

Nokeval
made to measure



Kombi-LWEU

Manual

ID10882 V24 2.2.2023
Firmware 1.0-1.8

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Introduction

Kombi-LWEU is an economical multi-sensor indoor air quality (IAQ) transmitters developed from the Kube-RHT series. Kombi measures temperature, humidity, total volatile organic compound (TVOC) concentration, differential pressure, carbon dioxide (CO₂) concentration, and certain models also particulate matter (PM). It uses the LoRaWAN technology for communication with the cloud.

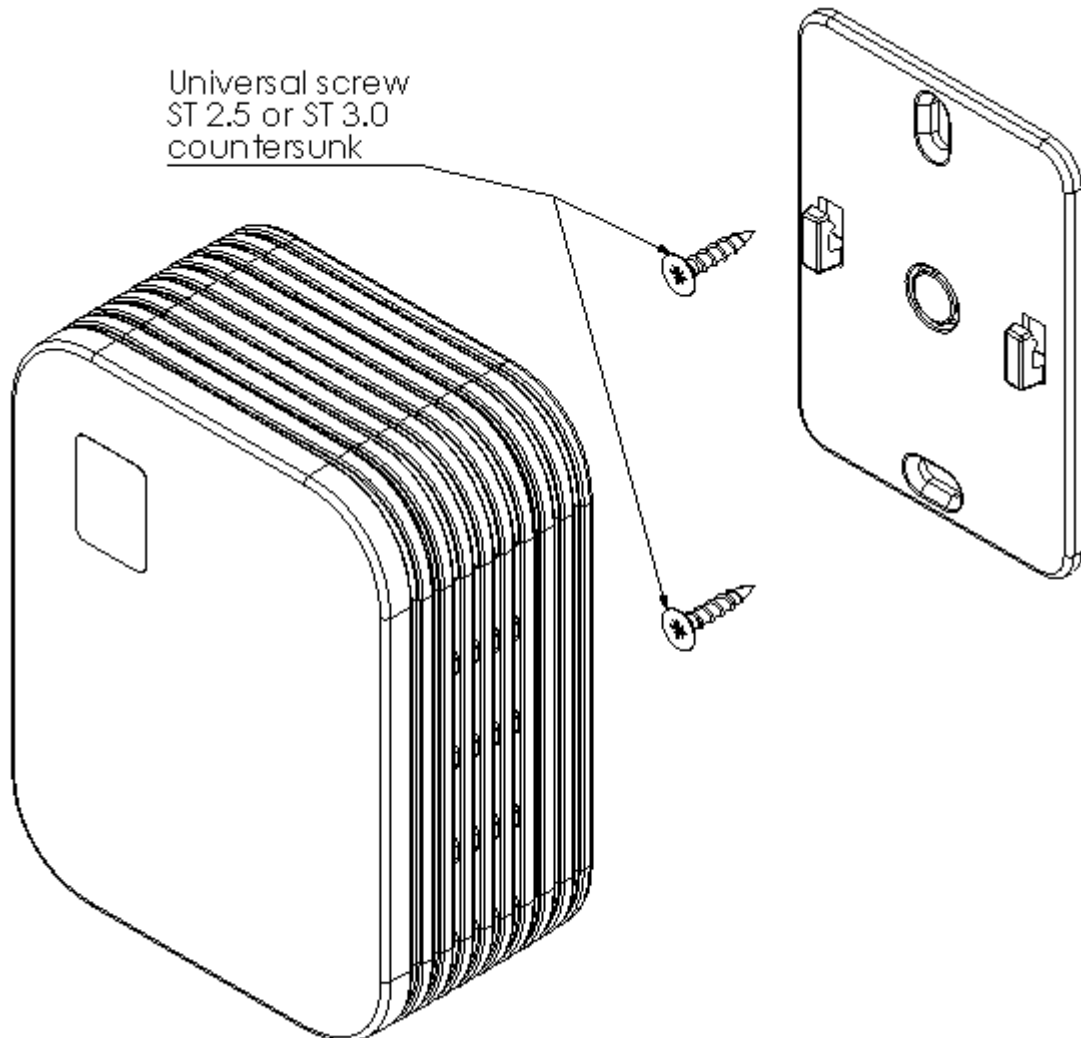
Before using the 868 MHz radio, make sure it is legal in your country.

Installation

Mounting

Select the installation place so that air can flow freely on all sides of the transmitter and that it represents 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:

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



- Place Kombi on any surface with the bottom facing down.

Power supplies

Kombi is powered with a 3.6V Lithium Thionyl battery pack.

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

Kombi 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. If the device has a particulate matter sensor (Dust13 and Dust40 models) and the USB cable is longer than 1 m, use a good quality cable with power wires at least 0.2 mm² (24 AWG).

Kombi indicates the powerup by blinking the LED next to the micro USB socket.

Settings

Kombi 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). 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 > 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 Kombi 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 Kombi 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 30 min.
- LoRaWAN
 - If Kombi 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 using up to 16 characters. From the next MekuWin session, the settings can't 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

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

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 Kombi is exposed to 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 Kombi is exposed to 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.

Particulate matter measurement (option)

A small fan sucks air from the opening in the top 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.

Monitor menu

In MekuWin Mon menu, you can monitor the measurement readings. 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

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 can't 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 can't 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

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

The payload data format consists of a protocol version field and 1 or more messages in length-type-data format. Example payloads are presented at the end of this section for reference.

Size	Name	Meaning
1B	Protocol version	Version=1
XB	1 or more messages	Messages in format presented below.

Message format:

Size	Name	Meaning
1B	Message length	Bits 0:6 - Message length in bytes, excluding length field and optional age field. Bit 7: If 1, age field is included.
(2B)	Optional age field	Age, uint16 * 60 seconds
1B	Message type	Type, e.g. 11 = Flagged utility
XB	Message data	Data based on message type

Message types

Message types:

- 10 Formatted measurement data
- 11 Flagged utility
- 12 Debug

The device may send other message types but those should be ignored. Start of next record can be found based on the length field at start of every message.

Type 10 subtype 1: Measurement data for temperature, humidity etc

Measurement data using bit-flags to describe which measurement fields are included. If the device failed to measure a value, that field will be missing. The format additionally contains status information bitflags field and related to measurements after the measurement data section.

After measurement data, has status bitflags field describing which status fields are included, similarly to the measurement bitflags. Generally if the device failed to produce a measurement, it will have a status code to help identify the issue.

Size	Name	Value/Meaning
2B	Measurement format	Always 1.
1B	Measurement flags	Tells which of the measurement fields are included. E.g. 0011 1110 = all 6 0010 1110 = All except T & dP
2B	0 – T	Conversion: int16 / 100 (°C)
2B	1 – RH	uint16 / 100 (%)
2B	2 – Reserved	Reserved for future use
2B	3 – VOC	uint16 (ppb)
2B	4 – dP	int16 / 100 (Pa)
2B	5 – CO2	uint16 (ppm)
1B	Status flags	Tells which of the measurement status fields are included.
1B	0 – T status	0: Reserved for future use 1+: error number
1B	1 – RH status	- -
1B	2 – absP status	- -
1B	3 – VOC status	- -
1B	4 – DP status	- -
1B	5 – CO2 status	- -

Type 10 subtype 10: Measurement data for particulate matter

Measurement data using bit-flags to describe which particulate matter fields are included. If the device failed to measure a value, that field will be missing. The format additionally contains status field.

Size	Name	Value/Meaning
2B	Measurement format	Always 10.
1B	Measurement flags	Bit flags, describes which fields are included in the message. E.g. 0000 0111 = PM1 + PM2.5 + PM10.
2B	0 - PM1	uint16 / 100 ($\mu\text{g}/\text{m}^3$)
2B	1 - PM2.5	uint16 / 10 ($\mu\text{g}/\text{m}^3$)
2B	2 - PM10	uint16 / 10 ($\mu\text{g}/\text{m}^3$)
2B	3 - PM40	uint16 ($\mu\text{g}/\text{m}^3$)
2B	4 - PM4	uint16 / 10 ($\mu\text{g}/\text{m}^3$)
1B	PM status	0: Particulate matter sensor OK 1+: error number

Type 11: Utility

Contains utility information about the device. Uses bit flags to describe which fields are included in the message, similar to message type 10.

Size	Name	Meaning
1B	Bit flags	If 0x00: Request to send utility. Otherwise describes which fields are included in the message. E.g. 0100 0001 = device type + serial number
3B	0 – Device type	<0-16777215>, the product number of the device.
2B	1 – Firmware ver	<major 0-255> <minor 0-255>
3B	2 – Firmware build	<0-16777215> Build number to identify FW version more precisely.
3B	3 – Firmware ID	<0-16777215> Firmware identifier, for use with firmware update.
1B	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 can't be measured, 127 = no battery attached
2B	5 – Calibration date	<0-65535> as days after 1.1.2000; 65535 means unknown
XB	6 – Serial number	<symbol> *[1-20], 32-126: Ascii-symbols, 128-227: 2 numbers encoded: "00", "01", "02" ... "99"

Type 12: Debug information

Debug information message. These should be skipped when reading.

Example uplinks

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

Bytes are presented as hex values, numbers are LSBF. E.g. consecutive bytes 0x01 and 0x23 converted to unsigned int16 equals $0x01 + 0x23 * 0x100$.

Example – normal measurement data

Bytes (hex): **01 0E 0A 01 00 3B 98 09 B0 0B AD 0D E3 FB 78 05 00**

Interpretation:

Bytes (hex)	Name	Meaning
01	Protocol version	01 – Version
0E	Message length	Message length 14, excluding length field.
0A	Message type	Type 10 = measurement data
01 00	Measurement format	Always 1
3B	Measurement flags	Which of the measurement fields are included. 0x3B = 0011 1011, meaning all except 2
98 09	0 – Temperature	2456 -> 24.56C
B0 0B	1 – Relative humidity	2992 -> 29.92%
AD 0D	3 – VOC	3501 ppb
E3 FB	4 – Differential pressure	-1053 -> -10.53 Pa
78 05	5 – CO2	1400 ppm
00	Status flags	00 = No errors

Example – measurement data with active status

Bytes (hex): **01 0C 0A 01 00 03 98 09 B0 0B 38 01 04 02**

Interpretation:

Bytes (hex)	Name	Meaning
01	Protocol version	01 – Version
0C	Message length	Message length 12, excluding length field.
0A	Message type	Type 10 = measurement data
01 00	Measurement format	Always 1
03	Measurement flags	Which of the measurement fields are included. 03 = 0000 0011, meaning temperature and relative humidity values
98 09	0 – Temperature	2456 -> 24.56C
B0 0B	1 – Relative humidity	2992 -> 29.92%
38	Status flags	Which status field are included. 0011 1000 = 3, 4, 5
01	3 – VOC status	VOC measurement status 1
04	4 – DP status	DP measurement status 4
02	5 – CO2	CO2 measurement status 2

Example – uplink containing 2 messages

If there are more than 1 message in an uplink they are simply one after another.

Bytes (hex):

01 0E 0A 01 00 3B 98 09 B0 0B AD 0D E3 FB 78 05 00 0C 0B 53 4B 83 01 00 16 59 50 AA AE BA

Interpretation:

Bytes (hex)	Name	Meaning
01	Protocol version	01 – Version
0E	Message length	Message length 14, excluding length field.
0A	Message type	Type 10 = measurement data
01 00	Measurement format	Always 1
3B	Measurement flags	Which of the measurement fields are included. 0x3B = 0011 1011, meaning all except 2
98 09	0 – Temperature	2456 -> 24.56C
B0 0B	1 – Relative humidity	2992 -> 29.92%
AD 0D	3 – VOC	3501 ppb
E3 FB	4 – Differential pressure	-1053 -> -10.53 Pa
78 05	5 – CO2	1400 ppm
00	Status flags	00 = No errors
0C	Message length	Message length 12, excluding length field
0B	Message type	Type 11 = utility
53	Utility bitflags	53 = 0101 0011, so fields 0,1,4,6 are included
4B 83 01	0 - Device type	Dev type 99147
00 16	1 – version	FWver 0.22
59	4 – battery	Battery 89%
50 AA AE BA	6 – Serial number	Serial number P424658

Maintenance

Checking the status

Press the button to check the status of Kombi. 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 doesn't blink at all, device isn't working properly.

Replacing the batteries

- Kombi is powered with a 3.6V Lithium Thionyl battery pack. The batteries should not be replaced by the users.

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.

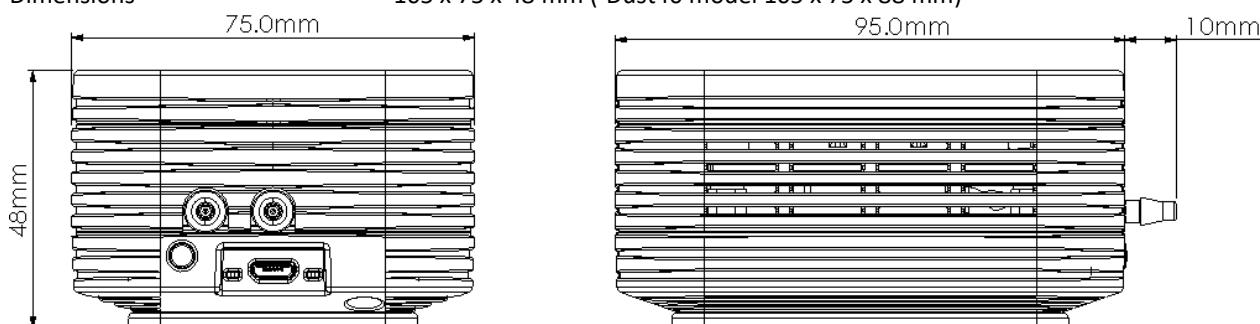
Specifications

Environment

Storage temperature	-40...+80°C, without batteries, non-condensing
Operating temperature	-30...+60°C, non-condensing
Protection class	IP20
Enclosure material	ABS+PC, white painted

Measurements

Weight	Kombi-LWEU-RHT-CO2-TVOC-DP 180g with batteries
Dimensions	105 x 75 x 48 mm (-Dust40 model 105 x 75 x 88 mm)



Power supply

Batteries	3.6V Lithium Thionyl battery pack (3 x AA size)
Typical battery life	5 years with 30 minutes transmission interval
External	Micro USB type B, 5 ± 0.5 V, max 200 mA, no suspend function

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	863-870 MHz (LoRaWAN 1.0.2 EU band)
Transmission power	Max +14 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 $\pm 0.1^\circ\text{C}$ (+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 ± 0.08 Pa + 3% rdg

Particulate matter measurement model -Dust13

Measurement range 0...1.2 million particles per litre (up to 10,000 particles per second)
Particle sizes 0.4...12.4 μm
Particle type For max accuracy, assumed to be spherical, density 1.65 g/ml, refractive index 1.5
Values measured PM1, PM2.5, PM4, PM10
PM10 range 0.01...1 500 000 $\mu\text{g}/\text{m}^3$

Particulate matter measurement model -Dust40

Measurement range 0...2.8 million particles per litre (up to 10,000 particles per second)
Particle sizes 0.4...40 μm
Particle type For max accuracy, assumed to be spherical, density 1.65 g/ml, refractive index 1.5
Values measured PM1, PM2.5, PM4, PM10, non-standard "PM40"
PM10 range 0.01...1 500 000 $\mu\text{g}/\text{m}^3$

Warnings



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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FI-37150 Nokia

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Declaration of conformity

EU Declaration of Conformity

Object of declaration: Wireless measuring device
Model/Type: Kombi-LoRaWAN
Description: Wireless 868MHz temperature, humidity, CO2, differential pressure, TVOC
LoRaWAN-transmitter based on LoRa-modulation.

Manufacturer: Nokeval Oy
Rounionkatu 107, 37150 Nokia, Finland

www.nokeval.com
tel. +358 33424 800
support@nokeval.com

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

Directive (RED) 2014/53/EU
Directive (RoHS) 2011/65/EU

The conformity is given based on the following harmonized standards:

RED:	EN 300 220-2 V3.1.1 (2017-02) EN 301 489-1 V2.1.1 (2017-02) EN 301 489-3 V2.1.1 (2017-03)
EMC:	EN 61326-1:2013
LVD:	EN 61010-1:2010
RoHS:	EN 50581:2012

Product is marked with CE mark to indicate compliance.
Product is designed and manufactured in Finland.

Signed for and on behalf of Nokeval Oy:

At Nokia 04.03.2020



Jani Vähäsyrinki, Managing Director