Your Global Automation Partner

TURCK

# TW-R33...
# Sensor Tag

Instructions for Use

# Contents

# Contents


Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

# 1 About these instructions

This manual describes the setup, the functions and use of the product and helps you to operate the product for its intended use. Read the instructions carefully prior to using the product. This will prevent the risk of personal injury and damage to property. Keep these instructions safe during the service life of the product. If the product is passed on, pass on these instructions as well.

## 1.1 Target groups

This document is written for specially trained personnel , and must be read carefully by anyone who is responsible for the mounting, commissioning, operation, maintenance, disassembly or disposal of the device.

## 1.2 Explanation of symbols

The following symbols are used in these instructions:

| | |
|---|---|
|  | **DANGER**<br>DANGER indicates a dangerous situation with high risk of death or severe injury if not avoided. |
|  | **WARNING**<br>WARNING indicates a dangerous situation with medium risk of death or severe injury if not avoided. |
|  | **CAUTION**<br>CAUTION indicates a dangerous situation of medium risk which may result in minor or moderate injury if not avoided. |
|  | **NOTICE**<br>NOTICE indicates a situation which may lead to property damage if not avoided. |
|  | **NOTE**<br>NOTE indicates tips, recommendations and useful information on specific actions and facts. The notes simplify your work and help you to avoid additional work. |
| ▶ | **CALL TO ACTION**<br>This symbol denotes actions that the user must carry out. |
| ⇨ | **RESULT OF ACTION**<br>This symbol denotes relevant results of actions. |

## 1.3 Other documents

- Data sheet

## 1.4 Naming convention

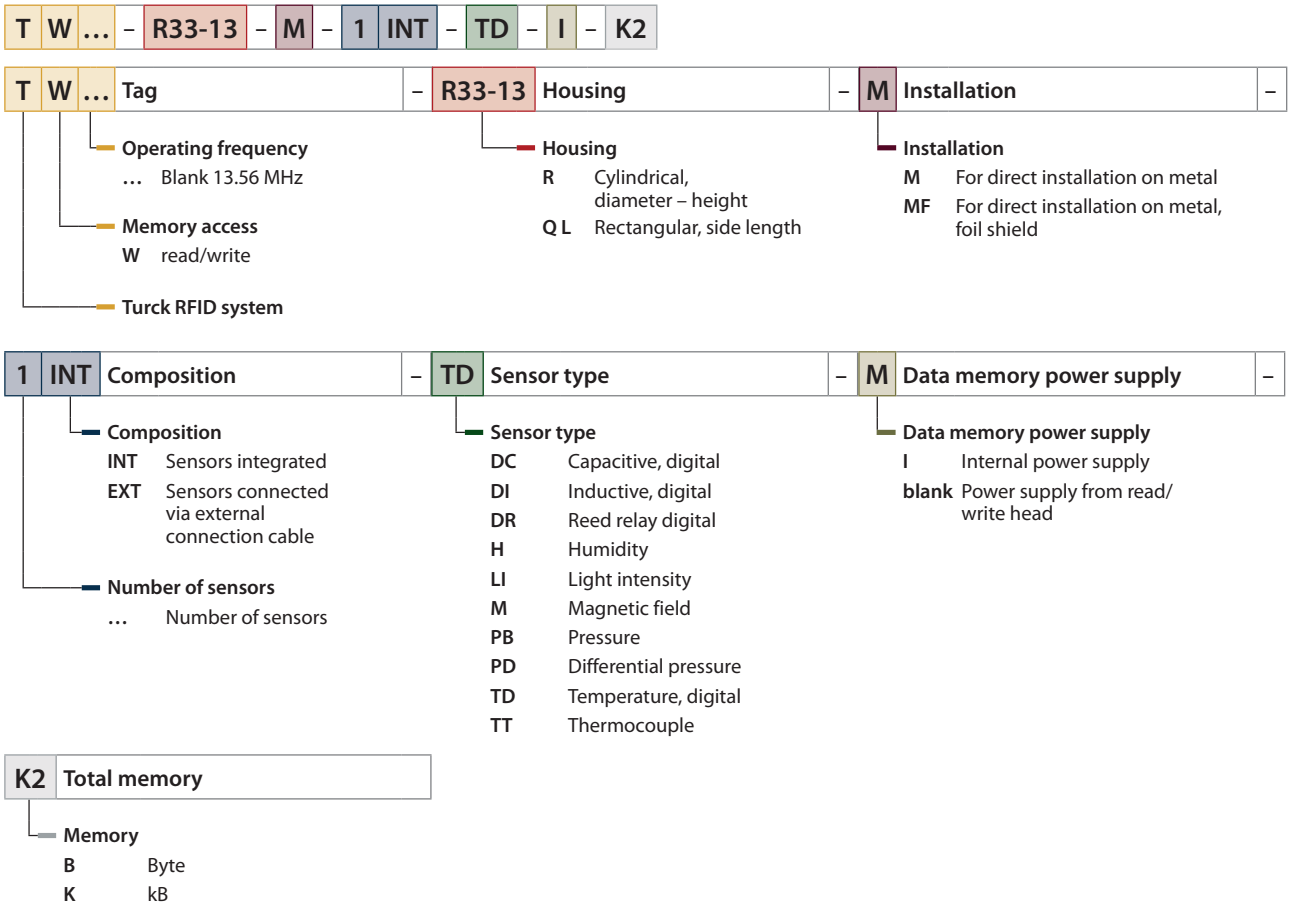
Common synonyms for "data carriers" include "tag", "transponder", and "mobile storage device". Read/write heads are also described as "transceivers" or "readers".

## 1.5 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to techdoc@turck.com.

# 2 Notes on the product

## 2.1 Product identification




## 2.2 Legal requirements

The device is subject to the following EC directives:

- 2014/30/EU (electromagnetic compatibility)
- 2011/65/EC (RoHS II Directive)

## 2.3 Manufacturer and service

Hans Turck GmbH & Co. KG
Witzlebenstraße 7
45472 Mülheim an der Ruhr
Germany

Turck supports you in your projects – from the initial analysis right through to the commissioning of your application. The Turck product database offers you several software tools for programming, configuring or commissioning, as well as data sheets and CAD files in many export formats. You can access the Product Database directly via the following address:
**www.turck.de/products**

For further inquiries in Germany contact the Sales and Service Team on:

- Sales: +49 208 4952-380
- Technical: +49 208 4952-390

For overseas inquiries contact your national Turck representative.

# 3 For Your Safety

The product is designed according to state of the art technology. Residual hazards, however, still exist. Observe the following warnings and safety regulations in order to prevent danger to persons and property. Turck accepts no liability for damage caused by failure to observe these warnings and safety instructions.

## 3.1 Intended use

The devices are designed solely for use in industrial applications.
The sensor tag operates with RFID technology and detects measured values and process values such as pressure or temperature via integrated sensors. The measured values can be stored on the tag and read via RFID read/write heads. Parts identification can also be implemented as a basic RFID function. Typical application areas are production processes in which process parameters on rotating or mobile components have to be checked.

The device must only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

## 3.2 General safety notes

- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- The device only fulfills the EMC requirements for industrial applications and is not suitable for use in residential areas.

# 4 Product description

Each Turck sensor tag is a customer or application specific product. The sensor element is replaceable and can be used to detect pressure, temperature, humidity, magnetic fields, reed contacts or inductive sensors. The sensor tags are available with integrated or external sensors.

## 4.1 Device overview

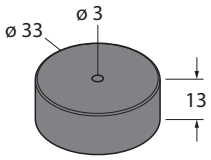



Fig. 1: Dimensions – TW-R33-…INT…

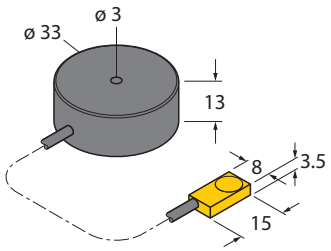



Fig. 2: Dimensions – TW-R33-…EXT…

## 4.2 Properties and features

- Detection of temperature, pressure, light, air humidity, magnetic field or operation as binary switch (depending on hardware configuration)
- ISO 15693 (13.56 MHz)
- 2 sensors per tag possible (depending on type)
- Internal or external sensors possible (depending on type)
- Configurable number of measuring points and measuring cycle
- Type of measured value storage: real, maximum value, minimum value or averaging

## 4.3 Operating principle

The sensor tags are either supplied with energy during the read operation via the read/write heads or via a separate energy source. If the tag reaches the transmission field of the read/write head, it is activated for writing and reading the data. The tag does not generate a its own field for this, but the field of the read/write head simply changes through load modulation. A load resistor is switched on and off in the cycle of the transferred data and the mutual inductance of the HF tag or the properties of the wave reflected by the UHF tag are consequently changed. These changes are detected by the read/write head and evaluated.

The Turck tags are suitable for contactless read and write operations with a number of Turck read/write heads. For this, the tag and the read/write head must operate in the same frequency range. Depending on the power and frequency used, the device ranges vary from a few millimeters up to several meters. The achievable distances may vary due to component tolerances, the mounting situation in the application, ambient conditions and the effect of materials (particularly metal and liquids).

## 4.4 Functions and operating modes

The sensor tags are either supplied with energy during the read operation via the read/write heads or via a separate energy source (autonomous mode). Autonomous mode makes it possible to record measured values without contact to the read/write head.

### 4.4.1 Compatible RFID interfaces

The tags are compatible with the following RFID interfaces:

- TBEN-S2-2RFID-4DXP
- TBEN-L…-4RFID-8DXP-…

## 4.5 Technical accessories

The tags can only be written or read with the correct read/write heads and handhelds. Information about compatible devices is provided in the product data sheet.
An overview of other RFID system components is provided in the RFID engineering manual.

# 5 Mounting

The mounting of the tags depends on the particular design.

- ▶ Mount the tags at the required location.

# 6 Assigning sensor tag parameters

The sensor tag can be set for the particular application via the parameters of the chip independently of the integrated sensors. The parameter data consists of 8 blocks of 8 bytes each.

**NOTE**
The commands described are suitable for the TBEN-S2-2RFID-4DXP and TBEN-L…-4RFID-8DXP-CDS…. RFID interfaces

## 6.1 Starting single measuring

Single measuring enables a single measured value of the sensor to be recorded.

▶ Send the following parameters to the tag via a write command:

| Parameter | Value |
|---|---|
| Block | 0 |
| Write data | 0x01 02 10 01 01 01 0E 00 |
| Start address | 0x00 |
| Length | 0x08 |

## 6.2 Reading a single measurement

A value measured by the sensor can be read via the process data. The measuring result is displayed in bytes 0 (Low byte) and 1 (High byte).

▶ Send the following parameters to the tag via a read command:

| Parameter | Value |
|---|---|
| Block | 9 |
| Start address | 0x48 |
| Length | 0x08 |

### Evaluating a single measurement – example: Digital temperature sensor

▶ Move the output value by one digit to the right (corresponds to a division by 16).
▶ Determine the sign by means of a bitwise ANDing of the measured value and the masking value 0x800.
⇨ If the result is 0 (false): The temperature value is positive (> 0°C).
⇨ If the result is 1 (true): The temperature value is negative (< 0 °C).
▶ Calculate the temperature value for temperatures over 0 °C:
Temperature = $(\text{measured value})_{\text{dec.}} \times 0.0625\ °C$
▶ Calculate the temperature value for temperatures below 0 °C:
Temperature = $(\text{0xFFF - measured value})_{\text{dec.}} \times 0.0625\ °C \times (-1)$

### Evaluating a single measurement of a temperature value – example

- The read measured value is 0x1810.
  - ▶ Move the output value by one digit to the right (corresponds to a division by 16): 0x181
  - ▶ Determine the sign by means of a bitwise ANDing of the measured value and the masking value 0x800.

| | Hexadecimal value | Binary value | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Measured value | 0x181 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Masking | 0x800 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Result of the AND operation | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | FALSE |

The measured temperature value is positive (> 0 °C).

- ▶ Calculate the temperature value:
  $(0x0181)_{dec.} \times 0.0625$ °C
  $385 \times 0.0625$ °C
  24.0625 °C
- ⇨ The measured temperature is 24.0625 °C.

## 6.3 Energy store – reading the charge state

The charge state of the energy store can be measured and read.

- ▶ Measure the charge state: Send the following parameters to the tag via a write command:

| Parameter | Value |
|---|---|
| Block | 0 |
| Write data | 0x01 02 0C 01 01 01 0E 00 |
| Start address | 0x00 |
| Length | 0x08 |

- ▶ Read the charge state: Send the following parameters to the tag via a read command:

| Parameter | Value |
|---|---|
| Block | 9 |
| Start address | 0x48 |
| Length | 0x08 |

The measuring result is displayed in bytes 0 (Low byte) and 1 (High byte).

### Evaluating the measuring result

- ▶ Convert the output hexadecimal value to a decimal value.
- ▶ Calculate the charge state with the following formula: [(measured value) × 0.9 × 1.47] / (16383 × 0.47)

### Evaluating measuring result – example

- The read measured value is 0x1AB8.
  - ▶ Convert the output hexadecimal value to a decimal value: $0x1AB8 = 6840_{dec.}$
  - ▶ Calculate the charge state: (6840 × 0.9 × 1.47) / (16383 × 0.47) = 1.175 V

## 6.4 Charging the energy store

The energy store can be charged via a write command.

▶ Send the following parameters to the tag via a write command:

| Parameter | Value |
|---|---|
| Block | 0 |
| Write data | 0x60 02 00 03 00 01 0E 00 |
| Start address | 0x00 |
| Length | 0x08 |

During the charge operation, the RFID interface stays in the “BUSY” state. The tag cannot be accessed during the charge operation.

## 6.5 Recording the measured value

The number of measured values and the measuring frequency can be set.
A maximum of 689 measured values can be recorded. The number of measured values can be set via the first 3 bits of byte 3 and all of byte 4 in block 0. The measuring frequency can be set via the last 5 bits of byte 3.

| **Byte** | **3** | | | | | | | | **4** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Function | Number of measured values | | | Measuring frequency | | | | | Number of measured values | | | | | | | |

▶ Example: Send the following parameters to the tag via a write command: The bytes relevant for measured value recording are marked in **bold**.

| Parameter | Value |
|---|---|
| Block | 0 |
| Write data (Example) | 0x0D 02 10 **41 B1** 01 0E 00 |
| Start address | 0x00 |
| Length | 0x08 |

### 6.5.1 Example: Defining the number of measured values and measuring frequency

The following example describes how the number of measured values can be defined. This example requires the recording of 689 measured values. A measured value must be recorded two times a second.

- ▶ Represent the required number of measured values in binary format. Example: $689_{10}$ = $010.1011.0001_2$
- ▶ Use the last 8 bits of the result as a hexadecimal value in byte 4. Example: $1011.0001_2$ = 0xB1
- ▶ Enter the required measuring frequency as per the table below. Example: $0.0001_2$

| Measuring frequency | Binary value (format: 5 bits) | Decimal value |
|---|---|---|
| 4 × per second | 0.0000 | 0 |
| 2 × per second | 0.0001 | 1 |
| 1 × per second | 0.0010 | 2 |
| 5 seconds | 0.0011 | 3 |
| 15 seconds | 0.0100 | 4 |
| 30 seconds | 0.0101 | 5 |
| 1 minute | 0.0110 | 6 |
| 2 minutes | 0.0111 | 7 |
| 5 minutes | 0.1000 | 8 |
| 10 minutes | 0.1001 | 9 |
| 30 minutes | 0.1010 | 10 |
| 1 hour | 0.1011 | 11 |
| 2 hours | 0.1100 | 12 |
| 5 hours | 0.1101 | 13 |
| 10 hours | 0.1110 | 14 |
| 24 hours | 0.1111 | 15 |

- ▶ Bring together the binary value for byte 3 and calculate hexadecimal values as per the following example table:

| Byte | 3 | | | | | | | | 4 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Function | Number of measured values | | | Measuring frequency | | | | | Number of measured values | | | | | | | |
| Binary value | $010_2$ | | | $0.0001_2$ | | | | | $1011.0001_2$ | | | | | | | |
| Hexadecimal value | 0x41 | | | | | | | | 0xB1 | | | | | | | |

- ▶ Transfer the calculated hexadecimal values as the values for byte 3 and byte 4 to the write data.
- ▶ Send the parameters to the tag via a write command:

| Parameter | Value |
|---|---|
| Block | 0 |
| Write data | 0x0D 02 10 41 B1 01 0E 00 |
| Start address | 0x00 |
| Length | 0x08 |

## 6.6 Measured value recording – read status

The current status of the measured value recording can be read via bit 0 and bit 1 in ISO block 0.

▶ Send the following parameters to the tag via a read command:

| Parameter | Value |
|---|---|
| Block | 0 |
| Start address | 0x00 |
| Length | 0x08 |

▶ Evaluate the read data according to the following table:

| Data | Meaning |
|---|---|
| 00 | Idle |
| 01 | Measured value recording active |
| 10 | Data available in the memory |
| 11 | Error with measured value recording |

## 6.7 Measured value recording – reading number of recorded measured values

The number of recorded measured values can be read via byte 5 (Low byte) and byte 6 (High byte) in ISO block 8

▶ Send the following parameters to the tag via a read command:

| Parameter | Value |
|---|---|
| Block | 8 |
| Start address | 0x40 |
| Length | 0x08 |

The number of recorded values is displayed in hexadecimal format.

## 6.8 Reading measured values

Depending on the number of recorded values, the measured values can be read in fragments of 64 bytes each. The measured values are stored on the tag from ISO block 9, byte 0.

▶ Send the following parameters to the tag via a read command:

| Parameter | Value |
|---|---|
| Block | 9 |
| Start address | 0x48 |
| Length | Depends on the number of measured values (max. 689) |

▶ Calculate measured values as per section “Evaluating a single measurement”. [▷ 12]

# 7 Troubleshooting

If the device does not function as expected, first check whether ambient interference is present.
If there is no ambient interference present, check the connections of the device for faults.
If there are no faults, there is a device malfunction. In this case, decommission the device and replace it with a new device of the same type.

# 8 Maintenance

The devices are maintenance-free, clean dry if required.

# 9 Repair

The device must not be repaired by the user. The device must be decommissioned if it is faulty. Observe our return acceptance conditions when returning the device to Turck.

## 9.1 Returning devices

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available at
**http://www.turck.de/en/retoure-service-6079.php**
and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

# 10 Disposal

The devices must be disposed of correctly and must not be included in normal household garbage.

TURCK

Over 30 subsidiaries and over
60 representations worldwide!

100002554 | 2018/08

www.turck.com