# WLAN / MQTT Module

for Gauges, Calipers, Micrometers,...

# Technical documentation

**rAAAreware**

# Inhaltsverzeichnis

Version 1.1.4.3 // 14.07.2021

# 1. Introduction

This document provides technical information about the WLAN MQTT modules for dial indicators, calipers and micrometers with "Digimatic" or other serial interface.

The module knows 2 operating modes:
* Configuration
* Normal operation

In [Configuration] mode, the module operates as a WLAN server and provides a WLAN access point.

Thus, a connection to the module can be established via any client - e.g. if an already configured access to an existing network is no longer possible or the module is set up for the first time. A configuration can be loaded into the module via the connection to this access point. The purpose of the configuration is to prepare the module for access to a specific network and a specific MQTT Server.

After successfully loading a configuration, the module starts in MQTT operation mode. The own WLAN access point is deactivated.

Instead, the module tries to connect to the configured WLAN access point. After successful connection to the access point a connection to the configured MQTT server will be established.

# 2. Documentation and software

The programs and documentation mentioned in this document can be downloaded directly from our server:

https://www.raaareware.de/service-support-download/

**Configuration software mqtt2file**
Windows software:
> https://dl.raaareware.de/messuhr/mqtt2file.zip

Android software:
> https://dl.raaareware.de/messuhr/mqtt2file.apk

documentation:
> https://dl.raaareware.de/messuhr/Messuhr_Software_MQTT2File.pdf

**OTA Firmware Update Tool**
> https://1st.bitbumper.de/ota-firmware-update-tool-for-esp8266/

**MQTT Tool** MQTT.fx
> https://mqttfx.jensd.de

**MQTT Broker** Mosquitto
> https://mosquitto.org

**Information and links about MQTT in general**
> https://mqtt.org
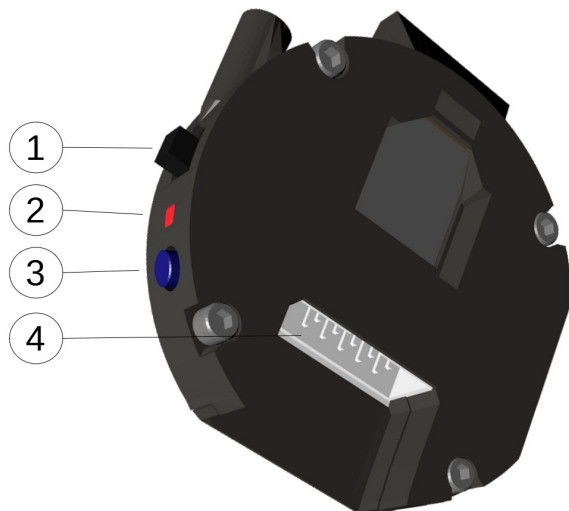
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# 2.1. Components of the devices

### 2.1.1. Model M3 (fixed case)

1. "Data" button
2. OLED display
3. Main switch (slide switch)
4. Service button
5. Charge indicator
6. USB port
7. Battery (Accumulator)
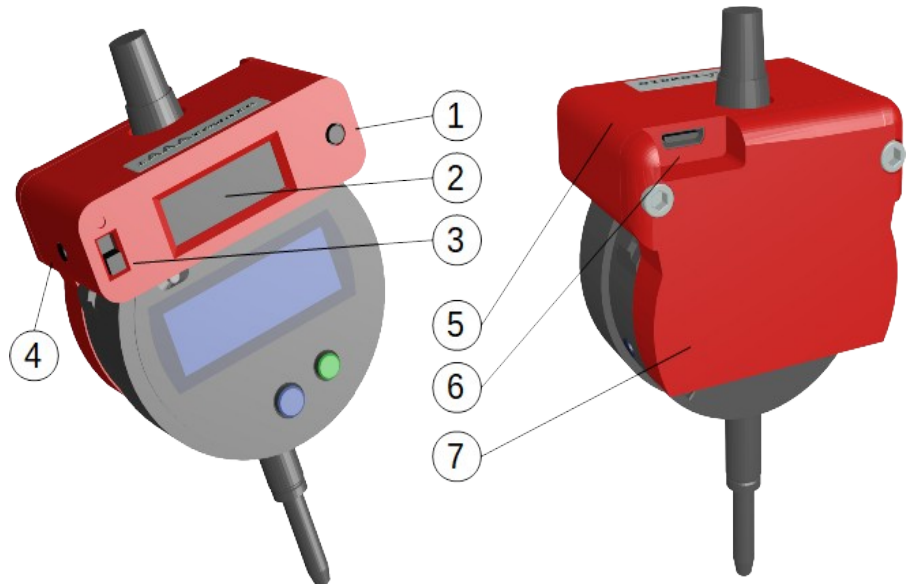
### 2.1.2. Model M4 (rear mount)

1. Main switch (slide switch)
2. State LED
3. Multifunctional switch
4. Module port

### 2.1.3. Modele M5 (caliper module)

1. Main switch (slide switch)
2. Multifunctional switch
3. State LED
4. Service port
5. Charging contacts
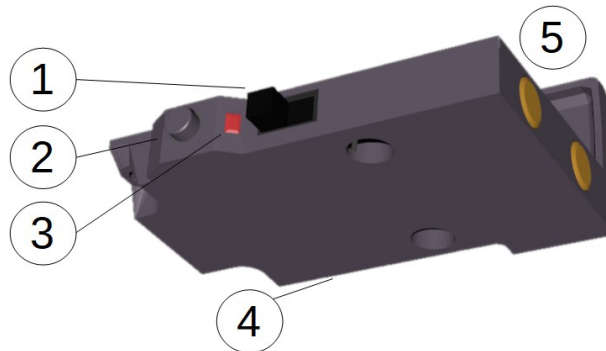
### 2.1.4. Module M6 (micrometer gauge module)

The components correspond to those of the caliper gauge. A service plug connection is not available on the micrometer gauge module.

## 3. Configuration

Before first use or after changing the WLAN/MQTT environment the module must be configured. The configuration is used to tell the module which WLAN it should dial into and which MQTT server it should connect to.

The configuration mode is recognized:
a) By the indication on the built-in display or a connected service display.

Konfiguration
AP:rare-ecfabc9cb33c
IP:192.168.123.1

b) By a service flash code of the built-in LED:
The LED flashes inverted: The continuous lighting is interrupted by 4 short pulses

The display 2nd line shows a WLAN access point under which the module can be reached. In the 3rd line "192.168.123.1" is displayed: This is the IP address under which the module can be reached within the access point.

To send the configuration a connection to the access point is first established from a computer. No password is necessary.

When the WLAN connection is established, the configuration can be transferred to the module using the program "Mqtt2File".

A detailed description of the procedure can be found in the documentation of the program "mqtt2file" (download links see above).

After successful configuration and a performed reset (e.g. by switching on/off) the module starts in normal operation mode ("normal operation").

## 4. Service functions

Special tasks can be performed on the WLAN measuring module using the service button on the back or side of the module body. Depending on the version the button can be operated directly or with a small object (operating pin) through the housing opening.
Each time the key is pressed, the blue status LED of the module lights up and the display shows the corresponding information. If a function has been stored for the displayed information, this function can be executed by pressing the key for more than 3 seconds. A short press of the key switches to the next information or function. After the last function, the first function is started again.
If no key is pressed for more than 2 seconds, the function selection returns to the initial state.

| Nr. | Display text | Description |
|---|---|---|
| 1 | | Current values/measured value is sent. |
| 2 | 2 - Spannung 3,22 Volt | Current supply voltage value. |
| 3 | 3 - IP 192.168.1.201 | Current local IP address (DHCP or static). |
| 4 | 4 - ID 23AB459000889933 | MAC-Address |
| 5 | 5 - Sleep Timer: 60 sek. | Current sleep timer value |
| 6 | 6 - Firmware update | Enable firmware update |
| 7 | 7 - Neu starten | Reset module |
| 8 | 8 - SSID: planet_earth | Current WLAN SSID |
| 9 | 9 - Factory reset | Enter configuration mode / reset settings. |
| 10 | 10- MQ=192.168.1.222 | Current MQTT broker IP |

If the module has no built-in display or no external display is connected to the module, a desired function can still be activated with the service button.
To change to the configuration mode, simply press the service button 10x short and then 1x long (>3sec). The following flashing code and the new WLAN access point will indicate that the module is in configuration mode.

## 5. Updating the firmware

The firmware of the measuring instrument extension can be updated via WLAN (OTA-Update/over the air update). After activation via the service button the new firmware can be sent. The update process is shown on the display.
The update is only activated if the entire firmware could be transferred without errors to the module via WLAN. The new firmware version number is then shown on the display after the next start of the module. For updating the firmware there is a separate program with its own instructions.
If a requested OTA update should not be executed after all, the module can simply be switched off and on again. Afterwards it is in normal mode again.
To update the firmware you can use the [FlashTool Esp8266 OTA]. This tool can be downloaded for free at the following URL:

https://1st.bitbumper.de/ota-firmware-update-tool-for-esp8266/

## 6. MQTT

The data exchange in operating mode is done via a MQTT data broker.
Data is only sent or received if the module is not in stand-by mode. This is indicated by the display being switched on and by the LED blips (the status LED flashes once every second).

To read or set MQTT Topics for test purposes the program MQTT.fx can be used. For simple measurement tasks, tests and the configuration of the module we recommend our program "Mqtt2File".

## 6.1. MQTT Broker

The MQTT data traffic is handled by a MQTT server/broker.
On the internet you can find a lot of information about MQTT, also how a server is installed and operated.
See for example https://mqtt.org/.

## 6.2. Topics

The topics are hierarchically structured:
[base_topic]/[modul-id]/[sub-topic]
The base_topc is usually "rare" or the customer name for branded OEM modules.
The module ID is the MAC address of the WLAN module without separators.

Sample:

All values are sent as ASCII strings.
All topics are sent in QoS 0.

In the module these [sub-topic] are defined:

### 6.2.1. Measurement values (publications)

| Sub-Topic | Description | Value sample |
|---|---|---|
| digimatic/value | current measurement value | -2.303 |
| digimatic/value/unit | unit of value above | mm |
| digimatic/task | current meas. task | Axialspiel |
| digimatic/workbench | current workplace | WB01 |
| adc/voltage | supply voltage | 3.23 |
| adc/voltage/unit | unit of value above | V |

### 6.2.2. Input values (publish targets)

| Sub-Topic | Beschreibung | Wertebeispiel |
|---|---|---|
| digimatic/request/set | request measurement | 0 (any, not evaluated) |
| intervalms/set | cyclic measurement | 5000 (millisekunden) The minimum value here is about 200 ms. See also under "Technical Information". The value "0" switches the interval off. |
| digimatic/task/set | set measuring task | Axialspiel |
| digimatic/workbench/set | set workbench | WB01 |

These values must be set again after a reset / power on.

### 6.2.3. Status and diagnosis

| Sub-Topic | Description | Value sample |
|---|---|---|
| $fw/version | Current firmware version | 1.0.2 |
| $localip | IP address of this module | 192.168.1.201 |
| $mac | MAC address of module | A0:20:A6:1A:53:F2 |
| $name | Name of module | Messtechnik |
| $online | Online state of module | true / false |
| $stats/interval | Time interval for status message | 60 (seconds) |
| $stats/signal | WLAN signal strength | 100 (%) |
| $stats/uptime | Current uptime/runtime | 55 (seconds) |

Each of these values is delivered once, as soon as the topic is subscribed to.
If e.g. the WLAN signal strength should be read again, the value must be requested again (SUBSCRIBE). The values are provided with the RETAINED flag.


### 6.2.4. Configuration Values

The configuration values are normally sent via the MQTT2File Tool once during commissioning.
Alternatively, individual configuration values can also be changed via MQTT. The values sent here are stored persistently in the module and do not need to be reset after each new start of the module or connection establishment.

| Sub-Topic | Description |
|---|---|
| $implementation/config/set | Send configuration value |

As data content these values are possible:

| Value | Description |
|---|---|
| sleep_sec=nnn | Time till standby/sleep in [nnn] sec.<br>Range: 0 - 9999. 0 = no standbyKein Standby; |
| battery_min=nn | The charge level of the battery in % from which the flashing code for "Battery low" is set. Possible range: 0..100 (%). |

The value has to be wrapped within a json string. Example:
`{"settings": {"sleep_sec": 68}}` or
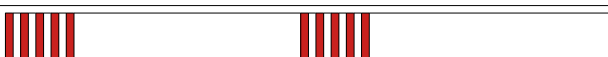`{"settings": {"sleep_sec": 424243, "battery_min": 44}}`

After sent of configuration values the modul will restart and reconnect with the Wifi-Network and the broker.

# 7. Technical informations

## 7.1. Codes of the state led

Blinkcodes of the rAAAreware MQTT modules.

### 7.1.1. Normal operation

| State | Led blinkcode |
|---|---|
| WLAN/WIFI search | |
| MQTT search | |
| Ready | |
| Value received | |
| Measurement value sent | |
| Measurement requested / Display set | |
| Dataerror digimatic | |
| Battery low | |

### 7.1.2. Configuration mode

In configuration mode the led blink inverted.

| Service code | Led blinkcode |
|---|---|
| Configuration mode | |
| Ready to receive firmware (OTA) update | |
| Transfer firmware in progress | |
| Firmware update done | |
| Firmware update failed | |

## 7.2. Power supply

The power supply of the modules may depend on the design.
Please observe the instructions on the module or your delivery note.
Basically the following applies:
If the module is equipped with a USB connection, the supply voltage is 5 volts.

For module M5 and M6: The module may only be supplied with power via the supplied charging station. The direct charging voltage here is 4.2V. The charging current is limited to 100mA depending on the LiIon battery used.

For module M3 with MCX connector: The charging voltage is normally 3.3V.

The internal power supply is 3.3V for the module and 1.5V or 3V for the dial gauge, caliper or micrometer.
The main switch only disconnects the module from the power source. The power supply of the handheld measuring device is always maintained so that the set zero point on the measuring device is maintained.

Neither the modules nor the charging stations include an internal fuse in case of short circuit or other defect. The modules must be protected by the external power supply. This can be achieved with a customer-side power supply by means of an isolating fuse or a short-circuit-proof power supply with current limitation.

## 7.3. Power consumption

The current consumption of the IoT module in active operation is approx. 100mA current at 3.3 Volt voltage.
Directly during the very short transmission phase of the measured value, the current consumption can rise briefly up to 250mA.
With continuous measurement and transmission every 10 seconds an average current consumption of 110mA is determined.
With continuous measurement and transmission of the measured values, a 1000mA battery will provide the required power for approx. 9 hours.
If the measurement is not continuous in practical operation, the battery life will be extended accordingly:
If, for example, every 10 minutes a measurement is carried out over one minute, the battery life is assumed to be about 10 times longer. A full battery charge should therefore provide enough energy for about 90 hours.

## 7.4. Power management

After a configurable time, the module switches to standby mode (Auto-Power-Off).
The power consumption in standby mode is almost negligible with less than 1 mA.
For e.g. longer storage of the module, the power supply should be completely disconnected via the main switch on the battery module.
To reactivate the module, it is switched off and on again briefly.

For a smooth operation a well thought out strategy should be followed how to control the power consumption of the module. This may vary depending on the required measurement task.

### 7.4.1. Single measurements

For single measurements it is recommended to switch on the WLAN module directly before the measurement, then to perform the measurement and then to switch off the module again. A short configured standby time of e.g. 60 seconds ensures that the module goes into power saving mode if the switch-off is forgotten.

### 7.4.2. Serial measurements

For serial measurements it may be necessary to leave the measuring device switched on for a longer period of time. Especially for modules with a small battery it is necessary to place the handheld measuring device in the charging station or the charging cradle during the measuring pauses so that it has enough energy available for the next measurements.

### 7.4.3. Complex measuring tasks

For complex software-controlled measurement tasks, the power management can be controlled via MQTT. MQTT Topics can be used to change the standby time as well as to determine whether the module is currently switched on or off. Furthermore, the battery status of the module can be queried, so that a message can be displayed on the screen if the charge level drops below a set value.

## 7.5. Measuring frequency

With the standard firmware a measuring interval lasts approx. 200 ms.
So the minimum time for the MQTT-Topic "intervalms/set" should not fall below 200 ms. If the value falls below the value, the values are retrieved faster, but it is not guaranteed that the values are actually transmitted faster.
If in a measurement application a faster measurement data transmission is required, a very high measurement frequency can be implemented with a special firmware.
Furthermore, the synchronized time stamp of the measurement can be transmitted as an additional topic. It would then also be possible to interpolate measured values to perform a quasi real-time measurement.

## 7.6. Technical data

| | M3 | M4 | M5 | M6 | Unit |
|---|---|---|---|---|---|
| Dimensions (BxHxT) | 61x50x44 | 55x52x9,5 | 36x20x51 | 27x27x30 | mm |
| Weight | 55 | 30 | 30 | 35 | g |
| Temperature range | 0 - 50 | | | | °C |
| Supply voltage | 5 (by default) | | | | V |
| Power consumption (SB) | <1 | | | | mA |
| Power consumption (measurement) | 100 | | | | mA |
| Power consumption (send) | 250 | | | | mA |
| Accumulator capacity | 650 | 650 | 80 | 80 | mAh |
| WLAN frequency | 2.4 (IEEE802.11b/g/n; channel 1-14) | | | | GHz |
| WLAN safety | WPA2-PSK | | | | |
| Measuring interval | 50 - 60.000 | | | | ms |
| Display | OLED, 128 x 32 | | - | - | pixel |

### 7.6.1. Accessories

M4 Battery pack (accumulator)

| | | Einheit |
|---|---|---|
| Maße (BxHxT) | 47 x 38 x 20 | mm |
| Gewicht | 24 | g |
| Temperaturbereich | 0 - 50 | °C |
| Spannung | 4.2 V - 2.8 V | V |
| Leistung | 650 o. 700 | mAh |

## 7.7. Zertificates

The microcontroller used with the corresponding WLAN radio module has CE mark and meets the requirements regarding safety, health, EMC (electromagnetic compatibility) and radio standards.
The standards complied with are in accordance with EN standards EN60950: 2006+A11:2009+A1:2010+A12:2011+A2:2013. EN62311: 2008. EN301 489-1 V1.9.2 (2011-09). EN301 489-17 V2.2.1 (2012-09). EN200 328 V1.8.1 (2012-06).

The module meets FCC standards and is approved under FCC ID: 2AHMR-ESP12S.

# 8. Others

## 8.1. Legal matters

MituToyo and Digimatic are probably registered trademarks of MituToyo.
Bluetooth is a registered trademark of Bluetooth SIG, Inc. ANT+ is a registered trademark of the ANT Alliance / Garmin. Zigbee is a registered trademark of the Zigbee Alliance, USA. Wi-Fi is a registered trademark of the Wi-Fi Alliance. Q-DAS and qs-STAT are trademarks of Q-DAS GmbH.
We use these designations here to explain the IoT module (the hardware and software) and have no connection with those companies.

## 8.2. Contact data

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