# MTR265B

## User Manual

# Contents

# Document information

Device Scope:          MTR265B
Firmware Versions:     2.0 - 2.1

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# Introduction

MTR265B is an IP65 rated wireless transmitter for Pt100, TC and mV inputs. The wireless concept allows easy installation, implementation and expansion also in difficult installation sites.

# Warnings

⚠️ MTR265B transmitter contains a primary battery and a low-power license-free ISM band radio transmitter operating at 433.92 MHz. Observe local regulations concerning the proper disposal of batteries and the use of the integrated radio transmitter.

# Trademarks

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# Description

## General

MTR265B transmitter is housed in impact resistant plastic enclosure which, when properly screwed together, is watertight to IP 65. The joint between the two parts is sealed with one rubber O-ring. The transmitter fulfills the mechanical and measuring accuracy requirements of the **EN 13485** standard. It also conforms to the requirements of the standards **EN 13486** and **EN 12830** where applicable.

The transmitter is delivered with a M12 male connector for connecting cable sensors and with MTR265B-SP wall mounting bracket for fastening.

MTR265B transmitter operates in license-free **433.92 MHz** ISM-band (Industrial, Scientific, Medical). The power consumption of the radio transmitter is so low, that it does not cause any adverse effects to living organisms or to other nearby radio transmitters operating on other frequencies.

Each radio transmitter has a unique ID number that is used to distinguish the measuring results coming from each individual transmitter. The transmitter is attached to the measuring target from the holes of an MTR265B-SP wall mounting bracket.

The transmitter measures temperature with **an external Pt100-sensor**. Measuring operation is performed with 24-bit AD converter, a micro controller and a 1.5 V size AAA alkaline battery. In typical use the endurance of the battery is about one year. The temperature measurement accuracy and the stability of the transmitter are very good.

Nokeval offers a wide range of different Pt100 and Pt1000 sensors. The transmitter works also with most other resistive temperature sensors, like Ni- and Cu-sensors. The sensor is screwed to M12-male connector delivered with the transmitter and connected to the M12-female connector of the transmitter.

# Installation

## Preparations

Open MTR265B and install the AAA battery delivered with it according to the polarity markings of on the circuit board. Installing the battery in a wrong way may break the device.

When screwing the housing together, O-ring is intact and that there is no gap between two parts of the housing. This is important for ensuring the watertight sealing of the transmitter.

Before installing of the transmitters it's always a good idea to make an installation plan of all the target locations and their names. While installing the transmitters it easy to write down the ID numbers of the transmitters to this plan. This will help when initializing the system.

## Maximum number of transmitters

International radio standards limit the use of radio frequencies and they also limit the use of the license-free ISM frequency band that Nokeval transmitters use. The maximum total number of Nokeval radio transmitters that can be simultaneously used in the same coverage area depends on the transmit interval. The following table gives guidelines on the maximum number of transmitters with different setups. The

default interval is 27 seconds for MTR265B. Transmit interval can be individually adjusted for each transmitter as instructed in the chapter Configuring.

The following table presents maximum number of transmitters with different intervals and with different numbers of repeaters.

| Interval | Receiver(s) only | Receiver(s) and 1 repeater | Receiver(s) and 2 repeaters |
|---|---|---|---|
| 5 s | 22 | 11 | 7 |
| 10 s | 43 | 22 | 14 |
| 20 s | 87 | 43 | 29 |
| 30 s | 130 | 65 | 43 |
| 40 s | 174 | 87 | 58 |
| 50 s | 217 | 109 | 72 |
| 60 s (1 min) | 261 | 130 | 87 |
| 70 s | 304 | 152 | 101 |
| 80 s | 348 | 174 | 116 |
| 90 s | 391 | 196 | 130 |
| 120 s (2 min) | 522 | 261 | 174 |
| 240 s (4 min) | 1043 | 522 | 348 |

# Dimensions

The following pictures present some dimensions in millimeters:
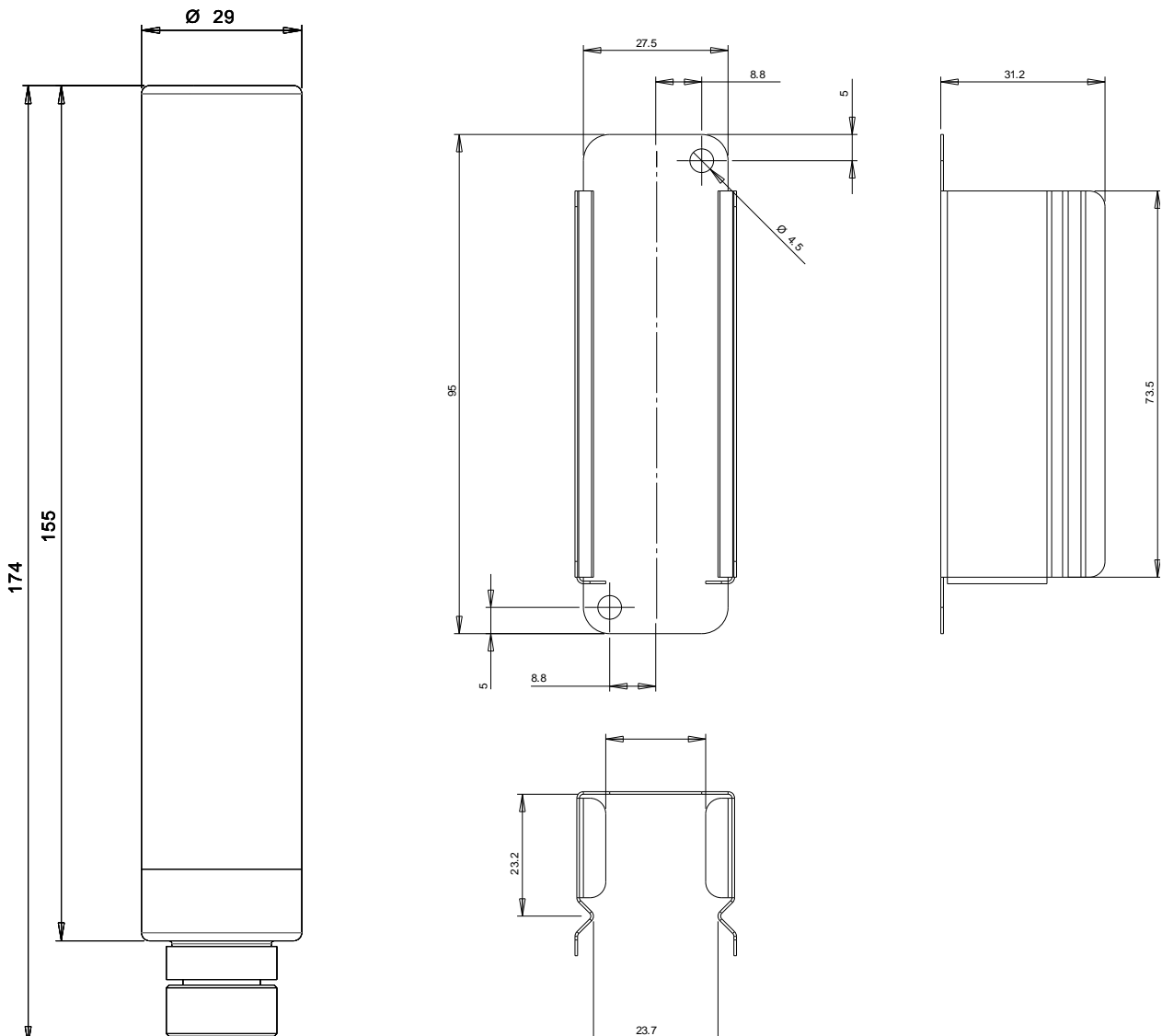
The total height of MTR265B is 227 mm including removable connector.

There are two mounting holes on the corners of MTR265B-SP wall mounting bracket which have a diameter of 4,5 mm. Choose correct type of screws depending on the wall material and with maximum of 4mm diameter.

# Mounting location

### Radio technical perspective

MTR265B transmitter has a typical *indoor maximum range* of 50...100 m depending on the number and quality of obstacles between the transmitter and the receiver. The best range is achieved when there is a line-of-sight between the transmitter and receiver. In unrestricted open space (outdoors) the maximum range can be over 500 meters. Walls and obstacles attenuate the signal and therefore reduce the range. Especially closed steel structures attenuate radio signals very effectively, and installation in or behind them should be avoided if possible. In the worst possible conditions, e.g. very thick reinforced concrete walls, bomb shelters, deep underground spaces, the range can be even less than 10 meters.

However, most spaces with metal walls have doors or openings of some sort, and these openings and the seals between them and the door, leak radio signals if the seals are made of non-conductive material. As a rule of thumb the device should be mounted with antenna positioned vertically just like the antenna of the radio receiver. The doors that leak the radio signals usually have larger vertical dimensions than horizontal and thus leak the vertically polarized signal from the vertically mounted antenna more effectively.

One more factor that affects the final transmission range and performance is the local radio interference and noise condition. This should be seriously considered in heavy industrial installation sites or any sites with lots of power electronics around, for example power inverters and large electric motors. At least the radio receiver should be located as far as possible from this type of radio interference sources.

In any case, it is worth considering the installation location from the radio technical perspective too. MTR265B with external sensor gives more flexibility in choosing the installation location of the transmitter itself. But even for this, the guidelines given in the next chapter should be followed when choosing the installation location for the external sensor.

### Measurement perspective

MTR265B transmitter can be installed in the limits of the length of the sensor form the place where temperature is to be measured. When choosing the installation location one must consider multiple effects affecting the temperature distribution in the space.

### Considerations for cold storage applications

Air tends to layer such that cooler air is lower and warmer air is higher. Evaporators and fans blow cold air into their vicinity. Doors, vents, lamps and other heat sources warm up their surroundings. The device or external sensor should be installed into a spot whose temperature follows as closely as possible to the temperature of the target products in the same space.

Therefore the device or the sensor should **not be installed:**

• close to the floor or ceiling,
• onto the floor or ceiling,
• near the evaporator of a refrigeration unit,
• near the place where the cold/hot air flows from the evaporator/radiator,
• near a door or other opening and definitely not above one,

• close to a lamp or other heat source nor

• in a location where it is likely that the device will be covered up or get mechanically damaged.

**A good installation location is:**

• on a wall as far away as possible from the door and the evaporator/radiator,

• at a height of about 3/4 of the height of the space,

• and where people rarely move about,

• and where air can freely move around.

## Considerations for oven applications

In the oven temperature measuring the maximum temperature of the sensor cable insulation has to be taken into account. For Teflon-insulated cables maximum is 250 °C. For rubber- and PVC insulated cables maximum is 105 °C. For glass fiber insulated special cables maximum is 400 °C. In the temperatures over 250 °C it is recommended to install sensor in a way that only metallic sensor head is located inside the hot space.  To get more information about sensors go to www.nokeval.com.

# Connections

MTR265B transmitter has a standard 4-pole M12 sensor connector for attaching the sensor. A compatible M12 plug is supplied with the transmitter. Refer to the following illustration for the pin out of the M12 connector on the transmitter. Connect the sensor wires to the plug according to the numbers.



### PT100 connections
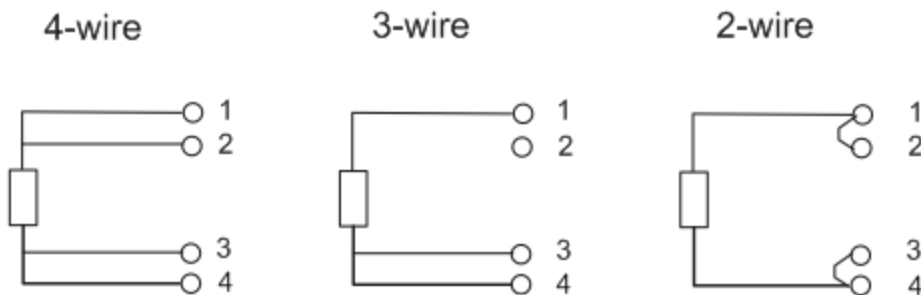


2-wire connection is not recommended, because the resistance of the sensor cable itself is not compensated. Pt100-sensor resistance is 0.385 ohms / °C and because of that it is important to remove the resistance with 3- or 4-wire connection. Also 2-wire connection can be used if the accuracy is not the main criteria. Pt100-connections can be extended with normal copper cables.

## Thermocouple connections
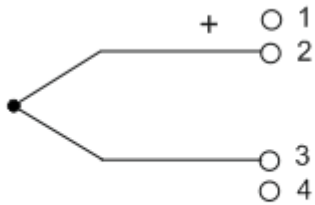


Thermocouple sensors have typically 2 meter long cables. If this length is not enough, the sensor cable can be extended, but this has to be made with correct type of thermocouple cable, **copper cable must not be used.** The most common thermocouple is K-type and the correct extension cable for it in below 105 °C ambient temperature is for example JHAS-K-7/0.2 cable. With higher ambient temperatures teflon covered extension cables can be used up to 250 °C maximum temperature. MTR265B is factory set for Pt100 3-wire sensor. Any other sensor settings have to be mentioned when ordering or changed by the customer with programming cables. To get more information about sensors go to www.nokeval.com.

Nokeval supplies Pt100- (product name TRE) and TC-sensors (product name TCSM12) with M12 male connector and with different dimensions, all of them can be installed straight to the M12 female connector of MTR265B. (See picture below)

# Maintenance

## Cleaning

The plastic parts can be cleaned with a soft cloth and soap water. Cleaning with isopropyl alcohol is also allowed.

⚠️ When cleaning with liquids, verify that the transmitter housing is securely sealed and screwed together to prevent liquids from entering the enclosures.
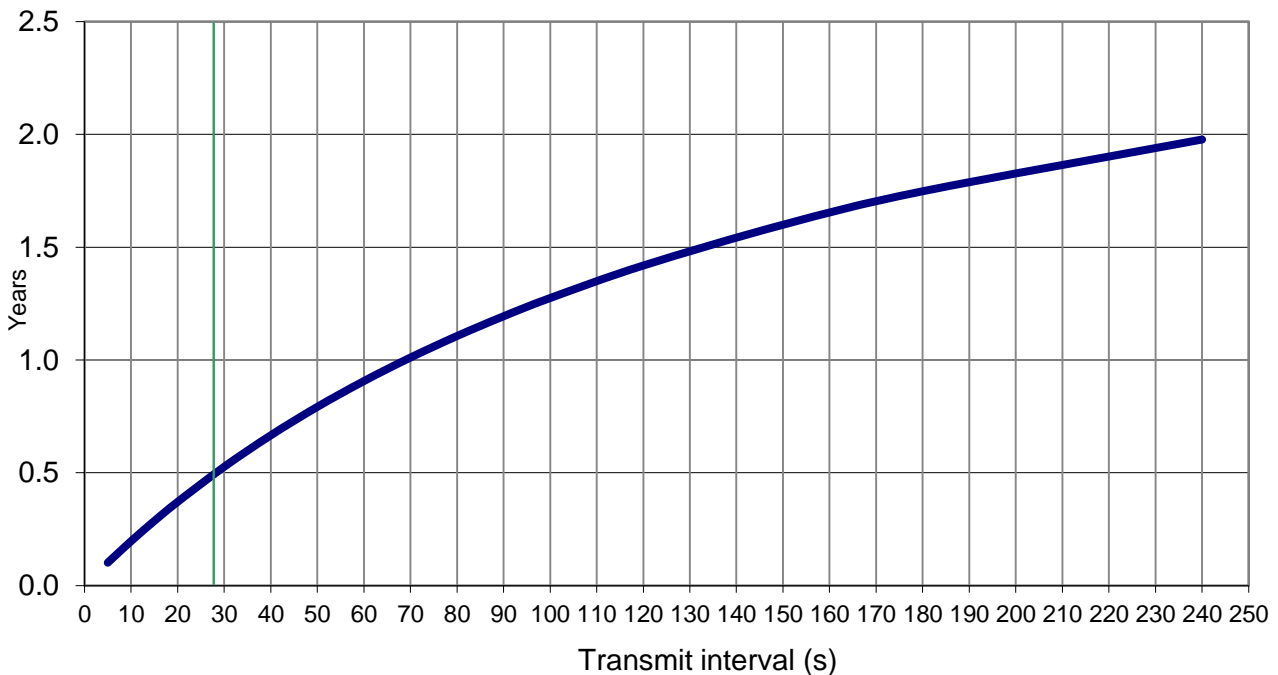
## Battery

### General

MTR265B is powered by single 1.5 V AAA-size alkaline battery.

### Life time

Battery life time depends on the used transmit interval. Ambient temperature also has an effect on the achievable battery life, which will be significantly shorter in extremely cold and very hot environments. The following graph gives a rough estimate of battery life with different transmit intervals. It should be noted that with long transmit intervals, the estimated battery life approaches the typical shelf-life of alkaline batteries. Thus also the age and quality of the battery affect the resulting battery life time.

Estimated battery life time (25°C)
1,5V 1000mAh AAA size alkaline cell



### Replacing the battery

The battery is user replaceable but it should be done carefully. To replace the battery, follow these steps:

1. Unscrew external sensor from transmitter.
2. Grab top part of the transmitter and pull it off from the wall mounting bracket.
3. Unscrew the enclosure. The meeting is between the main label and the serial number label.
4. Carefully pull the two enclosure parts apart.

5. Replace the battery with a high quality alkaline 1.5 V size AAA battery **observing the correct polarity.**
6. Carefully insert the two enclosure parts back together.
7. Screw the enclosure parts back together.
8. Screw the external sensor back to the transmitter.
9. Push the transmitter back to the wall mounting bracket, if using one.
10. Properly dispose the used battery observing the local regulations

# Calibration certificates

Individual calibration certificate is available for each calibrated MTR265B transmitter. To avoid printing, handling, sending and storing a large number of paper certificates that are easily misplaced, all calibration certificates are always available on Nokeval web site at address **www.nokeval.com**. On the pages select **Support** (top of the page) and then **Calibration** (left side). Finally select the item **Calibration certificates**. See the picture below.

Enter the serial number of the measuring module in question into the text entry box. The serial number has the format of A123456. The serial number of each measuring module can be found on the big white colored label, just below the bar code. After entering the serial number just click the button "**Get certificates**". Now you will see a list of certificates with corresponding dates. Click the PDF link next to the date to download and view the certificate. Adobe Reader is needed to view the certificates, it can be downloaded at **get.adobe.com/reader**.

# Configuring

## Programming cable

MTR265B transmitter has an internal Conf-programming connector, found on many other Nokeval products as well. Transmitter enclosure must be opened in order to reveal this connector and to be able to connect the programming cable.

The following programming cables are available:

- 6790 Hand held programmer + POL3-PIN adapter
- MekuWin program + DCS772 USB-POL-converter + POL3-pin adapter
- MekuWin program + POL-RS232 programming cable + POL3-PIN adapter

A free Windows program Nokeval MekuWin is available in the address **www.nokeval.com** in the location Software » Configuration software » MekuWin. The same location also includes user manual of MekuWin which includes more information on using MekuWin.

The communications parameters for MTR265B transmitters are always:

| | |
|---|---|
| Protocol | **SCL** |
| Baud | **9600** |
| Parity | **8N1** |
| Address | **0** |

## Menu

All common settings are located under Conf menu.
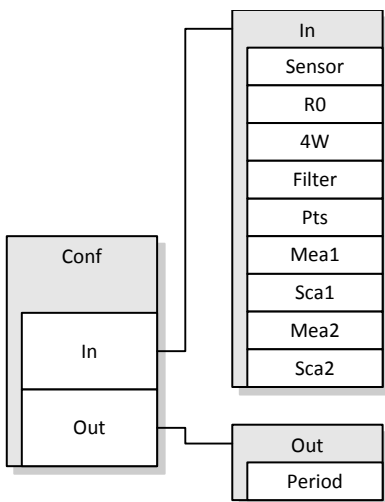
### In / Sensor

This setting selects the sensor type which can be one of the following values:

| Value | Description |
|---|---|
| Pt | Standard platinum RTDs (IEC 60751) |
| Ni | Nickel RTDs |
| Cu | Copper RTDs |
| Ohm | No sensor linearization, result of resistance measurement is sent in Ohms |
| mV | Voltage input -30...2000 mV |
| Tc | Thermocouple sensor with Receiver side linearization |
| TcB | Linearization for B-type thermocouple |
| TcC | Linearization for C-type thermocouple |
| TcD | Linearization for D-type thermocouple |
| TcE | Linearization for E-type thermocouple |
| TcG | Linearization for G-type thermocouple |
| TcJ | Linearization for J-type thermocouple |
| TcK | Linearization for K-type thermocouple |
| TcL | Linearization for L-type thermocouple |
| TcN | Linearization for N-type thermocouple |
| TcR | Linearization for R-type thermocouple |
| TcS | Linearization for S-type thermocouple |
| TcT | Linearization for T-type thermocouple |

### In / R0

This setting defines the resistance of the sensor element in reference temperature (0 °C). For Pt100 the default value is 100 and for Pt1000 it is 1000. If a more accurate value is known for the sensor in question, it can be entered here to obtain more accurate results

### In / 4W

This setting has to be enabled when using four or two wire **RTD sensors**.

### In / Filter

This is a selectable filter that attenuates the measurement noise. Three options are available:

| Value | Description |
|---|---|
| Off | No filtering; immediate response, higher noise. |
| Secondary | The secondary measurements, such as internal offset null and RTD wire compensation, are filtered, but not the main measurement. Attenuates the noise slightly (not on RTD 4-wire), but doesn't slow down the response. |
| Full | As Secondary, but additionally the final reading is filtered with a 10-tap floating average filter. The final settling takes 10 measurements, or 10 radio transmissions. |

This setting is available beginning from firmware V2.1. Firmware V2.0 acts like the Off position.

### In / Pts

This setting defines scaling. Possible values are **0**, **1** ja **2**.

| Value | Description |
|---|---|
| 0 | No scaling |
| 1 | One-point (offset) scaling (Uncal1 and Cal1 settings are visible) |
| 2 | Two-point scaling (Uncal1, Cal1, Uncal2 and Cal2 settings are visible) |

### Out / Period

This sets the transmit period or interval of all measurement results. Allowed range is from **2 to 127 units**. This corresponds to an approximate range of **5 seconds to 5 minutes and 43 seconds** because each unit represents about **2.7 seconds** in room temperature. Actual transmit interval varies slightly depending on ambient temperature. This variation is intentional to reduce the chance of collisions between transmitters.

This setting has a direct effect on battery endurance. Avoid using unnecessarily short transmit intervals because this causes the battery to drain faster and also limits the maximum number of wireless transmitters that can be used in the same coverage area. Refer to the Installation chapter's table for maximum number of transmitters with each period value and Maintenance chapter's Battery topic for more information on battery endurance.

# Troubleshooting

## No radio reception

If the radio packets of this transmitter cannot be received and the operation of the receiving system has already been verified according to their manuals and preferably also with a transmitter known to work, then the following should be checked:

1. Transmitter has an internal LED component in the middle part of the circuit board. Screw enclosure open and observe if the LED blinks every time there is a transmission.
2. If the above checks fail, attach POL3-PIN-adapter connected to programming cable to the transmitters internal Conf-connector. Check transmitter settings and battery voltage from the menu with MekuWin program. For more information on programming cables and configuration menu, refer to chapter Configuration.
3. If configuration attempts fail, remove battery and re-insert it to rule out any contact disturbances and try configuring the device again.
4. If the device still fails to respond to configuration attempts, replace the battery with a new one and retry configuring. If the transmitter is working and the battery is found to be fine, then try reorienting or relocating the transmitters and/or the receiver to improve radio reception. For more information on this topic refer to chapter Installation > Mounting location.

## Erroneous readings

If the received readings are obviously wrong or intermittent, first check the condition of the sensor, sensor cable and connection to the transmitter. Check also that the temperature is within the measuring range of the transmitter. Finally check the sensor and calibration settings of the transmitter.

## Troubleshooting tools

Useful information for troubleshooting can be found with MekuWin program from Mon section of the menu.

### Mea

Measured and linearized value of the transmitter.

### Sca

Scaled measurement value. Radio transmitter sends this value.

### VCJ

Cold junction temperature diode's voltage as millivolts. Only relevant when sensor is set as thermocouple.

### TCJ

Cold junction temperature in degrees Celsius.

### Vbatt

This is the measured battery voltage. The nominal voltage of the battery is 1.5 V. When new, the battery may yield almost 1.6 V. The battery is exhausted when the voltage drops below 0.9 V.

# Specifications

## MTR265B

### Environmental

| | |
|---|---|
| Operating temperature | -30…+60 °C |
| Storage temperature | -40…+70 °C |
| Humidity | < 95 %RH non-condensing |
| Protection class | IP 65 |
| Case material | POM |

### External dimensions

| | |
|---|---|
| Height (incl. connectors) | 227 mm |
| Width | 29 mm |
| Depth | 31 mm |

### Power supply

| | |
|---|---|
| Battery | 1.5 V type LR03 (AAA) alkaline, "heavy-duty" |
| Typical battery life time | 2 years with 4min trans.int. 6 months with 27s trans.int. |

### Regulatory information

| | |
|---|---|
| EMC immunity | EN 61326 |
| EMC emissions | EN 61326, class B |
| R&TTE-directive | EN 300 220, class 3, transmitter power class 8 EN 301 489 EN 300 339 |
| EC regulation 37/2005 | EN 13485 EN 13486 EN 12830 |

### Radio transmitter

| | |
|---|---|
| Type | Licence free 433.92 MHz ERC/REC/70-03 sub band f |
| Frequency band | 433.92 MHz ISM band |
| Power | +10 dBm E.R.P. maximum |
| Open space range | up to 500 m |
| Indoor range | 50…100 m typical |
| Antenna | integrated helix |
| Compatible radio receivers | Nokeval MTR, RTR, FTR, DPR and FT20 series 433.92 MHz radio receivers. |

### External temperature sensor measurement

| | |
|---|---|
| Sensor type | Pt, Ni, Cu resistive temperature sensors and thermocouple sensors |
| Cable length | < 3 m |
| Measuring ranges and linearity error (in parenthesis) | Pt100: -200…+700 °C Ni100: -60…+180 °C Cu10: -200…+260 °C Ohm: 0…10 kΩ mV: -30…2000mV TcB: 400…1700 °C (0.3 °C) TcC: 0…2300 °C (0.5 °C) TcD: 0…2300 °C (1 °C) TcE: -100…900 °C (0.2 °C) TcG: 1000…2300 °C (2 °C) TcJ: -160…950 °C (1 °C) TcK: -150…1370 °C (0.5 °C) TcL: -150…900 °C (0.5 °C) TcN: 0…1300 °C (0.1 °C) TcR: 0…1700 °C (0.5 °C) TcS: 0…1700 °C (0.5 °C) TcT: -200…400 °C (1 °C) |
| Accuracy (Pt100 4-wire) | 0.05% rdg + 0.2 °C @ 25 °C |
| Accuracy (mV) | 0.05% rdg + 0.01 mV |
| Accuracy (thermocouples) | 0.05% rdg + 0.6 °C + lin. error + ambient temp. effect |
| Thermal drift | 0.02 °C/°C ref. 25 °C |
| Noise (typical, RMS) | Pt100-3W no filter: 0.08 °C Pt100-3W sec filter: 0.05 °C Pt100-4W: 0.04 °C Cu10: 0.4 °C mV: 2.7 µV TcK: 0.06 °C |
| Load (mV) | >1 MΩ |