,417 | 18,428 | 18,439 | 18,449 | 18,460 | 18,471 | 18,482 | 18,493 |
| **1750** | 18,503 | 18,514 | 18,525 | 18,535 | 18,546 | 18,557 | 18,567 | 18,578 | 18,588 | 18,599 |
| **1760** | 18,609 | | | | | | | | | |

### *11.1.19 TC Typ T*

*Temperature range -160°C....+400°C*

*All resistance value in mV*

| °C in steps of 10 | °C tended to zero in step of one | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **-160** | -4,865 | -4,844 | -4,823 | -4,802 | -4,780 | -4,759 | -4,737 | -4,715 | 4,693 | -4,671 |
| **-150** | -4,648 | -4,626 | -4,604 | -4,581 | -4,558 | -4,535 | -4,512 | -4,489 | -4,466 | -4,443 |
| **-140** | -4,419 | -4,395 | -4,372 | -4,348 | -4,324 | -4,300 | -4,275 | -4,251 | -4,226 | -4,202 |
| **-130** | -4,177 | -4,152 | -4,127 | -4,102 | -4,077 | -4,052 | -4,260 | -4,000 | -3,975 | -3,949 |
| **-120** | -3,923 | -3,897 | -3,871 | -3,844 | -3,818 | -3,791 | -3,765 | -3,738 | -3,711 | -3,684 |
| **-110** | -3,675 | -3,629 | -3,602 | -3,574 | -3,547 | -3,519 | -3,491 | -3,463 | -3,435 | -3,407 |
| **-100** | -3,379 | -3,350 | -3,322 | -3,293 | -3,264 | -3,235 | -3,206 | -3,177 | -3,148 | -3,118 |
| **-90** | -3,089 | -3,059 | -3,030 | -3,000 | -2,970 | -2,940 | -2,910 | -2,879 | -2,849 | -2,818 |
| **-80** | -2,788 | -2,757 | -2,726 | -2,695 | -2,664 | -2,633 | -2,602 | -2,571 | -2,539 | -2,507 |
| **-70** | -2,476 | -2,444 | -2,412 | -2,380 | -2,348 | -2,316 | -2,283 | -2,251 | -2,218 | -2,186 |
| **-60** | -2,153 | -2,120 | -2,087 | -2,054 | -2,021 | -1,987 | -1,954 | -1,920 | -1,887 | -1,853 |
| **-50** | -1,819 | -1,785 | -1,751 | -1,717 | -1,683 | -1,648 | -1,614 | -1,579 | -1,545 | -1,510 |
| **-40** | -1,475 | -1,440 | -1,405 | -1,370 | -1,335 | -1,299 | -1,264 | -1,228 | -1,192 | -1,157 |
| **-30** | -1,121 | -1,085 | -1,049 | -1,013 | -0,976 | 0,940 | -0,904 | -0,867 | -0,830 | -0,794 |
| **-20** | -0,757 | -0,720 | -0,683 | -0,646 | -0,608 | -0,571 | -0,534 | -0,496 | -0,459 | -0,421 |
| **-10** | -0,383 | -0,345 | -0,307 | -0,269 | -0,231 | -0,193 | -0,154 | -0,116 | -0,077 | -0,039 |

| °C in steps of 10 | °C in steps of 10 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **0** | 0,000 | 0,039 | 0,078 | 0,117 | 0,156 | 0,195 | 0,234 | 0,273 | 0,312 | 0,352 |
| **10** | 0,391 | 0,431 | 0,470 | 0,510 | 0,549 | 0,589 | 0,629 | 0,669 | 0,709 | 0,749 |
| **20** | 0,790 | 0,830 | 0,870 | 0,911 | 0,951 | 0,992 | 1,033 | 1,074 | 1,114 | 1,155 |
| **30** | 1,196 | 1,238 | 1,279 | 1,320 | 1,362 | 1,403 | 1,445 | 1,486 | 1,528 | 1,570 |
| **40** | 1,612 | 1,654 | 1,696 | 1,738 | 1,780 | 1,823 | 1,865 | 1,908 | 1,950 | 1,993 |
| **50** | 2,036 | 2,079 | 2,122 | 2,165 | 2,208 | 2,251 | 2,294 | 2,338 | 2,381 | 2,425 |
| **60** | 2,468 | 2,512 | 2,556 | 2,600 | 2,643 | 2,687 | 2,732 | 2,776 | 2,820 | 2,864 |
| **70** | 2,909 | 2,953 | 2,998 | 3,043 | 3,087 | 3,132 | 3,177 | 3,222 | 3,267 | 3,312 |
| **80** | 3,358 | 3,403 | 3,448 | 3,494 | 3,539 | 3,585 | 3,631 | 3,677 | 3,722 | 3,768 |
| **90** | 3,814 | 3,860 | 3,907 | 3,953 | 3,999 | 4,046 | 4,092 | 4,138 | 4,185 | 4,232 |
| **100** | 4,279 | 4,325 | 4,372 | 4,419 | 4,466 | 4,513 | 4,561 | 4,608 | 4,655 | 4,702 |
| **110** | 4,750 | 4,798 | 4,845 | 4,893 | 4,941 | 4,988 | 5,036 | 5,084 | 5,132 | 5,180 |
| **120** | 5,228 | 5,277 | 5,325 | 5,373 | 5,422 | 5,470 | 5,519 | 5,567 | 5,616 | 5,665 |
| **130** | 5,714 | 5,763 | 5,812 | 5,861 | 5,910 | 5,959 | 6,008 | 6,057 | 6,107 | 6,156 |
| **140** | 6,206 | 6,255 | 6,305 | 6,355 | 6,404 | 6,454 | 6,504 | 6,554 | 6,604 | 6,654 |
| **150** | 6,704 | 6,754 | 6,805 | 6,855 | 6,905 | 6,956 | 7,006 | 7,057 | 7,107 | 7,158 |
| **160** | 7,209 | 7,260 | 7,310 | 7,361 | 7,412 | 7,463 | 7,515 | 7,566 | 7,617 | 7,668 |
| **170** | 7,720 | 7,771 | 7,823 | 7,874 | 7,926 | 7,977 | 8,029 | 8,081 | 8,133 | 8,185 |
| **180** | 8,237 | 8,289 | 8,341 | 8,393 | 8,445 | 8,497 | 8,550 | 8,602 | 8,654 | 8,707 |
| **190** | 8,759 | 8,812 | 8,865 | 8,917 | 8,970 | 9,023 | 9,076 | 9,129 | 9,182 | 9,235 |
| **200** | 9,288 | 9,341 | 9,395 | 9,448 | 9,501 | 9,555 | 9,608 | 9,662 | 9,715 | 9,769 |
| **210** | 9,822 | 9,876 | 9,930 | 9,984 | 10,038 | 10,092 | 10,146 | 10,200 | 10,254 | 10,308 |
| **220** | 10,362 | 10,417 | 10,471 | 10,525 | 10,580 | 10,634 | 10,689 | 10,743 | 10,798 | 10,853 |
| **230** | 10,907 | 10,962 | 11,017 | 11,072 | 11,127 | 11,182 | 11,237 | 11,292 | 11,347 | 11,403 |
| **240** | 11,458 | 11,513 | 11,569 | 11,624 | 11,680 | 11,735 | 11,791 | 11,846 | 11,902 | 11,958 |
| **250** | 12,013 | 12,069 | 12,125 | 12,181 | 12,237 | 12,293 | 12,349 | 12,405 | 12,461 | 12,518 |
| **260** | 12,574 | 12,630 | 12,687 | 12,743 | 12,799 | 12,856 | 12,912 | 12,969 | 13,026 | 13,082 |
| **270** | 13,139 | 13,196 | 13,253 | 13,310 | 13,366 | 13,423 | 13,480 | 13,537 | 13,595 | 13,652 |
| **280** | 13,709 | 13,766 | 13,823 | 13,881 | 13,938 | 13,995 | 14,053 | 14,110 | 14,168 | 14,226 |
| **290** | 14,283 | 14,341 | 14,399 | 14,456 | 14,514 | 14,572 | 14,630 | 14,688 | 14,746 | 14,804 |
| **300** | 14,862 | 14,920 | 14,978 | 15,036 | 15,095 | 15,153 | 15,211 | 15,270 | 15,328 | 15,386 |
| **310** | 15,445 | 15,503 | 15,562 | 15,621 | 15,679 | 15,738 | 15,797 | 15,856 | 15,914 | 15,973 |
| **320** | 16,032 | 16,091 | 16,150 | 16,209 | 16,268 | 16,327 | 16,387 | 16,446 | 16,505 | 16,564 |
| **330** | 16,624 | 16,683 | 16,742 | 16,802 | 16,861 | 16,921 | 16,980 | 17,040 | 17,100 | 17,159 |
| **340** | 17,219 | 17,279 | 17,339 | 17,399 | 17,458 | 17,518 | 17,578 | 17,638 | 17,698 | 17,759 |
| **350** | 17,819 | 17,879 | 17,939 | 17,999 | 18,060 | 18,120 | 18,180 | 18,241 | 18,301 | 18,362 |
| **360** | 18,422 | 18,483 | 18,543 | 18,604 | 18,665 | 18,725 | 18,786 | 18,847 | 18,908 | 18,969 |
| **370** | 19,030 | 19,091 | 19,152 | 19,213 | 19,274 | 19,335 | 19,396 | 19,457 | 19,518 | 19,579 |
| **380** | 19,641 | 19,702 | 19,763 | 19,825 | 19,886 | 19,947 | 20,009 | 20,070 | 20,132 | 20,193 |
| **390** | 20,255 | 20,317 | 20,378 | 20,440 | 20,502 | 20,563 | 20,625 | 20,687 | 20,748 | 20,810 |
| **400** | 20,872 | | | | | | | | | |