



WATERSENS USER MANUAL

(model: WA020100 – SMART IRRIGATION
CONTROLLER)



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2 SAFETY PRECAUTIONS AND OTHER CONSIDERATIONS

General considerations:

- Incorrect handling or installation of the unit may result in injury to personnel as well as damage to the unit or other equipment associated with the system.
- Read the manual carefully prior to connecting the unit. Follow all installation and maintenance instructions throughout the unit's working life. Pay special attention to the installation standards of the National Electrical Code.
- Do not use the device without the cover on.
- Aonchip recommends using the original cables and accessories that are supplied with the device.

FCC Caution:

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

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC RF Radiation Exposure Statement:

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2. This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.
3. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

IC declaration:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- this device may not cause interference, and
- this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- l'appareil ne doit pas produire de brouillage, et
- l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IC SAR Warning:

This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

Lors de l'installation et de l'exploitation de ce dispositif, la distance entre le radiateur et le corps est d'au moins 20 cm.

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This radio transmitter [IC: 26883-WA0201] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna Manufacturer	PYCOM
Antenna Model	LoRa (868MHz/915MHz) & Sigfox Antenna Kit
Antenna type	½ WAVE WHIP ANTENNA
Antenna gain	2.8 dBi

3 OVERVIEW

Nowadays water is becoming in one of the more appreciated substances in our planet. Climatic changes, growth of the worldwide population and extreme weather make we must to care water as a very important good.

Watersens is a smart irrigation controller able to manage several latch type electrovalves to save water for different types of applications as golf fields, parks, crops, etc



Figure 1. Watersens external appearance

Watersens is provided with LoRaWAN communication so it makes it possible to integrate in any platform based on this technology to change and monitor several parameters linked with the irrigation system.

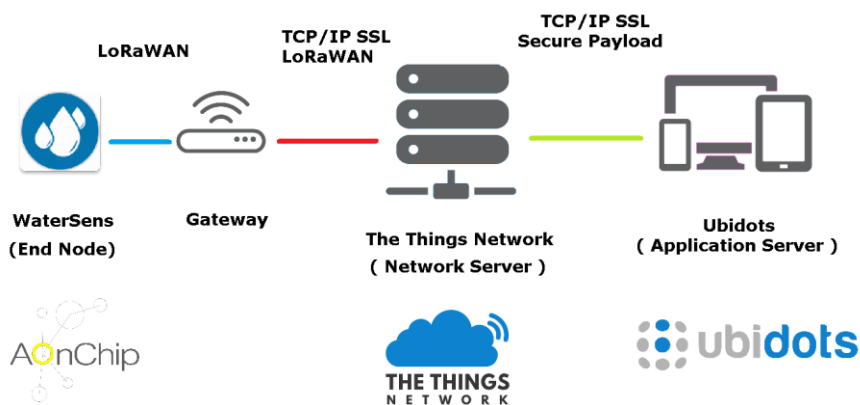


Figure 2. Example of LoRaWAN ecosystem

Watersens is also provided with NFC technology. It means the commissioning process can be carried out in an easy and safe way through any smartphone with NFC technology and using the app Watersens Tool.

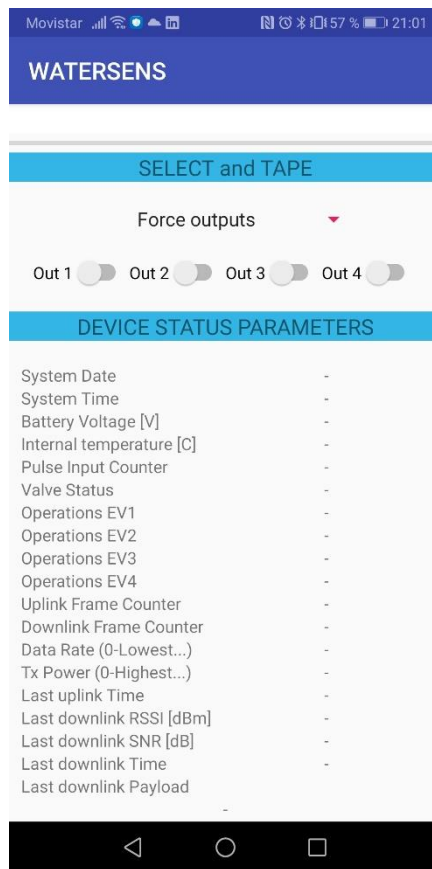


Figure 3. Status and configuration parameters can be obtained using the NFC technology in smartphones and Watersens Tool app

4 INSTALLATION

4.1 Connectors

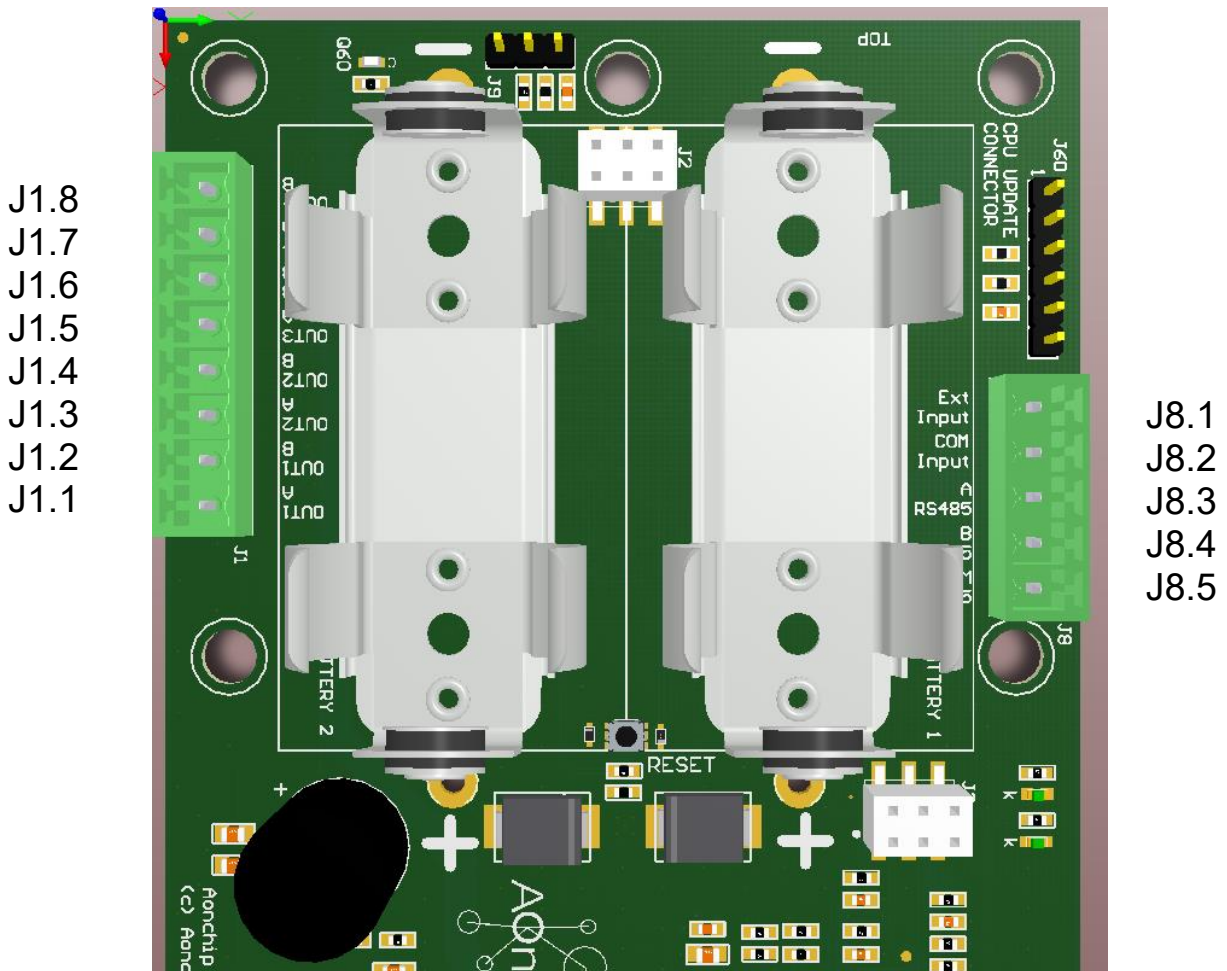


Figure 4. Connectors location in Watersens circuit

4.2 Electrovalve output wires (for all models)

Watersens is designed to be used with latch electrovalves. These devices require a short excitation pulse to open/close the valve to flow the water. Watersens applies a positive pulse to open the valve and a negative pulse to close it.

Connector position	Wire color	Description
J1.1	Brown	Output 1 – Voltage A
J1.2	Green	Output 1 – Voltage B
J1.3	Grey	Output 2 – Voltage A
J1.4	Yellow	Output 2 – Voltage B
J1.5	Pink	Output 3 – Voltage A
J1.6	Red	Output 3 – Voltage B
J1.7	White	Output 4 – Voltage A
J1.8	Blue	Output 4 – Voltage B

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NOTE

- To activate the electrovalve Watersens applies +9V or +12V (depending on model) in voltage A and 0V in voltage B.
- To deactivate the electrovalve the polarity of the output voltage is inverted (0V in voltage A and +9V or +12V in voltage B)

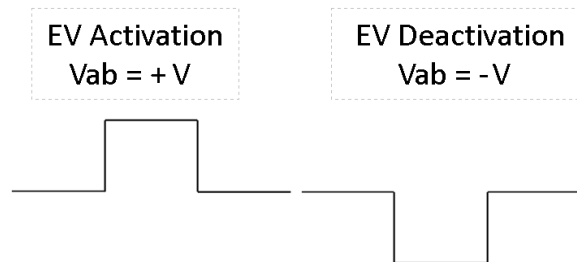


Figure 5. Output pulse waveform for electrovalve excitation

4.3 Sensors input wires (optional)

Watersens has the possibility to connect external sensors. There is a specific model with connections for this purpose

Connector position	Wire color	Description	Electrical value
J8.1	Grey	Pulse input (input to connect an external pulse emitter to the internal pulse counter - digital signal)	Range 0 – 3.3V or to connect an open collector / drain output
J8.2	Brown	Voltage reference for pulse input	0V
J8.3	White	RS485 communication port – signal A	From -7V to +12V
J8.4	Yellow	RS485 communication port – signal B	From -7V to +12V
J8.5	Green	Voltage reference for RS485 communication	0V

5 COMMISSIONING

5.1 NFC connectivity

First step is to configure the equipment to register in the LoRaWAN network and define the irrigation timetable. By default LoRaWAN communication and irrigation parameters are the values used during manufacturing process to guarantee Watersens works correctly for delivering to final customer.

It is possible to modify the default parameters via any smartphone with NFC communication. Tapping the cellular over the front of the housing the values can be read and modified with application Watersens Tool.

NOTES

- NFC communication is very selective. It means the NFC antennas of the smartphone and the Watersens must be aligned. Please check the position of the NFC antenna in smartphone to find the best match position with the Watersens. The figure below shows the position of the NFC antenna in Watersens.
- After manufacturing process Watersens is programmed in a deep sleep special mode. To wake up the Watersens from this mode only it is possible applying a NFC field (e.g. reading status or configuration via smartphone with Watersens Tool application). If this action is not performed Watersens could remain without activity.

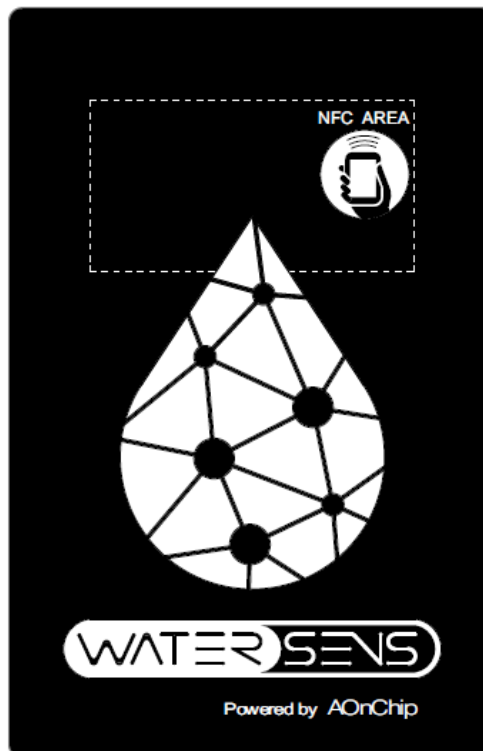


Figure 6. NFC antenna location - white dotted rectangle

5.2 Setting LoRaWAN communication parameters

5.2.1 Understanding Watersens LoRaWAN profile class

Watersens can be integrated in a LoRaWAN network as a class A device. It means the device implements a bi-directional communication profile in which the data sent by server only can be received by the node after performing an uplink transmission. In this moment when the node opens two short receive windows for the downlink as it is shown in the figure below.

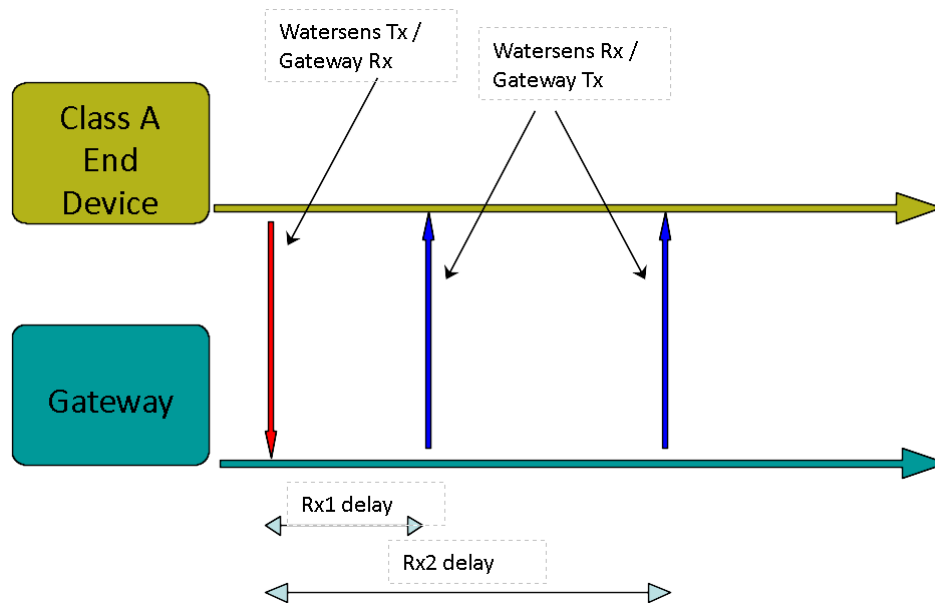


Figure 7. Uplink & Downlink diagram for a class A end device

This communication profile is the best option to preserve the life battery as it is the profile which the quantity of node transmissions is minimal.

5.2.2 LoRaWAN communication parameters

Time to update status

Each 15 minutes Watersens checks if an irrigation operation must be performed. In case of any change, the new output status is transmitted to the gateway.

On other hand it is possible to force an interval transmission according to the time defined in time to update status parameter. The value can be from 0 to 100:

- 0 - minimum update time. Each 3 minutes a transmission is done. This value is recommended only to verify the communication or to accelerate the datarate adjustment in case of datarate adjustment by the network.
- 1...96 - number of 15 minutes lapses between forced transmissions carried out by Watersens (1: 15 minutes, 2: 30 minutes, ...)
- 100 - Watersens transmission only in case of output status change

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Activation method

Watersens can be configured in 2 different methods depending on user preferences (security, band occupancy time, etc)

- **OTAA** (Over The Air Activation Method). Watersens receive a device address and an authorization token from which to derive sessions keys in combination with AppKey parameter after sending a JOIN request to the server. This method provides high level of security.
- **ABP** (Activation By Personalization). Sessions keys and device network address are predefined. Watersens doesn't send a JOIN request to server but the security level is lower than OTAA method.

Application EUI (AppEUI)

This parameter is used in OTAA method. It identifies the application during JOIN request. The length is 8 bytes.

Application KEY (AppKey)

This parameter is used in OTAA method. It encrypts data during the JOIN request. The length is 16 bytes.

Device Address (DevAddr)

This parameter is used in ABP method. It is the address in the Lora Network. The length is 4 bytes

Device EUI (DevEUI)

This parameter is used in ABP and OTAA method. The value cannot be modified (predefined in factory) and it is used to identify the device in Lora Network (it's unique for each device). The length is 8 bytes

Application Session Key (AppSKey)

This parameter is obtained automatically in OTAA mode, but must be defined by user in ABP mode. The Application Session Key encrypts data during transmission and other applications which can access to the network cannot see the content of messages. The length is 16 bytes.

Network Session Key (NwkSKey)

This parameter is obtained automatically in OTAA mode, but must be defined by user in ABP mode. The Network Session Key encrypts data during transmission and other networks cannot see the content of messages. The length is 16 bytes.

Adaptive Rate

Data rate can be adapted automatically by the network (AUTO) or can be adjusted in a fix value by the user (OFF).

Data Rate

This parameter is the speed at data which is transferred. It can be adjusted by user if adaptive rate is configured as OFF.

Depending on the region (EU868, US915, AU915, AS923, IN865, ...) the data rate takes different values.

Table for EU868

DataRate	Configuration	Indicative physical bit rate [bit/s]
0	SF12 / 125kHz	250
1	SF11 / 125kHz	440
2	SF10 / 125kHz	980
3	SF9 / 125kHz	1760
4	SF8 / 125kHz	3125
5	SF7/125kHz	5470
6	SF7 / 250kHz	11000
7	FSK: 50kbps	50000
8..15	RFU	

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Table for US915

DataRate	Configuration	Indicative physical bit rate [bit/s]
0	SF10 / 125kHz	980
1	SF9 / 125kHz	1760
2	SF8 / 125kHz	3125
3	SF7 / 125kHz	5470
5:7	RFU	

(visit <https://lora-alliance.org/resource-hub/lorawanr-regional-parameters-v102rb> for other regions)

Tx Power

The output power can be adjusted according to tables below depending on the region (EU868, US915 or AS923). Please, take into account the values indicated in tables are maximum limit values, and device could radiate in equal or lower level.

Table for EU868

TXPower	Configuration (EIRP)
0	Max EIRP (**)
1	Max EIRP - 2dB
2	Max EIRP - 4dB
3	Max EIRP - 6dB
4	Max EIRP - 8dB
5	Max EIRP - 10dB
6	Max EIRP - 12dB
7	Max EIRP - 14dB
8..15	RFU

(*) By default Max EIRP (Equivalent Isotropically Radiated Power) is +14 dBm

Table for US915 ()

TXPower	Configuration (maximum conducted power)
0	30 dBm – 2*TXpower
1	28 dBm
2	26 dBm
3:9	...
10	10 dBm
11:15	RFU

(visit <https://lora-alliance.org/resource-hub/lorawanr-regional-parameters-v102rb> for other regions)



Tx Port

Watersens port for data transmission. Values from 1 to 223

Rx Port

Watersens port for data reception. Values from 1 to 223

5.3 Setting Irrigation parameters

Setting the pulse duration

The pulse duration is defined in ms. The default value is 20ms and it can be modified at 200ms as maximum.

Must be considered that higher is the pulse duration higher will be the power consumption.

Valve output enable

If it is necessary and to preserve the battery life, it is possible to enable and disable the activation of the outputs. Each output can work in independent way.

Timetable irrigation identifier

To reduce the datalength of the communications between endnode and server it is necessary to assign an identification number to the timetable (from 0 to 65535). This parameter will be sent instead of the complete irrigation plan.

Setting the timetable

The timetable is defined along the day (24h) and it is divided in 15 minutes slots. This is the minimum time to carry out an irrigation operation. The number of operations is unlimited.

On the other hand, the timetable can be applied depending on the day of the week.

5.4 Checking the setup and establishing first communication

Once the equipment has been installed and the configuration parameters has been programmed according to user requirements, Watersens is ready to send and to receive data from server.

In most cases the coverage of the network is unknown and it depends on distance and relative height between node and gateway, the size and the quantity of obstacles in line transmission (as buildings), climatic conditions, etc. To ensure the success of data transmissions is recommended to initialize the Watersens communications at minimum data rate and maximum transmission power using the mobile application option «Reset COMs». On other hand configuring «Time to update status» at value 0 also is recommended to increase the quantity of transmissions performed by the equipment (each 3 minutes).

If adaptive data rate is configured as auto (network controls the data rate of the Watersens) after several communications, server and node will adapt the data rate to the value which the occupation of the band and the power transmission of the node will be lowest. In this case and if it is not necessary, user can modify the «Time to update status» to lower value to save energy from battery.

Finally to proceed the irrigation task properly, is necessary to configure date and time. These settings can be adjusted through Lora commands as can be chapter «Data frame format».



6 OPERATION

Watersens is a smart electrovalve controller which is powered by batteries. To preserve the battery life, it is very important to reduce the power consumption when equipment is not carrying out any task, therefore the Watersens enters in deep sleep mode.

Watersens exits from deep sleep mode if internal alarm wakes up the equipment or if it is detected a NFC signal.

6.1 Internal alarm wakeup

Watersens wakes up each 15 minutes matching with quarter hour (XX:00, XX:15, XX:30 and XX:45) with a random time deviation from 0s to +10s. This random time is performed by the control unit to avoid possible collisions for uplinks from different Watersens units.

After waking up Watersens carries out several tasks:

- Measures battery voltage
- Measures internal temperature
- Performs an irrigation operation if it is scheduled according to timetable for each electrovalve and updates valve cycles counters
- Reads external inputs (depending on the model)
- If it is scheduled sends device status and receive data from server
- Check if it is the end of the day (00:00h) to update in EEPROM counters (electrovalve operations, frame counters, etc),

All these tasks take 30 seconds

6.2 NFC signal detection

When NFC field is detected, Watersens wakes up and checks if it is received any command from mobile application. Commands available are:

- Read status parameters
- Read memory configuration (communication and irrigation parameters)
- Write memory configuration (communication and irrigation parameters)
- Time and date synchronization
- Initialize communications

When the NFC field disappears Watersens enters again in deep sleep mode.



7 DATA FRAME FORMATS

7.1 UPLINK FRAMES (FROM NODE TO SERVER)

7.1.1 UPLINK 00 – DEVICE STATUS

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11
tf	te	mv	em	es	dd	hh	mm	ss	ti_hi	ti_lo

tf. Type of uplink frame (00 - Watersens status)

te. Temperature in °C (data type 8 bits signed)

mv. microcontroller voltage supply in volts x10 (data type 8 bits). Examples:

- Voltage OK (>2.9V) - **mv** = 33 means 3.3V
- Low battery (<2.9V) - **mv** = 28 means 2.8V

em. Electrovalve control mode. Parameter which contains the flags to know if valves are controlled in manual way or they work according to irrigation schedule (variable type mask). Examples:

- 0x01 – EV1 in manual mode
- 0x02 – EV2 in manual mode
- 0x04 – EV3 in manual mode
- 0x08 – EV4 in manual mode
- 0x0F - All in manual mode
- 0x00 - All valves in auto mode

es. Electrovalve status. Parameter which contains the flags to know the status of the valves (variable type mask). Examples:

- 0x01 - EV1 ON.
- 0x02 - EV2 ON.
- 0x04 - EV3 ON.
- 0x08 - EV4 ON.
- 0x0F - All ON
- 0x00 - All OFF

dd. Current day of the week. Values:

- 01 – Monday
- 02 – Tuesday
- 03 – Wednesday
- ...
- 07 - Sunday

hh. Hour in time format in 24H

mm. Minutes

ss. Seconds

ti_hi-ti_lo. Timetable identification. To avoid long transmissions sending the irrigation timetable of all valves, user can assign a code during setup process to identify the irrigation programmed in Watersens. This code will be included in the status uplink frame to know what is the current irrigation schedule.

Example - ti_hi = 01
 ti_lo = 05
 table_identifier = 1*256 + 5 = 261

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7.1.2 UPLINK 01 – IRRIGATION PROGRAMMING

After receiving the command from the server requesting the irrigation schedule for a valve, Watersens will perform in 3 minutes an uplink with this info. The format of the payload is described below

byte 1	byte 2
tf	er

byte 3	byte 4	byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11	byte 12	byte 13	byte 14	byte 15
rr1	rr2	rr3	rr4	rr5	rr6	rr7	rr8	rr9	rr10	rr11	rr12	dd

tf. Type of uplink frame (01 - irrigation schedule info)

er. Electrovalve schedule requested. This parameter contains the identifier number of the valve of which irrigation schedule info is required

rr1..rr12 Timetable in bytes.

Each bit is a slot of 15 minutes.

Each byte is a slot of 2 hours.

dd Days of the week to apply the timetable defined in rr1..rr12 (mask variable)

0x01 – Monday

0x02 – Tuesday

0x04 – Wednesday

0x08 – Thursday

0x10 – Friday

0x20 – Saturday

0x40 – Sunday

0x7F – All week

Timetable examples

Irrigation from 21:00 to 21:45 all week

byte 3	byte 4	byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11	byte 12	byte 13	byte 14	byte 15
0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x70	0x00	0x7F

Irrigation from 07:00 to 07:30 and from 20:30 to 21:00 – Monday, Wednesday and Friday

byte 3	byte 4	byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11	byte 12	byte 13	byte 14	byte 15
0x00	0x00	0x00	0x30	0x00	0x00	0x00	0x00	0x00	0x00	0x0C	0x00	0x15

NOTE

- Take into account the length of this uplink frame in some regions in combination with low data rate (DR) are not allowed. Example, in US915 for DR0 the maximum payload length is 11. It is necessary a higher DR to allow Watersens send this uplink frame successfully.

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7.1.3 UPLINK 03 – CONFIRMATION OF UPLINK PERIOD

After receiving from server the command programming the time slot between uplinks, Watersens will perform in 3 minutes an uplink to confirm the new setup. The format of the payload is described below

byte 1	byte 2
tf	up

tf. Type of frame (03 - Confirmation uplink time period)

up. Value configured. Possible values:

- 0 - 3 minutes between uplinks (commissioning purpose)
- 1..96 - multiple of 15 minutes time slots between uplinks
- 100 - uplinks only performed when outputs status has changed. Transmission not forced

Example - confirmation of 3 minutes between uplinks

tf = 03 / up = 00 - Payload: 03 00



7.1.4 UPLINK 05 - LoRaWAN NETWORK STATUS

After receiving from server the command requesting the network status seen from the device side, Watersens will perform in 3 minutes an uplink with this info. The format of the payload is described below

byte 1	byte 2	byte 3	byte 4	byte 5
tf	ri	sn	dr	tp

tf. Type of uplink frame (05 - network status uplink)

ri. RSSI of the last link received by Watersens in dBm data (data type 8 bits signed)

sn. SNR of the last link received in dB data (data type 8 bits signed)

dr. Data rate adjusted in Watersens (for more detail according to the region visit <https://loralliance.org/resource-hub/lorawanr-regional-parameters-v102rb>)

tp. Tx Power adjusted in Watersens (for more detail according to the region visit <https://loralliance.org/resource-hub/lorawanr-regional-parameters-v102rb>)



7.2 DOWNLINK FRAMES (FROM SERVER TO NODE)

7.2.1 DOWNLINK 01 – IRRIGATION PROGRAMMING

byte 1	byte 2	byte 3	byte 4
tf	ti_hi	ti_lo	ev

byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11	byte 12	byte 13	byte 14	byte 15	byte 16	byte 17
rr1	rr2	rr3	rr4	rr5	rr6	rr7	rr8	rr9	rr10	rr11	rr12	dd

tf. Type of downlink frame (01 - Update irrigation schedule)

ti_hi-ti_lo. Timetable identification. To avoid long transmissions sending the irrigation timetable of all valves, user can assign a code to identify the irrigation programmed. This code will be included in the status uplink frame to know what is the current irrigation schedule

Example - User defines identifier code 3 for the irrigation

ti_hi = 00

ti_lo = 03

table_identifier = 0*256 + 3 = 3

ev. Electrovalve to be updated. This parameter contains the flags to indicate the valves which will be programmed with schedule defined in rr1-rr12 bytes. Examples:

0x01 – EV1.

0x02 – EV2.

0x04 – EV3.

0x08 – EV4.

0x0F – All valves programmed with the schedule

rr1..rr12 Timetable in bytes.

Each bit is a slot of 15 minutes.

Each byte is a slot of 2 hours.

dd Days of the week to apply the timetable defined in rr1..rr12 (mask variable)

0x01 – Monday

0x02 – Tuesday

0x04 – Wednesday

0x08 – Thursday

0x10 – Friday

0x20 – Saturday

0x40 – Sunday

0x7F – All week

Timetable examples

Irrigation from 21:00 to 21:45 – All week

byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11	byte 12	byte 13	byte 14	byte 15	byte 16	byte 17
0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x70	0x00	0x7F

Irrigation from 07:00 to 07:30 and from 20:30 to 21:00 – Monday, Wednesday and Friday

byte 5	byte 6	byte 7	byte 8	byte 9	byte 10	byte 11	byte 12	byte 13	byte 14	byte 15	byte 16	byte 17
0x00	0x00	0x00	0x30	0x00	0x00	0x00	0x00	0x00	0x00	0x0C	0x00	0x15

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NOTE

- After receiving the new schedule, it will be applied 3 minutes later and Watersens will perform an uplink type 00 (device status) to notify the change
- Take into account the length of this downlink frame in some regions in combination with low data rate (DR) are not allowed. Example, in US915 for DR0 the maximum payload length is 11. It is necessary a higher DR to send this downlink frame successfully



7.2.2 DOWNLINK 02 – MODE CONTROL AND STATUS FOR VALVES

byte 1	byte 2	byte 3
tf	em	es

tf. Type of downlink frame (02 - mode control and status for electrovalve outputs)

em. Electrovalve control mode. Parameter which contains the flags to program valves in manual mode or in auto mode according to irrigation schedule (variable type mask). Examples:

- 0x01 – EV1 manual
- 0x02 – EV2 manual
- 0x04 – EV3 manual
- 0x08 – EV4 manual
- 0x0F – All manual
- 0x00 – All Auto

es. Electrovalve status. Parameter which contains the flags to know the status of the valves (variable type mask). Examples:

- 0x01 - EV1 ON.
- 0x02 - EV2 ON.
- 0x04 - EV3 ON.
- 0x08 - EV4 ON.
- 0x0F - All ON
- 0x00 - All OFF

NOTE

- After receiving the command, it will be applied 3 minutes later and Watersens will perform an uplink type 00 (device status) to notify the change



7.2.3 DOWNLINK 03 – CONFIGURATION UPLINK PERIOD

byte 1	byte 2
tf	up

tf. Type of frame (03 - Configure uplink time period)

up. Parameter to configure the slot time between uplinks. Values:

- 0 - 3 minutes between uplinks (commissioning purpose)
- 1..96 - multiple of 15 minutes time slots between uplinks
- 100 - uplinks only performed when outputs status has changed. Transmission not forced

Example - configure 30 minutes as slot time between uplinks

time = 2 * 15 = 30 minutes

up = 02



7.2.4 DOWNLINK 04 – TIME AND DATE UPDATE

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7	byte 8
tf	hh	mm	ss	ww	dd	rr	yy

tf. Type of frame (04 - Uplink configuration for time and date)

hh. Hours (Time in format in 24H)

Example

11:00 AM - **hh** = 11
11:00 PM - **hh** = 23

mm. Minutes

ss. Seconds

ww. Day of the week

01 – Monday
02 - Tuesday
...
07 –Sunday

dd. Day of the month (1..31)

rr. Month of the year

01 – January
02 – February
...
12 –December

yy. Two last dates of the year

Example

2018 - **yy** = 18

NOTE

- After receiving the command, the new date and time will be applied immediately and 3 minutes later Watersens will perform an uplink type 00 (device status) to notify the change.



7.2.5 DOWNLINK 06 – NEXT DATA REQUESTED FOR UPLINK

By default Watersens performs uplinks with the status parameters of the device. If it is needed another type of info, it could be requested with the downlink specified below

byte 1	byte 2	byte 3
tf	nu	ev

tf. Type of frame (06 - Next data requested for uplink)

nu. Data Type for next uplink:

- 00 - Watersens parameters status
- 01 - Irrigation schedule of the electrovalve specified in **ev** byte
- 03 - Uplink period
- 05 - LoRaWAN Network status

ev. Electrovalve requested (only necessary to request irrigation schedule)

Examples

- To know the network status, send to Watersens the downlink payload

(**tf** = 06 / **nu** = 05 / **ev** not required) - **06 05**

- To know the irrigation schedule of electrovalve connected to output 2, send to Watersens the downlink payload

(**tf** = 06 / **nu** = 01 / **ev** = 02) - **06 01 02**

NOTE

- After sending the requested data (different from device status), the Watersens will send again the device status



8 TROUBLESHOOTING

Problem	Cause → Solution
Device doesn't work	<ul style="list-style-type: none"> · Low battery or defective batteries → Replace batteries · Wrong battery replacement → Ensure battery polarity · Watersens in deep sleep mode → Tap the Watersens with a smartphone with NFC interface enabled. The device should detect the NFC signal and it should enter in running mode
Electrovalves don't work according to timetable	<ul style="list-style-type: none"> · Wrong irrigation parameters configured → Review timetable, ensure valve outputs are enabled and check time and date. Verify electrovalve activation time is correct. On the other hand, verify internal time and date are synchronized · Wrong solenoid connection → Check the output valve signals are properly connected to open/close electrovalve
Watersens cannot be commissioned by app	<ul style="list-style-type: none"> · NFC is not enabled in smart phone → Enable NFC communication through settings · Access code has not been entered before any read/write operation → Enter access code and check mobile can read status and configuration parameters
Watersens cannot send uplink frames	<ul style="list-style-type: none"> · Wrong communication parameters configured → Review all RF parameters and apply correct settings. · Data rate and transmission powers are not correct → Configure Data Rate parameter as AUTO and apply a reset in communication module via Watersens Tool. This action will initialize communication settings in maximum power transmission and lowest data rate to ensure maximum network coverage

9 MAINTENANCE AND TECHNICAL SERVICE

9.1 Battery replacement

If the device is going to be switched off for a long time it is recommended to configure the LoRaWAN Parameter Time to update status as 100 (only transmission when a change occurs in valve outputs) and to program the irrigation timetable without any operation. In this way the current consumption is minimum and battery life is preserved.

In case of battery replacement, replace them by batteries with same features (voltage, capacity, maximum output current, etc)

Procedure for battery replacement:

1. Disconnect Watersens from external sensors and electrovalves
2. Remove screws from housing
3. Remove housing from the cover. Be careful with internal antenna cable and wire connectors
4. Remove old batteries from holders and put new batteries
5. Press reset button to reset the system (this step is very important to avoid reset all system to work properly)
6. Make all connections and ensure all well done
7. Ensure the O-ring is placed correctly to avoid humidity inside the housing in wet environments.
8. Fit the housing and the cover and screw them
9. Date and time were lost. Configure time and date through downlink frame type 2 (time and date setup) or via NFC with Watersens app (select synchronize date-time)

9.2 Firmware update

Watersens can be updated with last firmware version to get new features or to solve any deviation detected in previous versions. For this purpose, it is necessary:

- Last firmware Watersens version can be downloaded from web www.aonchip.com
- Software to download firmware to Watersens: https://www.st.com/content/st_com/en/products/development-tools/software-development-tools/stm32-software-development-tools/stm32-programmers/flasher-stm32.html
- USB to TTL cable FTDI TTL-232R-3V3 or similar: https://www.ftdichip.com/Support/Documents/DataSheets/Cables/DS_TTL-232R_CABLES.pdf

Procedure for firmware update:

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1. Disconnect Watersens from external sensors and electrovalves
2. Remove screws from housing
3. Remove housing from the cover. Be careful with internal antenna cable and wire connectors
4. Connect communication cable to programming connector and press the reset button. GND pin cable must be connected in pin 1 of the circuit connector

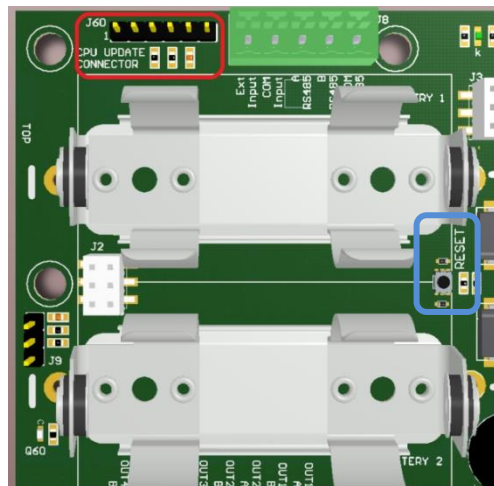


Figure 8. Programming connector and reset button locations

5. Launch the PC software and follow indications.

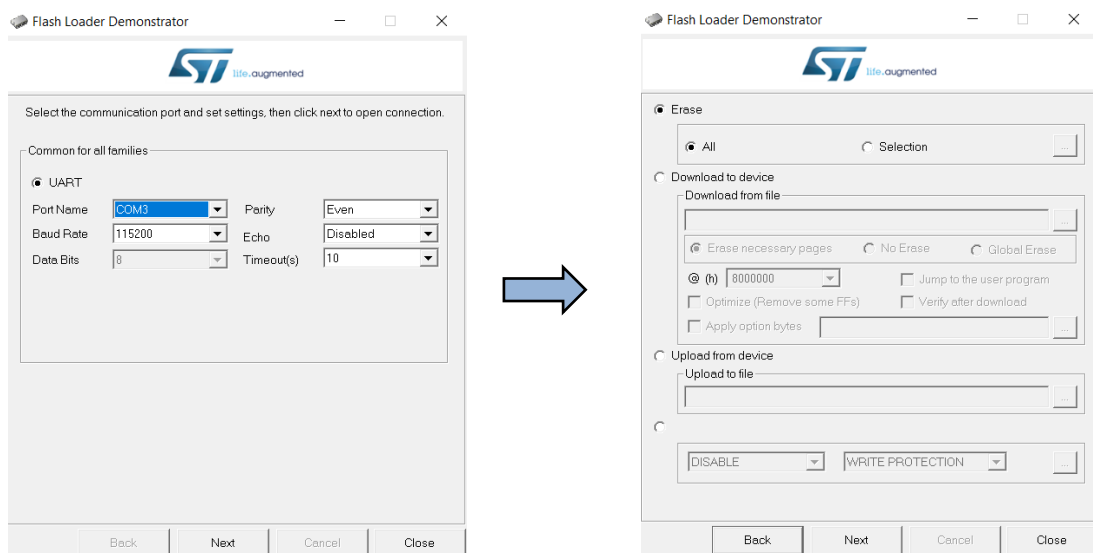


Figure9. Screenshot of the PC software for Watersens updating

6. Once the Watersens is updated, press reset button to start normal operation.
7. Ensure the O-ring is placed correctly to avoid humidity inside the housing in wet environments.
8. Fit the housing and the cover and screw them
9. Perform a reset communication through Android app via NFC connectivity

10 TECHNICAL FEATURES

Power supply	
Type	2x Type C battery
Voltage	3.6V
Maximum pulse current	2500mA
Capacity	2x 6000mAh
Life expected	10 years (*)

(*) Conditions:

- 2 irrigation operations per day
- 1 latch electrovalve connected (9V - 2W coil activation)
- Data Rate 0 (SF12) TxPower 0
- No external sensors connected

Environmental features	
Operating temperature	-10°C...+50°C
Storage temperature	-20°C...+60°C
Air humidity	15...+90 %rH non-condensing

Mechanical features	
Dimensions (WHD)	110x150x40mm (without antenna)
Weight	320g
IP class	IP67
Housing material	ABS UL94 V-0

LoRaWAN communication	
LoRaWAN Specification	v1.0.2 (with Regional Parameters v1.0.2rB)
End device type	Class A
Frequency	EU863-870MHz ISM Band US902-928MHz ISM Band AS923MHz ISM Band
Maximum transmit power (dBm)	EU863-870MHz ≤+14dBm US902-928MHz ≤+ 20dBm AS923MHz ≤+16dBm
Sensitivity (dBm)	-136dBm
Antenna	1/2 Wave Whip SMA connector

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NFC communication	
Frequency	13.56MHz
Interface	Passive NFC
Memory access	Read - allowed Write - allowed

Internal sensor	
Housing temperature	Range: -20°C...+60°C Resolution: ±1°C

Inputs and other ports (optional - depending model)	
External pulse reader	Digital signal Range [0...3.3V] / Free potential contact (open collector /drain) Maximum frequency 1kHz Protected against ESD
Serial port communication	RS485 RTU Modbus communication

Outputs	
Number of electrovalves available	4
Output pulse activation voltage (Vab)	+9V or +12V (depending model)
Output pulse deactivation voltage (Vab)	-9V or -12V (depending model)
Protection	Protection against ESD and voltages peaks originated by solenoid switching
Maximum output current	1.8 A
Pulse duration	20ms...200ms
Maximum wire length recommended	2m

11 PRODUCT REGULATIONS

Watersens is a product in conformity with the following directives and standards

RED Directive (2014/53/EU)		
EMC	Emissions EN 301 489-3 V2.1.	Radiated Emissions EN 55032
	Immunity EN 301 489-3 V2.1.	Electrostatic discharges EN61000-4-2 Radiated immunity EN61000-4-3
Radiospectrum efficiency	Short Range Devices operating on 25MHz to 1000MHz EN 300 220-2 V3.1.1	Radiated spurious
	Short Range Devices operating on 9kHz to 30MHz EN 300 330 V2.1.1	Radiated spurious (<30MHz) Permitted range of operating frequencies Operating frequency ranges Modulation bandwidth Transmitter H-filed requirements
FCC Standard		
LoRa connectivity	FCC CFR Title 47 Part 15 Subpart C Section 15.247	
NFC connectivity	FCC CFR Title 47 Part 15 Subpart C Section 15.225	
IC Standard		
LoRa connectivity	RSS-247 Issue 2: February 2017	
NFC connectivity	RSS-210 Issue 10: December 2019 RSS-Gen Issue 5: April 2018	
RoHS Directive (2011/65/EU)		
	Evaluation EN50581	

Watersens is a LoRaWAN Certified Product





12 TRADEMARKS

All referenced brands, product names, services names and trademarks are the property of their respective owners.



13 GUARANTEE

Aonchip guarantees its products against any manufacturing defect for two years after the delivery of the units.

Aonchip will repair or replace any defective factory product returned during the guarantee period.

Pay attention

- No returns will be accepted and no unit will be repaired or replaced if it is not attached a report indicating the defect detected or the reason for the return.
- The guarantee will be void if the units have been improperly used or the storage, installation and maintenance instructions listed in this manual have not been followed. "Improper usage" is defined as any operating or storage condition not allowed in the national electrical code or that overcomes the limits indicated in the technical and environmental features of this manual.
- Aonchip accepts no liability due to the possible damage to the unit or other parts of the installation, nor will it cover any possible sanctions derived from a possible failure, improper installation or "improper usage" of the unit. Consequently, this guarantee does not apply to failures as: - Excessive temperatures; - Improper installation and/or lack of maintenance; - Buyer repairs or modifications without the manufacturer's authorization.



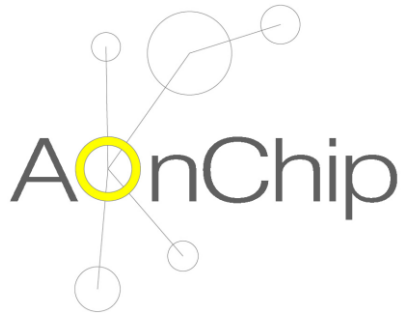
14 DOCUMENT HISTORY

Rev.	Date	Changes
A	30-Oct-2018	Preliminary version
B	05-Feb-2019	<ul style="list-style-type: none">· Pictures updated· Modification in uplink frame type 01 according to new functionality
C	05-Mar-2019	<ul style="list-style-type: none">· Contact information updated
D	04-Jun-2019	<ul style="list-style-type: none">· Product pictures updated· Features updated with AS923 ISM Band
E	27-Sept-2019	<ul style="list-style-type: none">· Added new uplink and downlink frames according to new functionality
F	12-June-2020	<ul style="list-style-type: none">· Extension of the irrigation functionality adding week calendar· Features update· Errata correction
G	02-January-2021	New features according to last Watersens hardware version: <ul style="list-style-type: none">· Firmware update· RS485 communications· Regulations and standards update

15 CONTACT INFORMATION

For more information, please visit: <http://www.aonchip.com>

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