

Device

WACS Series is a range of IoT devices intended to online asset management. They allow the remote control and remote supervision of equipment, cargos, vehicles and any other kind of asset, commercial and industrial system.

.WACS.

WS2-2xx devices were developed with focus on long battery life in indoor and outdoor applications with CAT-M, CAT-M/2G, NB-IoT and NB-IoT/2G.

WACS can be configured to send messages in a periodic behavior (called log) or when a specific condition is detected (called event). In both log and event behaviors the available variables are:

- Temperature measurement - That can be sent as log or trigger events
- Relative humidity - That can be sent as log or trigger events
- Location estimation - Based on Wi-Fi access points location
- Motion detection - Using a 3-axis accelerometer, WS2-Cellular is able to count motions, indicate when the motion was detected or even trigger location estimation when motion condition is detected, or end of motion condition is detected

Additionally, the IoT platform AYGA dots supports integrally all features of WS2-Cellular and it is an extremely easy and powerful way for connecting WACS devices.

Main features of WS2 Cellular:



- Compatibility with multiple cellular networks.
- Indoor and outdoor geolocation
- Internal temperature and motion sensors
- Replaceable battery up to 10 years
- Remote parameterization with usage profiles
- Compatible with the AYGA dots platform
- Compact size
- IP64 or IP67 class
- High level of flexibility intended for different applications
- Compact and robust mechanical structure
- Models compatible with CAT-M, CAT-M/2G, NB-IoT and NB-IoT/2G.

Profiles

General

The use of profiles that gather typical parameterizations for each application facilitates their quick configuration.

There are four profiles available in WS2-Cellular devices: **Tracking and motion**, **Cooler**, **Temperature and humidity** and **Cold chain**. Each one of them has a specific set of parametrization according to each specific use case (and according to device model):

Tracking and motion

Used for locating and monitoring mobile or fixed assets, this profile brings a wide range of applications, such as:

- Mobile equipment location
- Vehicle location
- Containers and trailers location
- Returnable Industrial Package (RIPS) location
- Medical and hospital equipment location

It can also be configured to identify motion, with **Motion count log**, **Motion occurrence log**, **On motion event**, and **No motion event**, this options allows a series of application possibilities and combined with tracking can be used to:

- Sends an event message when the device **stops** motion
- Sends an event message when the device **starts** motion
- Counts how many times the device was in motion
- The device identify when a container, RIP or other load is in motion

The following features are available in this profile: **Remote parametrization request**, **Hall sensor function**, **Motion count log**, **Motion occurrence log**, **On motion event**, **No motion event**, **Location** and **Location on motion**.

Cooler

Specific profile for Freezers and Coolers. In this profile, WACS can measure **temperature** (periodic log, maximum, minimum, and average) and send location periodically. If installed in a Cooler's door it is also possible to count door openings (periodic log and absolute counter)

The set of features available in Cooler profile brings the following information for a cooler application:

- Equipment health and possibility of predictive maintenance.
- **Low/High temperature events** for sensitives applications, such as Ice cream equipment.
- **Location** for asset monitoring.
- Usage profile analysis, being possible to detect peaks of usage, "best sellers" coolers and other advanced metrics.

The following features are available in this profile: **Remote parametrization request**, **Motion count log**, **Temperature log**, **Temperature event** and **Location**.

Cold Chain

This profile allows a wide range of temperature and location features designed to register and send events in order to guarantee the quality in the supervision of medical fridges and storage of pharmaceutical products, some examples of applications are:

- Monitoring system for moving packages with thermal sensitive goods.
- Monitoring system for warehouses.
- Monitoring system for pharmacies.
- **Low/High temperature events** for sensitives applications, such as vaccines.

The following features are available in this profile: **Remote parametrization request**, **Temperature log**, **Temperature event** and **Location**.

Temperature and humidity

Specific profile for temperature and humidity monitoring. In this profile, WACS can measure **temperature** (periodic log, maximum, minimum, and average), **humidity** (periodic log, maximum, minimum, and average) and trigger events (alarms) if the device detects a value out of specified parameters. Some examples of applications are:

- **Low/High temperature events** for sensitive application
- **Low/High humidity events** for sensitive applications
- Temperature monitoring
- Humidity monitoring

The following features are available in this profile: **Remote parametrization request**, **Temperature/Humidity log**, **Temperature/Humidity event**.

Compatible products

AYGA dots platform is fully compatible with WACS devices and is an extremely easy and powerful way to deploy WACS devices.

Product features

General features

| Feature | WACS |
|---|--|
| IoT interface | CAT-M, CAT-M/2G, NB-IoT and NB-IoT/2G |
| Location | Yes, through the estimation of latitude and longitude made by <u>dots</u> or third-party platforms |
| Internal temperature sensor | Measurement range: -20 to 65 °C Resolution: 0,1 °C Precision: 0,5 °C |
| External temperature sensor (WS2-21x and WS2-22x devices) | Measurement range: -40 to 100 °C Resolution: 0,1 °C Precision: 0,5 °C |
| Humidity temperature sensor (WS2-23x) | Operating range: 0-100%RH Accuracy; +-2%RH |
| Motion sensor | Maximum acceleration: + 4 g Maximum update rate: 200 Hz |
| Battery monitoring | Yes, sent as diagnostic information |
| Real time clock | Yes, for precise log |
| Battery | Yes, Replaceable battery lasting up to 10 years |
| Diagnostic LED | Yes |
| Remote parameterization | Yes, via configurable Remote parametrization request |
| Sensor hall (WS2-29x/S) | Yes, available in devices |
| Operation temperature | -20 à 65 °C |

| | |
|-----------------------------|---|
| Material | ABS plastic (acrylonitrile butadiene styrene) |
| Mounting | Screw (WS2-110/S and WS2-100/S) |
| Dimensions | 59 x 89 x 28 mm |
| Weight | 100 g |
| IP level | WS2-20x/S: IP67 Other models: IP64 |
| AYGA <u>dots</u> compatible | Yes |

Certifications

WACS products has Anatel certification and CE certification:



Product behaviour and operating modes

Parametrization request

Allows fast and safe remote parametrization and there are two ways to use it based on AYGA dots setup:

1. Starting new commissioning process
2. Periodically with custom period

Parametrization request with the button

With a short press of the button:

1. WACS is turned on and starts a new commissioning process
2. If the device is already on, only a new commissioning process is started. Check your Ayga dots to monitor the progress of the process

With a long press of the button:

1. WACS is turned **OFF**

Commissioning process

With a **SHORT** press of the button:

1. WACS enters in commissioning state and fast blinks for 30 seconds to indicate the process started.
2. Sends 3 sequential and specific messages to Ayga dots (or third-party platform) to check the signal quality.
3. Sends a **Parametrization request** 1 minute after the signal checking.
4. If all steps are successful, LED will turn on during 30 seconds to indicate it.
5. If not, WACS will repeat step 4 two more times.

Motion states

There are two motions states available in WACS that can influence logs and events:

On motion state

When the accelerometer detects motions WACS enter in On motion state (if configured to).

No motion state

When the accelerometer does not detect motion WACS enter in No motion state (if configured to).

Logs and events

There are two types of Cellular messages sent by WACS to dots:

1. **Log message:** Sends periodic messages of read data. Examples:
 - **Temperature log**
 - **Location**
2. **Event message:** Sends event messages when detected a value out of specified parameters or changes the device state of motion. Examples:
 - If the detected temperature is higher than **high temperature threshold** sends a event message
 - If the device state changes to **on motion** sends an event

Once the period of the Log message is configurable by the user, the number of messages sent per day is predictable.

Events have an opposite behaviour, the number of messages sent per day is directly proportional to the number of event conditions and the duration of these conditions. WACS has two different features to have better prediction of sent messages even in case of event messages:

- **Minimum period between event messages:** When enabled one event, it is defined as the minimum period between consecutive event messages. It means that even in continuous event condition, the device will limit the number of messages respecting the configured minimum period between event messages.
- **Automatic disabling (and enabling) of temperature events:** For temperature events, it is possible to specify the maximum time with continuous event condition, after this interval, temperature event will be disabled until the temperature condition returns to the expected value for a specific period.

Logs

Periodic logs

Period between reading and register variables before sending through Cellular messages. The following periodic logs are available on WS2-Cellular devices:

- **Sample of temperature per period**
- **Sample of humidity per period**
- **Minimum value of temperature per period**
- **Maximum value of temperature per period**
- **Out of range temperature per period**
- **Motion count per period**
- **Motion occurrence per period**
- **Location estimation per period**

All periodic logs can be enabled/disabled or configured independently.

Temperature log

- I. Temperature measurement is executed and stored internally after the end of the specified period. After 10 periods, WACS sends all temperature logs in one Cellular message.
- II. To assure data delivery and enable data recovery, use **ADD** feature, if this feature is enabled WACS sends one Cellular message every 6 readings instead of 10.

Out of range log

WACS stores if temperature remained or exceeded the **high or low threshold** set value during the specified period.

After 40 periods, WACS sends a Cellular message indicating the following information for each period:

- if the temperature stayed inside the range (between temperature thresholds)
- or if it was detected out of temperature range for each of all the 40 periods

Motion count log

Counts how many times the device detected motion during the defined period, stores internally and sends it after 10 periods in one Cellular message.

Motion occurrence log

Registers if the device detected at least one motion occurrence during the defined period, stores internally and sends it after 80 periods in one Cellular message.

This option is indicated when it is required to know the **OCCURRENCE** of motion instead of **QUANTITY**.

Events

If there is some value out of specified parameters or changes the device state of motion, send an event message. The following events are available on WS2 Cellular devices:

- **High temperature event**
- **Low temperature event**
- **High humidity event**
- **Low humidity event**
- **On motion event**
- **No motion event**

Events detection can be also enabled/disabled independently.

Temperature Events

If the measured Temperature remains higher than **High temperature threshold** or lower than **Low temperature threshold** for a configurable period, a new event is sent for a pre-set period (determined in **Time to disable temperature event**), after that the temperature event is disabled.

Humidity Events

If the measured Temperature remains higher than **High humidity threshold** or lower than **Low humidity threshold** for a configurable period, a new event is sent for a pre-set period (determined in **Time to disable temperature event**), after that the temperature event is disabled.

Motion events

Sends an event message when the motion state changes.

Diagnostic message

WACS sends a diagnostic message with information of battery voltage, periodic counter and additional diagnostic variable when an event is detected or each 20 Cellular Messages.

Temperature features

This feature has 4 important topics to be exposed, which will influence temperature log and events: **Low pass temperature filter, offset, high and low threshold**.

- I. The **Low pass temperature filter**, decreases temperature spikes in abrupt temperature changes and also simulates a higher mass thermal inertia.

The selected value corresponds to the time constant (RC constant), which means that after the end of 1 period of RC constant the temperature indicates 63,2 % of temperature step change, after two periods indicated 86,5%, and so on, as shown in the following example:

EXAMPLE: Low pass temperature filter: 2 minutes

| Low pass period | RC constant | Transfer percentage |
|-----------------|-------------|---------------------|
| 2 minutes | 1 RC | 63,2% |
| 4 minutes | 2 RC | 86,5% |
| 6 minutes | 3 RC | 95,0% |
| 8 minutes | 4 RC | 98,2% |
| 10 minutes | 5RC | 99,3% |
| 12 minutes | 6RC | 99,8% |
| 14 minutes | 7RC | 100% |

II. Offset value is a temperature adjustment that can be necessary depending on the application site.

Ex.: Offset value: -5°C

Current temperature value: 30°C

Resulting temperature value: 25°C (this is the value that will be computed).

III. **High and Low temperature thresholds** are used as the limit values to generate **temperature events** and define **out of range** in **Temperature log type**.

Location

Location

WACS sends messages for location estimation every set period (Period 1, 2, 3, 4 or custom).

Location estimation

WACS scans and filters Wi-Fi access points and sends its respective MAC address through a Cellular message to dots or a third-party platform that estimates location based on the received data.

To increase location precision there are two features available:

1. **Increased location precision with RSSI:** Additional message with respective RSSI data of MAC sent for location estimation, combined with dots or other platforms which use RSSI data, it is possible to reach better estimative precision
2. **Number of MACs:** Number of Access Points used to estimate the device's location. The greater the number of MACs the greater the accuracy of the latitude and longitude estimation, but the higher battery use.

Configurable parameters

Location

| Parameter | Description | Impacted features |
|--|--|-------------------|
| Number of MACs | Number of Access Points used to estimate the device's location (The greater the number of MACs the greater the accuracy of the latitude and longitude estimation, but the higher battery use) | Location |
| Increased location precision with RSSI | Additional message with respective RSSI data of MAC sent for location estimation. When using <u>dots</u> or other platforms which use RSSI data, it is possible to reach better estimative precision. | Location |

Temperature

| Parameter | Description | Impacted features |
|----------------------------------|--|--|
| Temperature thresholds | Temperature value used to generate high or low temperature event when measured temperature is out of specified values. | Temperature event, High temperature threshold, Low temperature threshold |
| Temperature event delay | Determines the delay required to send the temperature event message. EXAMPLE: If a delay of 5 minutes is set, the event must occur during the whole time to send the Cellular event message. | Temperature event |
| Time to enable temperature event | Period without temperature events required to enable/ re-enable temperature event feature. | Temperature event |
| Temperature filter | Low-pass filter used to decrease temperature spikes. | Temperature log type, Temperature events |

Motion

| Parameter | Description | Impacted features |
|------------------|--|---|
| Wakeup threshold | Set the accelerometer sensibility to identify a motion condition to enter in | On motion event, No motion event, Motion count log, Motion occurrence log |

| | | |
|------------------------------|---|---|
| | on motion state. The higher the number of “g”, the lower the sensibility is and vice versa. | |
| Accelerometer sampling rate | Accelerometer sampling rate. Higher values detect shorter acceleration peaks but results in higher battery consumption. It is recommended 50 Hz as a good relation between sampling rate and battery consumption. | On motion event, No motion event, Motion count log, Motion occurrence log |
| Time for no motion condition | Time required, after the last motion detection, with no additional motion detection to enter in <u>NO motion state</u> . | No motion event, On motion event, Motion occurrence log. |

WACS installation

General care

- I. Avoid wrapping the device in metallic structures
- II. Position as far from the ground as possible.
- III. Give preference to the product being in an upright position.

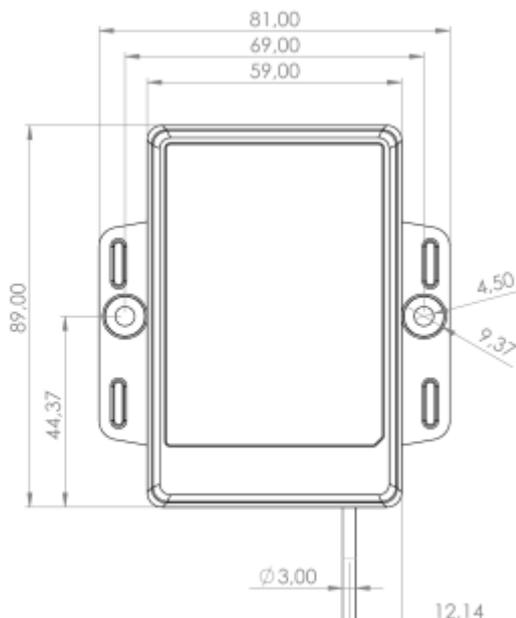
Proper WACS installation with tape:

- I. Clean the installation surface with a cloth and make sure it is dry before installing your device.
- II. Press WACS against the surface to guarantee a good adhesion of the tape.

Proper WACS installation with screw:

- I. Fasten WACS with screw

Dimensions



Safety instructions



SAFETY INSTRUCTIONS: Non-compliance with these safety instructions can result in fire, electric shock, injury, or damage to WACS or other property. Read all the safety information below before using WACS.

- WACS can only be opened and operated by qualified people.
- The appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge.
- WACS can not have direct contact with food.
- It is not safe to operate WACS out of specified temperature values.
- Forbid to put flammable and explosive objects and any other fire or heat source around WACS. Also is not allowed to use the device in an environment full of flammable gas and powder.
- Incorrect repair or replacement can damage WACS internal battery, causing overheat and result in serious injury.
- Please turn off and unplug WACS battery before cleaning or maintenance.
- Do not attempt to replace the WACS power source with a non-authorized battery.
- WACS contains radios that emit electromagnetic fields which may interfere with pacemakers, defibrillators, or other medical devices. Do not maintain WACS within close proximity this kind of device.
- Do not keep WACS within close proximity to your body.
- WACS devices are not resistant to hard impacts, such as falls and high vibration.

Legislation instructions



LEGISLATION INSTRUCTIONS:

- Ayga does not assume responsibility for any law violation. Before using the device, check if it is allowed according to the legislation in your country
- WACS internal battery disposal should follow each country legislation. Ayga does not assume responsibility for incorrect battery disposal.