



Aqua-Scope Rain Sensor LoRaWAN

SKU: RANLWE01

Version: 1.0.0



Product Description

This rain sensor measures the amount of rain at its location in milliliters using a tipping bucket mechanism and transmits the quantity within a 15-minute interval with an accuracy of 0.5 mm of water column, along with the temperature. In the case of heavy rain exceeding 15 l/h, a heavy rain alarm is triggered promptly. Both the heavy rain threshold and the measurement interval are configurable. The device is entirely open-source, and both hardware and firmware can be downloaded from <https://github.com/aqua-scope/lorain>.

The device is controlled via LoRaWAN commands and operates as a LoRaWAN Class A device. The use of the device requires LoRaWAN network coverage. Otherwise, you need to install and operate your own LoRaWAN gateway.

The device is powered by two AAA batteries. The provided VARTA batteries allow for an approximate runtime of about 2 years. A low battery level is reported wirelessly, allowing for battery replacement before the device shuts down.

Connection to LoRaWAN Network



This device, with its three keys (Dev EUI, Join EUI, Join Key), needs to be registered with a LoRaWAN network operator that covers the device's location with radio signals.

If you purchased the device directly from Aqua-Scope's online shop, use the email address used for the purchase and the public device key (Dev EUI) on the website <https://aqua-scope.com/lora>. You will receive a message with all three keys to the provided email address. The public key is also printed on the device as a 16-digit number and as a QR code for scanning. The QR code and 16-digit number are also printed on the outer packaging.

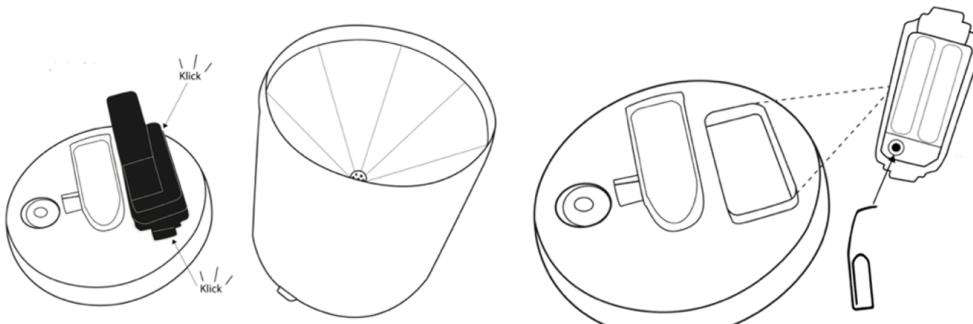
If you purchased the device from a dealer, the dealer will provide the three keys. If they do not, please contact support@aqua-scope.com by email.

Immediately upon inserting the batteries or connecting a power supply, the device will attempt to connect to the LoRaWAN network using the three keys you provided. The LEDs will blink during this process. After approximately 25 seconds, this process, called 'JOIN,' will either be successful or aborted. In the latter case, the device immediately enters sleep mode.

If, for any reason, the sensor loses connection to the server, an automatic reconnection process, called 'Rejoin,' will take place. This process repeats whenever the device attempts to send a message to the LoRaWAN network.

Pressing the button always initiates a LoRaWAN communication, leading to a 'Rejoin' as explained above. Please observe the Duty Cycle regulation—sending messages or Rejoins too quickly in succession may be ignored by the LoRaWAN network.

Starting and Placing the Device



1. Open the device by rotating the cover counterclockwise against the device base.
2. Remove the electronics box by releasing the two click fasteners on the right and left of the electronics box.
3. Insert the two supplied AAA batteries. The device will immediately attempt to



connect to the LoRaWAN network. You can observe the status of the device next to the button with the red and green LEDs. Red/green blinking indicates the 'JOIN' process.

4. You can operate the button with a screwdriver or a paperclip.
5. Click the electronics box back into the housing base. If you now tilt the device, this will be interpreted as rain, and quickly tilting it in succession will trigger a heavy rain alarm. Again, please observe the Duty Cycle regulation of the LoRaWAN network, which is checked by both the device itself and the gateway and LoRaWAN server.
6. The sensor must now be placed on a flat surface. The magic eye on the bottom of the housing assists in positioning. If the sensor is tilted, incorrect or no rain values will be transmitted.
7. It is recommended to securely screw the sensor to the ground. Three suitable wood screws and corresponding dowels are included. If the sensor is not screwed in, strong wind may tip the device over.

Sensor Values

When it rains, the sensor will transmit the corresponding amount of rain every 15 minutes. If no rain is detected, the sensor only reports every 6 hours with a 'zero report.' Each message also includes the temperature in the device. This temperature is measured inside the device and may not be very accurate.

The minimum resolution of the sensor is 0.5 mm of water column. Please note that this amount of rain can only be measured precisely at the sensor. Just a few meters away, different amounts of rain may occur.

In the case of heavy rain, an appropriate alarm is immediately sent, which is cleared when the rain intensity drops below the threshold. The threshold for heavy rain can be defined in configuration parameter 3 and is factory-set to 15 liters/hour.

General Information Regarding Rain Measurement

Rain is measured either in millimeters of water column above a point or as a quantity in liters on an area of 1 square meter. 1 liter/square meter corresponds to a water column of 1 mm. In the case of snowfall, this 1 mm water column corresponds to a snow depth of about 1 cm.

Professional meteorological institutes use standardized rain gauges with an opening of at least 200 mm. In contrast, this sensor has an aperture of only 130 mm, allowing sufficient measurement accuracy without taking up too much space.

Communication Protocol

The device can be controlled directly via LoRaWAN. For this purpose, different



commands are defined, which are used either 'uplink', i.e. from the device to the LoRaWAN network, or 'downlink', i.e. from the LoRaWAN network to the device. Commands can be cascaded up to the maximum number of 52 bytes. All values of the command descriptions are bytes, unless otherwise specified.

Downlink-Commands (using FPort 2):

- **0x03:** Get hardware ID, device answers with uplink command 0x03
- **0x04 PP VV_MSB VV_LSB:** Set configuration parameter PP for new 16 Bit value VV
- **0x1a:** Get firmware version, device answers with uplink command 0x03a
- **0x14 PP:** Get configuration parameter PP, device answers with uplink command 0x04

Uplink-Commands (using FPort 2):

- **0x03 XX YY_MSB, YY_LSB:** Report hardware version XX and device capabilities bitmap YY
- **0x04 PP VV_MSB VV_LSB:** Report 16 Bit Value VV of configuration parameter PP
- **0x06 YY VV_MSB VV_LSB:** Report 16 Bit Sensor Value
 - **YY=0x01:** Temperature in 0.1 degree Celsius. Please note, the temp sensor is based on uncalibrated NTC. Therefore it only gives a rough estimate of the temperature.
 - **YY=0x03:** Uptime in days
 - **YY=0x81:** Rain level in measurement steps of 0,5 mm water level (example YY = 0x06 0x81 0x03 means 1.5 mm water or 1.5 l/m²).
- **0x0a YY_MSB YY YY YY_LSB:** Report firmware version as 32 Bit value
- **0x0b XX YY ZZ_MSB, ZZ_LSB:** Report alarm state XX (1 or 0) of alarm type YY with optional value Z. Current alarm types are
 - **XX=0x03:** heavy rain alarm (Z is the current amount of rain in l/m²),
 - **XX=0x0c:** battery alarm
- **0x12 XX YY_MSB, YY_LSB:** Battery status, XX = voltage in 100 mV, YY Consumption since reboot in mAh

Configuration Parameters

- **Parameter 2 - Heartbeat Interval** This parameter defines after how many measurement intervals the sensor will send a report regardless of rainfall. The factory default is 24 which translates together with the default value of parameter #4 (900 seconds = 15 minutes) into 24 * 15 minutes = 6 hours.
- **Parameter 3 - Heavy Rain Threshold** This parameter defines the heavy rain level as time interval (in seconds) for 0.5 mm rain. The default value of 120 means that 0.5 in 120 seconds or less will cause heavy rain alarm. This translates into 15 liter/h.
- **Parameter 4 - Measurement Interval in Seconds** Rain Level is only measured within. Certain time interval. This parameter defines the time



interval for these reports in sec. The default is 900 = 15 minutes. The value range is 10 – 60000.

- **Parameter 5 - Calibration of Temperature Sensor** This parameter allows a linear correction of the reported temperature value. The default value is 100.

Scope of Delivery

- Main Device
- Mounting Screws
- 2 * AAA Batteries

Technical Data

- Platform: STM32WLE5CCU6 inside RAK 3172
- Wireless Connection:
 - LoRa point-2-point
 - SF 9, coding 4/5
 - Frequency: EU868
 - Range: > 2km (TX 22 dB)
- Measurements:
 - Rain:
 - Min amount of rainfall: 0.5 mm or 0.5 l/m³
 - Metering Interval: 15 minutes
 - Temperature:
 - Precision: +/- 3 Degree
 - Range: - 20 °C ... 50 °C
 - Heartbeat: every 6 hours unless there is rain
 - Threshold for Heavy Rain Alarm: 25 l/h, can be configured
- User Interface: 3 colored LED, single button
- Power Supply:
 - 2 * AAA Battery
 - Voltage: 2.2 ... 3.6 V
- Environmental Conditions:
 - Shipment and Storage: -65 °C ... 125 °C
 - Operation: - 20 °C ... 50 °C
 - Rel. Humidity: 0...90 %
- Protection: IP 55
- Size of device: 132x132x139 mm
- Size of packaging: 140x140x150 mm
- Weight: 219 gr.



Support and Contact

Should you encounter any problem, please give us the opportunity to address it before returning this product. Please check our website www.aqua-scope.com and particularly the support section for answers and help. You can also send a message to info@aqua-scope.com.

While the information in this manual has been compiled with great care, it may not be deemed an assurance of product characteristics. Aqua-Scope shall be liable only to the degree specified in the terms of sale and delivery. The reproduction and distribution of the documentation and software supplied with this product and the use of its contents is subject to written authorization from Aqua-Scope. We reserve the right to make any alterations that arise as the result of technical development.

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Declaration of Conformity



Aqua-Scope Technology OÜ, Sakala 7-2, 10141 Tallinn, Republic of Estonia, declares that this radio emitting device works on the following frequencies:

Български С настоящото Aqua-Scope Technology OÜ декларира, че този тип радиосъоръжение RANLWE01 е в съответствие с Директива 2014/53/EU. Цялостният текст на ЕС декларацията за съответствие може да се намери и в следния интернет адрес: www.aqua-scope.com/ce.

Čeština Tímto Aqua-Scope Technology OÜ prohlašuje, že typ rádiového zařízení RANLWE01 je v souladu se směrnicí 2014/53/EU. Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese: www.aqua-scope.com/ce.

Dansk Hermed erklærer Aqua-Scope Technology OÜ, at radioudstyrstypen RANLWE01 er i overensstemmelse med direktiv 2014/53/EU. EUoverensstemmelseserklæringens fulde tekst kan findes på følgende internetadresse: www.aqua-scope.com/ce.

Deutsch Hiermit erklärt Aqua-Scope Technology OÜ, dass der Funkanlagentyp RANLWE01 der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: www.aqua-scope.com/ce.

Eesti Käesolevaga deklareerib Aqua-Scope Technology OÜ, et kesolev raadioseadme tüüp RANLWE01 vastab direktiivi 2014/53/EL nüetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: www.aqua-scope.com/ce

English Hereby, Aqua-Scope Technology OÜ declares that the radio equipment type RANLWE01 is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: www.aqua-scope.com/ce



Español Por la presente, Aqua-Scope Technology OÜ declara que el tipo de equipo radioeléctrico RANLWE01 es conforme con la Directiva 2014/53/UE. El texto completo de la declaracion UE de conformidad está disponible en la direccin Internet siguiente: www.aqua-scope.com/ce

Ελληνικά Με την παρούσα ο/η Aqua-Scope Technology OÜ, δηλώνει ότι ο ραδιοεξοπλισμός RANLWE01 πληροί την οδηγία 2014/53/EΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: www.aqua-scope.com/ce

Français Le soussigné, Aqua-Scope Technology OÜ, déclare que l'équipement radioélectrique du type RANLWE01 est conforme la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible l'adresse internet suivante: www.aqua-scope.com/ce

Hrvatski Aqua-Scope Technology OÜ ovime izjavljuje da je radijska oprema tipa RANLWE01 u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: www.aqua-scope.com/ce

Italiano Il fabbricante, Aqua-Scope Technology OÜ, dichiara che il tipo di apparecchiatura radio RANLWE01 conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE disponibile al seguente indirizzo Internet: www.aqua-scope.com/ce

Latviešu Ar šo Aqua-Scope Technology OÜ deklarē, ka radioiekārta RANLWE01 atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta v ietnē: www.aqua-scope.com/ce Lietuviai Aš, Aqua-Scope Technology OÜ, patvirtinu, kad radio ierīču tipas RANLWE01 atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo internet adresu: www.aqua-scope.com/ce

Magyar Aqua-Scope Technology OÜ igazolja, hogy a RANLWE01 típus rádiberendezés megfelel a 2014/53/EU irányelvnek. Az EU megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: www.aqua-scope.com/ce

Malta B'dan, Aqua-Scope Technology OÜ, niddikjara li dan it-tip ta' tagħmir tar-radju RANLWE01 huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan I-indirizz tall-Internet li ġej: www.aqua-scope.com/ce

Nederlands Hierbij verklaar ik, Aqua-Scope Technology OÜ, dat het type radioapparatuur RANLWE01 conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres: www.aqua-scope.com/ce

Polski Aqua-Scope Technology OÜ niniejszym oświadcza, że typ urządzenia radiowego RANLWE01 jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności z UE jest dostępny pod następującym adresem internetowym: www.aqua-scope.com/ce

Português O(a) abaixo assinado(a) Aqua-Scope Technology OÜ declara que o presente tipo de equipamento de rádio RANLWE01 está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet: www.aqua-scope.com/ce

Română Prin prezenta Aqua-Scope Technology OÜ declară că tipul de echipamente RANLWE01 este în conformitate cu Directiva 2014/53/UE. Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet: www.aqua-scope.com/ce

Slovensko Aqua-Scope Technology OÜ potrjuje, da je tip radijske opreme RANLWE01 skladen z uredzením 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu: www.aqua-scope.com/ce

Slovensky Aqua-Scope Technology OÜ týmto vyhlasuje, že rádiové zariadenie typu RANLWE01 je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese: www.aqua-scope.com/ce



Soumi Aqua-Scope Technology OÜ vakuuttaa, että radiolaitetyyppi RANLWE01 on direktiivin 2014/53/EU mukainen. EUvaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: www.aqua-scope.com/ce

Svenska Härmed försäkrar Aqua-Scope Technology OÜ att denna typ av radioutrustning RANLWE01 verensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EUförsäkran om verensstämmelse finns på följande webbadress: www.aqua-scope.com/ce

Disposal Guidelines



Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging health and well-being.