



**eGate-Kombi-LWUS-RHT-CO2-TVOC-Dust40-DP**  
**eGate-Kombi-LWUS-RHT-Dust40**  
**eGate-Kombi-LWUS-RHT-Dust13**  
**eGate-Kombi-LWUS-RHT-DP**  
**eGate-Kombi-LWUS-RHT**  
**eGate-Kombi-LWUS-RHT-IP42**  
**Manual**

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## Introduction

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The Kombi-LWUS is an economical multi-sensor indoor air quality (IAQ) transmitter series. Depending on the variant, Kombi-LWUS can measure temperature, humidity, total volatile organic compound (TVOC) concentration, differential pressure, carbon dioxide (CO2) concentration, and particulate matter (PM). Kombi-LWUS uses LoRaWAN for communication with the cloud.

**Before using the 915 MHz radio, make sure it is legal in your country.**

## Pictures of variants

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**-RHT-IP42**



**-RHT-Dust40**



**-RHT-Dust13**



**-RHT-DP**



**-RHT**

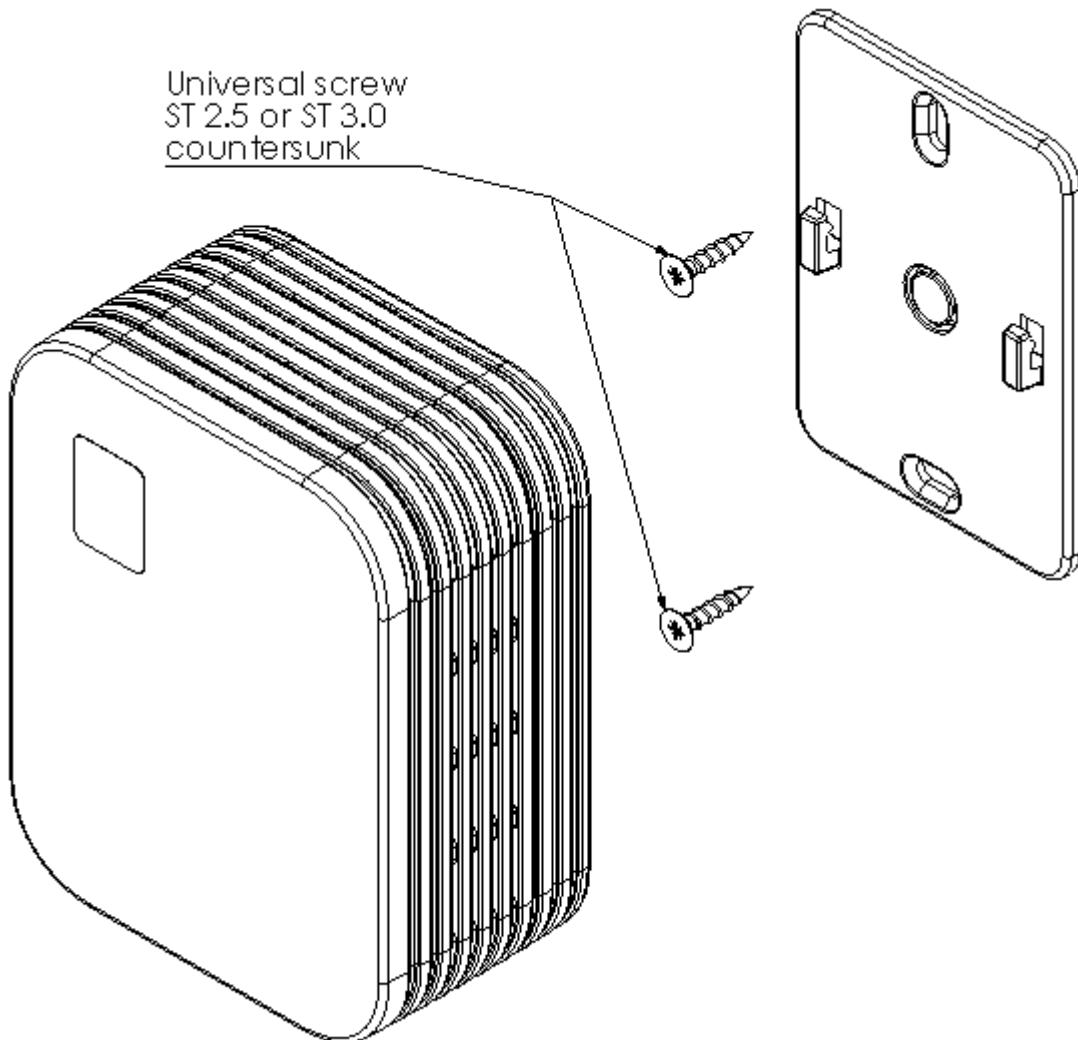


# Installation

## Mounting

Select the installation place so that the air can flow freely on all sides of the transmitter, representing the air that is to be measured. Avoid heat sources and direct sunlight. Place the device to the measuring location with one of the following ways:

- Place the Kombi-LWUS on any surface with the bottom facing down.
- Mount the wall holder with two universal countersunk screws (ST 2.5 or ST 3.0). Use applicable length depending wall material. In the correct orientation, the wall holder has its hooks pointing upwards. Attach the Kombi-LWUS to the holder.



## Power supplies

The Kombi-LWUS indicates the powerup by blinking the led next to the micro USB socket.

### -RHT-DP, -RHT, -RHT-IP42 variants

These variants are powered with 3 pcs LR6 batteries (AA 1.5 V alkaline). High quality batteries should be used, for example Energizer EN91.

The device is supplied with batteries already installed, so it is ready to be used.

The Kombi-LWUS can alternatively be powered with an external supply. When an external power supply is used, the batteries can be omitted or used as a backup supply. Use the micro USB socket to connect an external supply into the device.

### -Dust13, -Dust40, -RHT-CO2-TVOC-Dust40-DP

These variants with PM sensor must be powered with an external supply. Use the micro USB socket to connect an external supply into the device.

## Settings

The Kombi-LWUS works with its default settings and no parameter configuration is normally required. However, if it is necessary to change the settings of the device, it can be done with Nokeval's MekuWin software (available for free at [www.nokeval.com](http://www.nokeval.com)). Following procedure should be followed in order to get access to the settings:

- Connect a micro-USB cable to the connector and the other end of the cable to a computer.
- If Windows requests for a driver, download it at [www.nokeval.com](http://www.nokeval.com) > Support, unzip it to a temporary folder, and show that directory as the location for the driver. If there are problems during the installation, try pushing the button every 5-15 seconds or keeping it pressed so that the Kombi-LWUS will not shut down its USB port.
- Launch the MekuWin program.
- In MekuWin, choose the right COM-port from the Ports-menu. If the port is not visible, try pushing the button on the Kombi-LWUS to wake up the port.
- From the Port settings -menu, choose Protocol = ModbusRTU, Address = 1.
- Click Direct.
- A new window will open for the settings.

The configuration menu includes the following settings:

- Protection
  - Describes password protection status "None", "Locked", "Unlocked".
- Password input/setup
  - Unlock protection or change password. See "Protecting the settings" section below for details.
- Period
  - Time between measurements with options from ranging 5 minutes to 6 hours. Default is 15 min.
- LoRaWAN
  - If the Kombi-LWUS is used with the Nokeval cloud platform, the default settings are ok. If you wish to manually set the LoRaWAN credentials and/or integrate it with your cloud platform, see "LoRaWAN settings" and "Uplink payload structure" chapters.

## Protecting the settings

To protect the settings from being easily adjusted, the configuration menu provides a password box. The password can be formed by using up to 16 characters. From the next MekuWin session, the settings cannot be adjusted without knowing the password.

If the displayed status is “Locked”, changes will not be saved to the device. Write the correct password in the “Password input” field and press enter to unlock.

If displayed status is “Unlocked”, the settings and password can be changed and the menu will become locked again after menu is closed.

Note that the password cannot be reset by the user. If the password is forgotten, the password reset can only be made by the manufacturer. Please make sure that the password is remembered if changed.

# Operation

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After the Kombi-LWUS is successfully installed, it operates on its own. However, there are some considerations that are good to know when using the Kombi-LWUS.

### RHT measurement

Temperature is given in °C. Humidity is given in %RH.

### TVOC measurement

An auto calibration is necessary for the TVOC sensor. A prolonged exposure to high TVOC concentrations will affect the baseline of the sensor and the sensor will give incorrect readings until the baseline is corrected. The auto calibration can work properly only if the Kombi-Sky is exposed to a fresh air at least some hours after the prolonged exposure. TVOC concentration is given in ppb.

### dP measurement

The pressure difference between the outlets is measured using the air flow. The direction of the air flow determines the sign of the reading. If the outlet in the left-hand side is in higher pressure than the outlet in the right-hand side, the reading is positive and vice versa. The pressure difference is given in Pa.

### CO2 measurement

An auto calibration is necessary for the sensor. Without it, the sensor will drift over time and eventually give incorrect readings. The auto calibration can work properly only if the Kombi-LWUS is exposed to a fresh air at least some hours during each week. In practice, the room must be unoccupied, and its ventilation must be switched on. Concentration is given ppm.

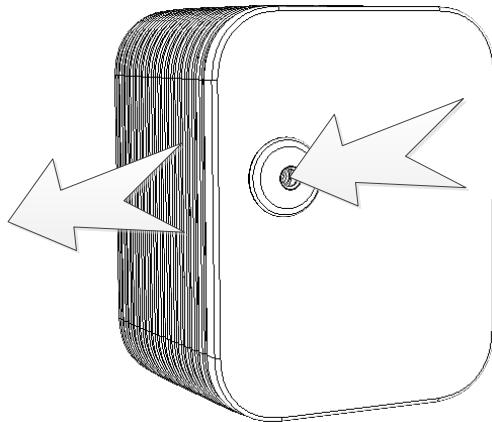
### Particle measurement

A small fan sucks air from the opening in the cover. Inside the device the air passes through a laser beam. The particles will cause a flash when passing the laser, allowing them to be counted and their sizes (diameter) estimated.

The mass of the particles is estimated by assuming that they have a density of 1.65 g/ml and making assumptions of their shape. The result is not accurate if the density, shape, or refractive index deviates significantly from the estimates used in the calibration.

Dust13 sensor variants measure PM1, PM2.5 and PM10. The larger Dust40 sensor measures PM1, PM2.5, PM10 and PM40.

The sensor does not need periodic recalibration. If it appears to have dust deposited inside, compressed air can be used with extreme care to blow it clean.



## Monitor menu

In MekuWin Mon-menu, the measurement readings can be monitored. The sensors are kept continuously on. The values update at the rate the sensor can produce new readings.

Information about LoRaWAN is also displayed to help with potential connection issues.

## Cal menu

The calibration menu settings are only for the manufacturer use. They are not explained in this manual.

# LoRaWAN settings

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## Conf menu

### Quality

- Unidirectional – uplinks are sent as unconfirmed data with 1 attempt. Acknowledgement is not requested.
- Bidirectional – uplinks are sent as confirmed data. Acknowledgement is requested, and up to 3 attempts are used if acknowledgement is not received.

DevEUI (readonly) – shows the DevEUI of the device. Note that DevEUI cannot be modified.

### LoRaWAN credentials

These should be only changed if manually provisioning the device to your own system.

AppKey, AppSKey, NwkSKey: If set, these are displayed as “\*\*\*” when the menu is re-opened. They cannot be read from the device afterwards.

The keys and EUI:s are written as hex symbols 0-9/A-F, 4 bits per symbol.

- OTAA - Activation mode. If toggled on, Over-the-air-activation is used, else Activation by personalization is used.
- (OTAA mode only) AppEUI – 16 hex symbols
- (OTAA mode only) AppKey – 32 hex symbols
- (ABP mode only) DevAddr – 8 hex symbols
- (ABP mode only) AppSKey - 32 hex symbols
- (ABP mode only) NwkSKey - 32 hex symbols

## Other LoRaWAN details

The device always uses Adaptive Data Rate. If it receives no messages from server for 2 subsequent messages, it will lower data rate by 1 step. Then it will lower the data rate by 1 step after every 2 messages until a message is received or data rate 0 is reached. When the device is connected to server, the MAC layer controls the data rate.

# Uplink payload structure

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This information is only relevant for integrating the Kombi-LWUS with the customer's own cloud platform.

Consists of several message types, one message per uplink. All values are LSBF unless otherwise specified.

Terms:

- uint8 = unsigned 8-bit integer
- uint16 = unsigned 16-bit integer

Uplink fPort is 2 by default.

## Type 1 – Utility

Bytes	Name	Meaning
1	Type	1: Utility
1	Bit flags	Describes which fields are included in the message. E.g. 0001 0011 = device type + firmware version + battery.
3	0 – Device type	<0-16777215>, the product number of the device.
2	1 – Firmware ver	<major 0-255> <minor 0-255>
3	2 – Firmware build	<0-16777215> Build number to identify FW version more precisely.
3	3 – Firmware ID	<0-16777215> Firmware identifier, for use with firmware update.
1	4 – Battery info	<number 0-255>, highest bit describes whether the device has auxiliary power. Other bits: 0-100 = main battery empty/full (1% resolution), 101-121 = reserve battery empty/full (5% resolution), 126 = battery cannot be measured, 127 = no battery attached
2	5 – Calibration date	<0-65535> as days after 1.1.2000; 65535 means unknown
X	6 – Serial number	<symbol> *[1-20], 32-126: Ascii-symbols, 128-227: 2 numbers encoded: "00", "01", "02" ... "99"

## Type 4: Debug information

Debug information. These messages can be ignored

## Type 5 – RH+T+VOC+DP+CO2 measurements

Contains first bitflags and then measurement fields based on the bitflags. The bitflags describe which fields are included; if there's not a bitflag matching the field number, that field is missing from the message, so for example RHT variants will only have T and Rh bitflags and values.

Conversion defines the formula to find the measurement result. Range of possible results and step between possible results (for example with step 0.5 results can be 0.0, 0.5, 1.0 etc) are shown for information.

Part of the result range is reserved for status/error codes. For example for temperature, uint16 value 65503 means status 3, and not an actual measurement result.

Bytes	Name	Unit	Notes/conversion	Range	Step
1	Type		5: Kombi Rh,T,VOC,CO2,dP		
1	Flags		Bit flags, describes which fields are included in the message. For example: 0000 0011 = T + Rh.		
2	0 - T	°C	Conversion: <= 65500: (uint16/100) – 50 >= 65501: status	-50 .. +605.00	0.01
1	1 - Rh	%	<= 200: uint8/2 >= 201: status	0..100	0.5
2	2 – VOC	ppb	<= 65500: uint16 >= 65501: status	0..65500	1
2	3 – dP	Pa	<= 65500: (uint16/100) – 320 >= 65501: status	-320 .. +335.00	0.01
2	4 - CO2	ppm	<= 65500: uint16 >= 65501: status	0..65500	1

## Type 6 - PM measurements

Similar to type 5 measurements.

Bytes	Name	Unit	Notes	Range	Step
1	Type		6: PM measurements		
1	Flags		Bit flags, describes which fields are included in the message. For example: 0000 0111 = PM1 + PM2.5 + PM10.		
2	0 - PM1	µg/m3	Conversion: <= 65500: uint16 / 100 >= 65501: status	0 .. 655.00	0.01
2	1 - PM2.5	µg/m3	<= 65500: uint16 / 10 >= 65501: status	0 .. 6550.0	0.1
2	2 - PM10	µg/m3	<= 65500: uint16 / 10 >= 65501: status	0 .. 6550.0	0.1
2	3 - PM40	µg/m3	<= 65500: uint16 >= 65501: status	0 .. 65500	1

## Example uplinks

Here are some example uplinks to help clarify how the uplink payloads are structured.

050be51d1ce8ff

- Type: 05 -> measurements type 5
- Bitflags: 0b = 11 = 1+2+8 = flags 0, 1, 3 -> T, Rh and dP included
- T: e51d -> 26.53
- Rh: 1c -> 14
- dP: e8ff -> status 11

01236d500001059c1e

- Type: 01 -> utility type 1
- Bitflags: 0x23 = 35 = 32 + 2 + 1 = flags 0, 1, 5 -> Device type, firmware version, calibration date
- Device type: 6d5000 -> type 20589
- Firmware version: 0105 -> v1.5
- Calibration date: 9c1e -> 7836 days after 1.1.2000

# Maintenance

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## Checking the status

Press the button to check the status of the Kombi-LWUS. The led located next to the micro USB socket will indicate the status:

- If the led blinks green, everything is fine, and the remaining battery capacity is estimated to be over 20%.
- If the led blinks red, the remaining battery capacity is estimated to be below 20%.
- If the led does not blink at all, the device isn't working properly.

## Replacing the batteries

- Remove the device from the wall holder by pushing it upwards.
- Remove the two PZ1 screws and open the cover.
- Replace the batteries with 3 new LR6 (alkaline AA) batteries observing the polarity. Avoid touching the electronics.

## Cleaning

If there is visible dust inside the device, blow it away with pressurized air while avoiding too strong pressure. The enclosure exterior can be wiped with a damp cloth, but no drop of liquid must enter the device.

# Specifications

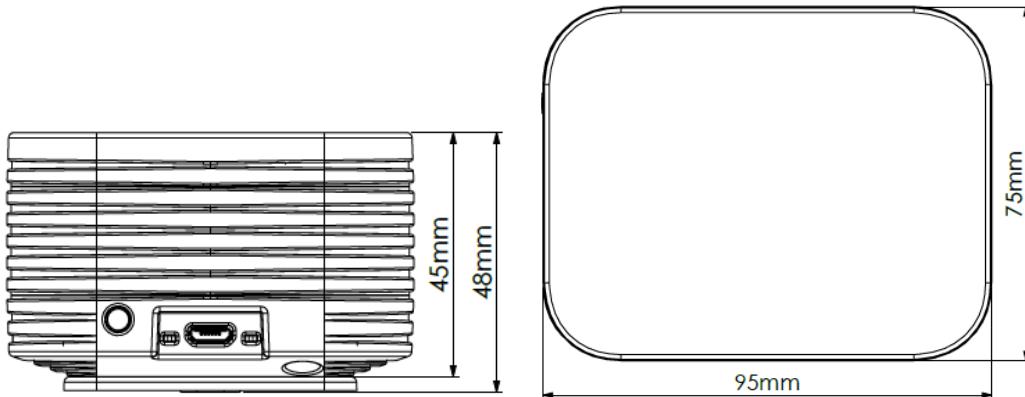
## Environment

Storage temperature	-40...+80°C, without batteries, non-condensing
Operating temperature	
With -Dust13:	-10...+40°C, non-condensing
With -Dust40:	-10...+50°C, non-condensing
Other models:	-30...+60°C, non-condensing
Protection class	IP20
Enclosure material	ABS+PC, white painted (except RHT-IP42) ASA (RHT-IP42)

## Measurements

Weight	RHT: 190 g with batteries RHT-IP42: 460 g with batteries RHT-DP: 200 g with batteries RHT-Dust13: 140 g RHT-Dust40: 260 g RHT-CO2-TVOC-Dust40-DP: 280 g
Dimensions	RHT: 95 x 75 x 47 mm RHT-IP42: 160 x 121 x 66 mm RHT-DP: 95 x 75 x 47 mm RHT-Dust13: 95 x 75 x 47 mm RHT-Dust40: 95 x 75 x 87 mm RHT-CO2-TVOC-Dust40-DP: 95 x 75 x 87 mm Wall mount +1 mm (except RHT-IP42)

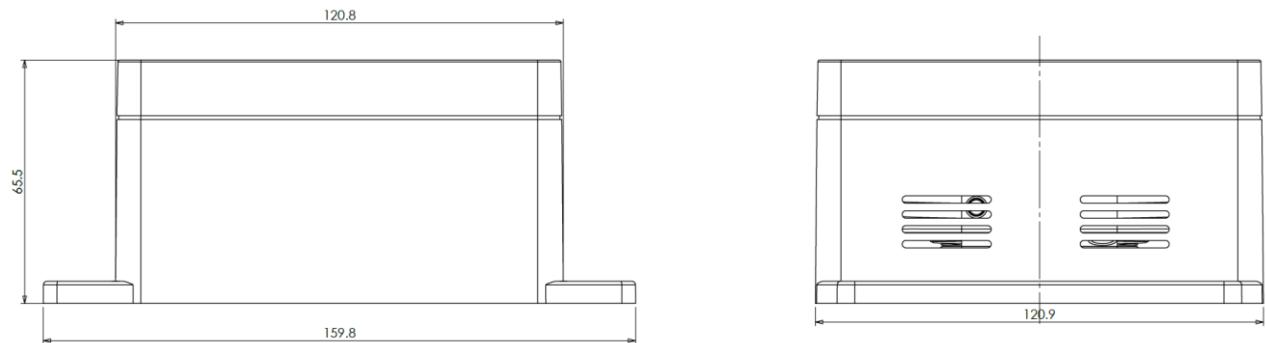
Dimensional drawing, -RHT:



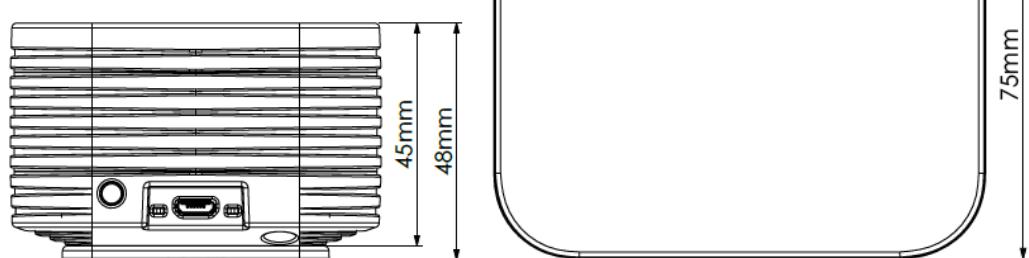
Dimensional drawing, -RHT-DP:



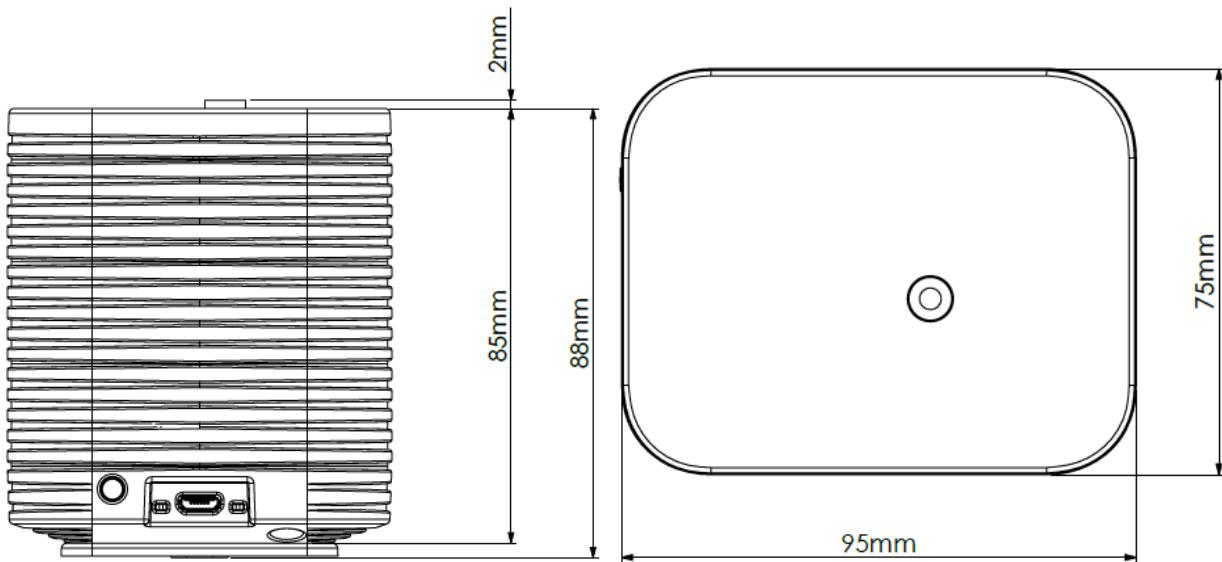
Dimensional drawing, -RHT-IP42:



Dimensional drawing, -RHT-Dust13:



Dimensional drawing, -RHT-Dust40:



## Power supply

### ***-RHT-DP, -RHT, -RHT-IP42 variants***

Batteries	3 pcs LR6 (AA 1.5 V alkaline). For the estimated battery life, high quality batteries should be used, e.g. Energizer EN91.
Typical battery life	5 years with 15 minutes transmission interval
External	Micro USB type B, 5 ± 0.5 V, max 200 mA, no suspend function

### ***-Dust13, -Dust40, -RHT-CO2-TVOC-Dust40-DP***

External	Micro USB type B, 5 ± 0.5 V, max 200 mA, no suspend function
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## Measuring and data transmission

Interval	Configurable: 5min / 10min / 15min / 20min / 30min / 1h / 2h / 3h / 4h / 6h
Radio	LoRa radio technology with Murata ABZ-093 LoRaWAN modem.
Antenna	Internal
Frequency band	902-928 MHz (LoRaWAN 1.0.2 US band)
Transmission power	Max +20 dBm E.R.P.
Range, line-of-sight	Depends on installation location and environment, in good conditions 10 km

## Temperature measurement

Sensor	High-accuracy semiconductor sensor, Swiss
Measurement range	-40...+125°C
Accuracy	Typically ±0.1°C (+20...+60 °C)

## Humidity measurement

Sensor	High-accuracy semiconductor sensor, Swiss
Measurement range	0...100 %RH
Accuracy	Typically ±2 %RH (+0...+80°C, 0...100 %RH)

## Carbon dioxide concentration

Sensor	NDIR sensor
Measurement range	400...5000 ppm
Accuracy	Typically ±45 ppm + 3% rdg
Autocalibration	Must see fresh air (unoccupied room) once a week

**Total volatile organic compound concentration**

Sensor	Semiconductor sensor, Swiss
Measurement range	0.3...30 ppm
Accuracy	Typically $\pm 15\%$

**Differential pressure measurement**

Sensor	High-accuracy flow sensor, Swiss
Measurement range	-125...+125 Pa
Accuracy	Typically $\pm 0.08$ Pa + 3% rdg

### **PM0413 measurement**

Measurement range	0...1.2 million particles per litre (up to 10,000 particles per second)
Particle sizes	0.4...12.4 $\mu\text{m}$
Particle type	For max accuracy, assumed to be spherical, density 1.65 g/ml, refractive index 1.5
Values measured	PM1, PM2.5, PM10
PM10 range	1...6550 $\mu\text{g}/\text{m}^3$

### **PM0440 measurement**

Measurement range	0...2.8 million particles per litre (up to 10,000 particles per second)
Particle sizes	0.4...40 $\mu\text{m}$
Particle type	For max accuracy, assumed to be spherical, density 1.65 g/ml, refractive index 1.5
Values measured	PM1, PM2.5, PM10, non-standard PM40
PM10 range	1...6550 $\mu\text{g}/\text{m}^3$
EMC note	The sensor may malfunction when subjected to intense radio frequency fields (>2V/m below 300MHz). The sensor recovers automatically after the RF disturbance ends.

# FCC labels

FCC ID: 2A3B4KOMBI1

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## FCC CAUTION

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.

# Warnings

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The device must not be disposed in household waste. Observe local regulations concerning the disposal of electrical waste. The device may contain a battery.

## Manufacturer

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