S2W-Temp

USER MANUAL

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Introduction

1 Introduction

1.1 About

1. About this guide

This document provides the specifications of the **S2W-Temp** and **S2W-Temp-Ext** Wi-Fi sensors.

2. Revision of document

For revision history of this document, please refer to the last page.

3. Documentation change notification

ELBIS provides notifications to keep customers updated on changes to technical documentation. Please subscribe to www.elbis.gr

4. Certifications

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1.2 Overview

- **ELBIS**[®] **S2W-Temp** is a small, standalone, integrated device that measures the temperature of an area or the temperature of a specific item.
- The device is intended for indoor or outdoor¹ use. It can operate in noisy and harsh environments including moisture, greasy, and dirty environments.
- It can be used as a standalone temperature sensor without need of extra access point. It uses Wi – Fi technology to connect directly to the router and then to the S2W² cloud platform.
- It operates with external power supply or 3xAAA batteries that can provide autonomous operation up to one year.
- It uses the best practice of cyber security, that place the device in one of the highest levels of cyber protection.
- The device is based on **S2W main board**³, the best in the class of integrated and autonomous sensing devices.

- (2) S2W platform is an IoT cloud platform created by ELBIS. For more details visit https://elbis.gr/iiot/s2w/
- (3) S2W main board is referred to the core MCU

⁽¹⁾ For outdoor use, extra accessory for IP65 is needed

1.3 Features



- Standalone temperature Wi Fi Sensor based on DS18B20 onewire chip
- ∠ High Accuracy measurements
- ∠ Device Size: 107mm x 60mm x 23mm
- ✓ Wide USB power supply range (3V 5V) or 3xAAA batteries
- On board LED indication for connectivity, power supply and data transfer
- 🖉 Alarm and Fault alerts
- ∠ Low power consumption
- ∠ Over the Air update
- High level security through most common IoT communication protocols (HTTPS, MQTT)
- ∠ Easy installation
- ∠ No need for extra access point
- ∠ 4.000 values memory
- 🗷 Real time clock
- ∠ One year battery life¹
- 🖉 Low cost

(1) Tested in an area with strong Wi – Fi signal coverage. 3xAAA 1000mAh batteries were used. Taking of measurements every 20 minutes and sending every 9 measurements to the cloud.

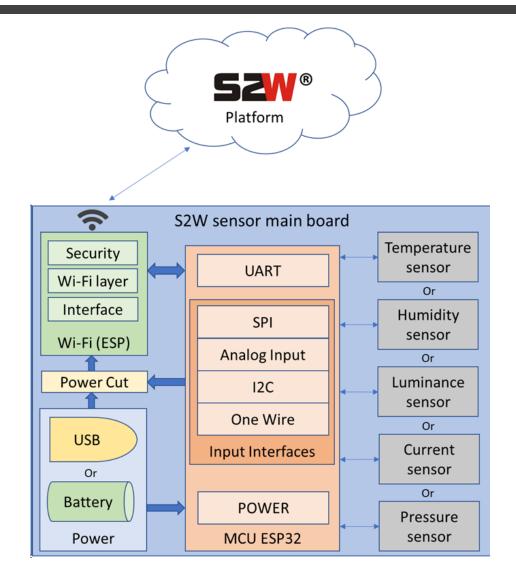
1.4 Applications



- 🗷 Logistics
- 🖉 Wineries
- 🖉 Industrial Units
- ✓ Storage Cold Rooms
- ∠ Hotels
- 🗷 Dining Areas

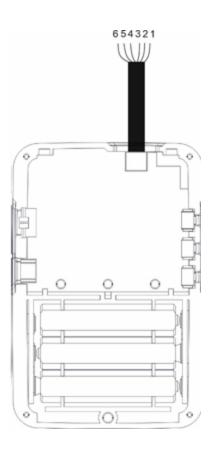
S2W-Temp device

- 2 S2W-Temp device
- 2.1 Block Diagram

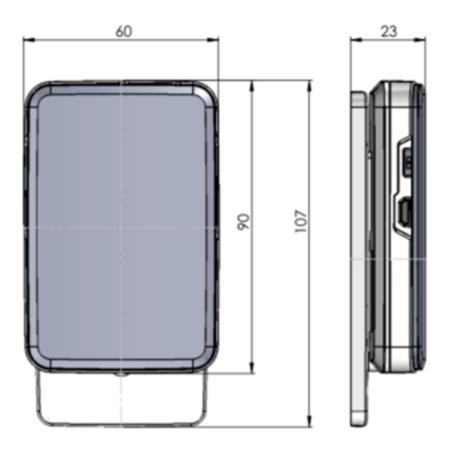


2.2 Pinout

Wire Number	Description
1	Vo (Sensor Power supply)
2	SCL/CLK (I ² C clock / SPI clock)
3	1-Wire/CS (1-wire interface data bus / SPI Chip Select)
4	Int/ADC/MISO (External Interrupt / Analog Input / SPI Master Input Slave Output)
5	GND (Sensor Ground)
6	SDA/MOSI (I ² C data / SPI Master Output Slave Input)



2.3 Dimensions



2.4 Absolute maximum ratings

Symbol	Parameter	Min	Max	Unit
Vdd	Power supply voltage	-0.3	5.3	V
lmax	Overall current consumption	-	1.100	mA
Toper	Toper Operating temperature		+50	°C
Tstore	Storage temperature	-20	+50	°C
Tprobe	Measuring Temperature	-55	+125	°C

2.5 Electrical Characteristics (3.3V, 25°C)

Symbol	Parameter	Min	Typical	Max	Unit
Vdd	Power supply voltage	3	3.3	5	V
Vbat	Battery power supply	3	3.3	4.8	V
ltransmit	Transmit 802.11b, DSSS 1 Mbps, POUT = +19.5 dBm	-	240	-	mA

S2W-Temp device

Itransmit	Transmit 802.11g, OFDM 54 Mbps, POUT = +16 dBm	-	190	-	mA
ltransmit	Transmit 802.11n, OFDM MCS7, POUT = +14 dBm	-	180	-	mA
Ireceive	Receive 802.11b/g/n	92	-	105	mA
Imeasurement	One measurement current consumption	22	-	29	mA
lsend data	Connection and send one packet of data consumption	22 + I transmit	-	29 + I transmit	mA
lsieep	Sleep mode consumption	-	10	-	uA
	One measurement discharge	0.006	-	0.008	mAh
	Send one packet discharge ¹	0.84	-	1.25	mAh
Cın	Pin capacitance	-	2	-	pF

S2W-Temp device

ViH	High-level input voltage	0.75×Vdd ²	-	Vdd+0.3 ⁵	v
Vil	Low-level input voltage	-0.3		0.25×Vdd ⁵	V
Ін	High-level input current	-	-	50	nA
lı	Low-level input current	-	-	50	nA
Voн	High-level output voltage	0.8×Vdd ⁵	-	-	v
Vol	Low-level output voltage	-	-	0.1×Vdd ⁵	V
Іон	High-level source current High-level source current (VDD1 = 3.3 V, VOH >= 2.64 V, output drive strength set to the maximum)	-	40	-	mA
Ιοι	Low-level sink current Low-level sink current (VDD1 = 3.3 V, VOL = 0.495 V, output drive strength set to the maximum)	-	28	-	mA

(1) Check Waveform 1.(2) VDD is the I/O voltage for a particular power domain of pins.

15

2.6 Thermal Characteristics

Symbol	Parameter	Min	Typical	Max	Unit
Toper,	Operating temperature ¹	-20	-	+50	°C
Tstore	Storage temperature	-20	-	+50	°C
TprobeOper.	Probe operating temperature	-55	-	+125	°C
TprobeStore	Probe storage temperature	-55	-	+125	°C

(1) It is referred to the device with the ABS enclosure. The separated probe is working in a more wide temperatures range (see table 1)

2.7 Recommended Operation Conditions

Symbol	Parameter	Min	Typical	Max	Unit
Vdd	Power supply voltage	3.0	5.0	5.3	V
lvdd	Current delivered by external power supply	0.5	-	-	А
т	Operating temperature	-40	-	85	°C

2.8 Wi-Fi Radio

Parameter	Condition	Min	Typical	Max	Unit
Operating frequency range ¹	-	2412	-	2484	MHz
	-	-	Note 2	-	Ω
	11n, MCS7	12	13	14	dBm
	11b mode	17.5	18.5	20	dBm
Out impedance ² TX power ³	11b, 1 Mbps	-	-98	-	dBm
Sensitivity	11b, 11 Mbps	-	-89	-	dBm
	11g, 6 Mbps	-	-92	-	dBm

S2W-Temp device

	11g, 54 Mbps	_	-74	-	dBm
	11n, HT20, MCS0	-	-91	-	dBm
	11n, HT20, MCS7	_	-71	-	dBm
	11n, HT40, MCS0	-	-89	-	dBm
	11n, HT40, MCS7	-	-69	-	dBm
Adjacent channel rejection	11g, 6 Mbps	-	31	-	dB
	11g, 54 Mbps	-	14	-	dB
	11n, HT20, MCS0	-	31	-	dB
	11n, HT20, MCS7	-	13	-	dB

(1) Device should operate in the frequency range allocated by regional regulatory authorities. Target operating frequency

range is configurable by software.

(2) For the modules that use IPEX antennas, the output impedance is 50 Ù. For other modules without IPEX antennas, users do not need to concern about the output impedance.

(3) Target TX power is configurable based on device or certification requirements

2.9 BLE Radio

Parameter	Conditions	Min	Тур	Max	Unit
Sensitivity @30.8% PER	-	-	-97	-	dBm
Maximum received signal @30.8% PER	-	0	-	-	dBm
Co-channel C/I	-	-	+10	-	dB
	F = F0 + 1 MHz	-	-5	-	dB
	F=F0-1MHz	-	-5	-	dB
Adjacent	F=F0+2MHz	-	-25	-	dB
channel selectivity C/I	F=F0-2MHz	-	-35	-	dB
	F=F0+3MHz	-	-25	-	dB
	F=F0-3MHz	-	-45	-	dB

Out-of-band blocking performance	30 MHz ~ 2000 MHz	-10	-	-	dBm
	2000 MHz ~ 2400 MHz	-27	-	-	dBm
	2500 MHz ~ 3000 MHz	-27	-	-	dBm
	3000 MHz ~ 12.5 GHz	-10	-	-	dBm
Inter- modulation	-	-36	-	-	dBm

2.10 Transmitter

Parameter	Conditions	Min	Тур	Max	Unit
RF transmit power	-	-	0	-	dBm
Gain control step	-	-	3	-	dBm
RF power control range	-	-12	-	+9	dBm

S2W-Temp device

Adjacent	$F = F0 \pm 2 MHz$	-	-52	-	dBm
channel transmit	F = F0 ± 3 MHz	-	-58	-	dBm
power	F = F0 ± 3 MHz	-	-60	-	dBm
∆ f1avg	-	-	-	265	kHz
Δ f2max	-	247	-	-	kHz
Δ f2avg/Δ f1avg	-	-	-0.92	-	-
ICFT	-	-	-10	-	kHz
Drift rate	-	-	0.7	-	kHz/50 μs
Drift	-	-	2	-	kHz

2.11 Power Consumption Waveforms



In this waveform we can see all the stages of the device from wake up to sleep again.

- A. Wake up from sleep, start up device and reading sensor
- B. Initialize Wi-Fi and connecting to backend.
- C. Sending data to the cloud and reading settings from the cloud.
- D. Prepare to sleep and falling to sleep.

All above stages are completed in 12 Seconds.

Temperature sensor Sen-Temp

- 3 Temperature sensor Sen-Temp
- 3.1 General Description



The **Sen-Temp** sensor probe is based on DS18B20 digital temperature chip. It consists of **stainless-steel cover**, high resistance humidity glue and **1 meter cable** with two internal wires. Provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The **Sen-Temp** communicates over a **1-Wire bus** that requires only one data line (and ground) for communication with a central microprocessor. In addition, the **Sen-Temp** can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply.

Each **Sen-Temp** has a unique **64-bit serial code**, which allows multiple **Sen-Temp** to function on the **same 1-Wire bus**.

Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.

3.2 Pin Configurations



Pin Number	Description			
1	1-Wire (One wire interface bus for parasite power supply)			
2	GND (Sensor ground)			

3.3 Benefits and Features

- Unique 1-Wire[®] Interface Requires Only One Port Pin for Communication
- Reduce Component Count with Integrated Temperature Sensor and EEPROM
- Measures Temperatures from -55°C to +125°C
- ±0.5°C Accuracy from -10°C to +85°C
- Programmable Resolution from 9 Bits to 12 Bits
- No External Components Required
- Using Parasitic Power Mode that requires only 2 Pins for operation (1-wire data bus and GND)
- Simplifies Distributed Temperature-Sensing Applications with Multidrop Capability
- Each Device Has a Unique 64-Bit Serial Code Stored in On-Board ROM
- Flexible User-Definable Nonvolatile (NV) Alarm Settings with Alarm
- Search Command Identifies Devices with Temperatures Outside Programmed Limits

Symbol	Parameter	Min	Max	Unit
Vo	Power supply voltage	-0.5	5.0	V
lsink	Overall current consumption	-	4	mA
Toper	Operating temperature	-55	+125	°C
Tstore	Storage temperature	-55	+125	°C

3.4 Absolut Maximum Ratings

3.5 DC Electrical Characteristics

Parameter	Parameter	Min	Тур	Max	Unit
Vdd1	Supply Voltage	+3.0	-	+5.5	V
VPU	Parasite power	+3.0	-	+3.0	V
t _{err} Temperature Error under conditions ²	Thermometer Error	±0.5	-	±2.0	°C
	-10°C to +85°C	-	±0.5	-	°C
	-30°C to +100°C	-	±1	-	°C
	-55°C to +125°C	-	±2	-	°C
۱L	Sink Current	4.0	-	-	mA

Temperature sensor Sen-Temp

ldds	Standby Current ³	-	750	1000	nA
ldd	Active Current ⁴	-	1.0	1.5	mA
ldq	DQ Input Current⁵	-	5	-	uA
	Drift ⁶	-	±0.2	_	°C

(1) All voltages are referenced to ground.

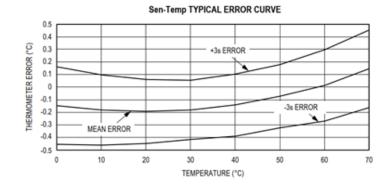
(2) See typical performance curve in Table 13 and Table 14. Thermometer Error limits are 3-sigma values

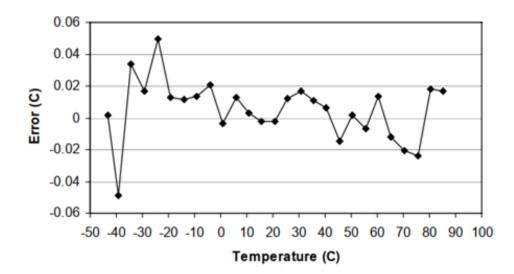
(3) Standby current specified up to +70°C. Standby current typically is 3μ A at +125°C. To minimize IDDS, DQ should be within the following ranges: GND \leq DQ \leq GND + 0.3V or VDD - 0.3V \leq DQ \leq VDD

(4) Vdd = 5V. Active current refers to supply current during active temperature conversions or EEPROM writes.

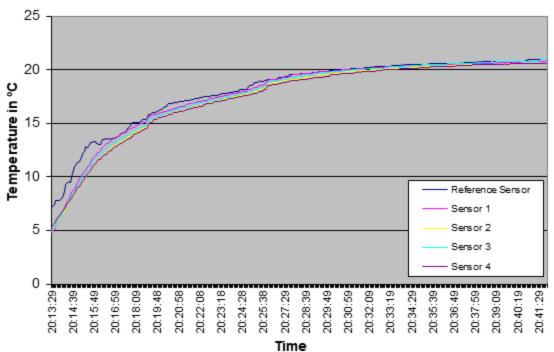
(5) DQ line is high ("high-Z" state).

(6) Drift data is based on a 1000-hour stress test at +125 °C with VDD = 5.5V.



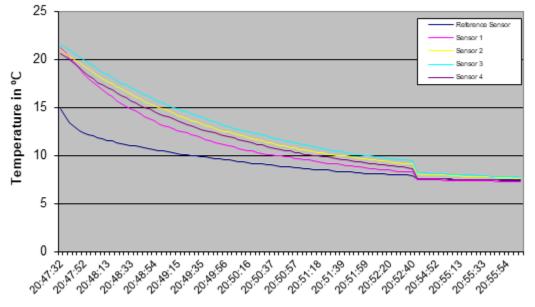


3.6 Sen-Temp probe Thermal Inaction



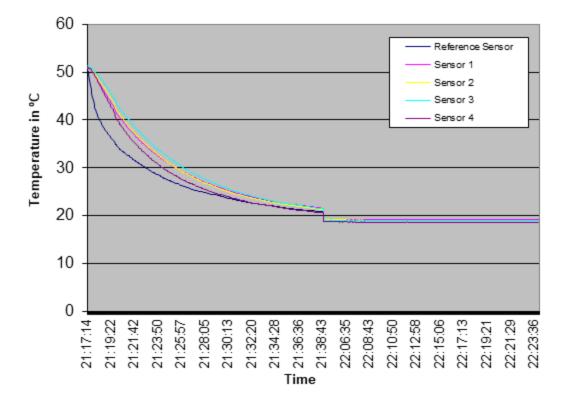
Sensor response : From cold to Normal

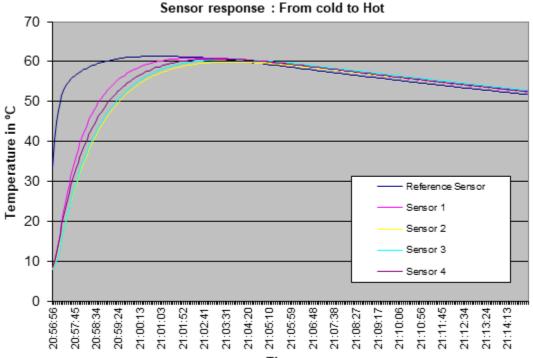




Time

Sensor response : From Hot to Air





Installation

4 Installation

4.1 Batteries Power Supply

For the installation you will need to unscrew from the back side of the device one screw and add 3 batteries **3xAAA** (Figure 1,2). The sensor or the appliance must be placed away from doors or windows, appliances, heat pipes, cooling devices or anything that can affect the credibility of the measurements, for the correct recording of values.

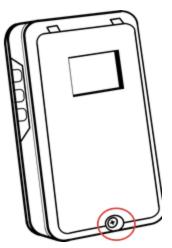


Figure 1

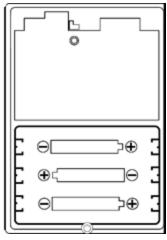


Figure 2

4.2 USB Power Supply

You can also connect the USB cable from the left side (**Figure 3**). The USB cable is included in the package. The end user has only to supply an **AC** to **DC** adapter (220V to 5V).

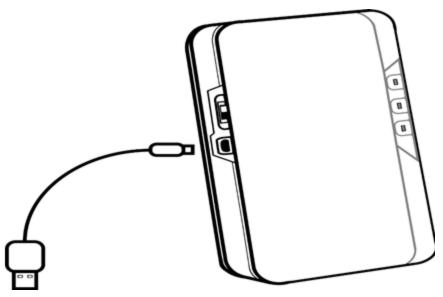
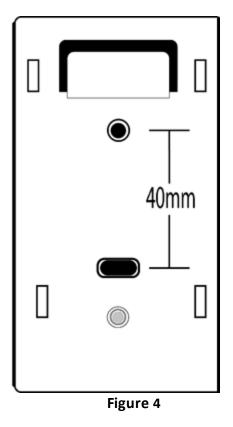


Figure 3

4.3 Wall Mount

Inside the packaging device you will also find a wall mount for the **S2W** device (**Figure 4**). For wall mounting you will need only one screw M3x.



4.4 First Steps

To activate the S2W device, make sure that the power switch is downwards. (see Figure 5).

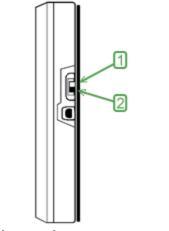


Figure 5 (Power Switch 1:Off, 2:On)

When we switch on the device, three red LED lights will start flashing in the front side of the device (**Figure 6**). You will observe that the first LED from the left side of the device will be flashing continuously, while the second one will be flashing twice every 30 seconds.

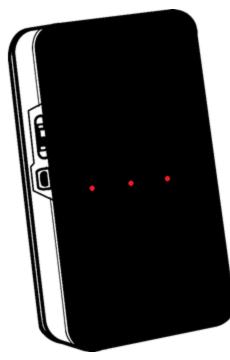


Figure 6 (Led flashing)

4.5 External Sensor (Sen-Temp)

S2W-Temp series is equipped with the temperature sensor on board as a basic model (S2W-Temp). If an extension is necessary, an external sensor can be plugged in at the top side of the device as shown in **Figure 7a**. In this way, the sensor can be extended to the point where we want to measure.

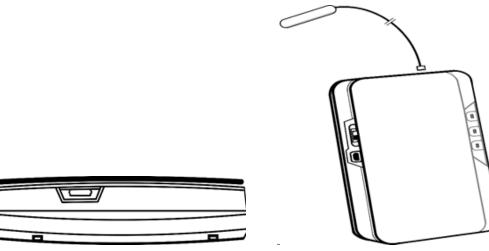


Figure 7a

Figure 7b

4.6 Led table

Description	LED 1	LED 2	LED 3
Search WIFI-Link	•	• 0	0
Wake Up/Measurement Send	•	•	Ο
Miniapp	•	••	0
Alarm	0	•	0
No Wi Fi	•	••	ο

(•) LED On

(°) LED Off

Cyber Security

5 Cyber Security

5.1 Platform Security Features

- 1. We use X509 certificates stored in S2W's flash in order to be able to connect to AWS MQTT Broker.
- 2. All flash partitions are encrypted using AES-256 algorithm with a 32-byte key
- 3. We enable ESP32's secure boot in order to prevent flash rewriting
- 4. We have VPCs defined which allow only certain instances to communicate in the same Virtual Private Circuit
- 5. We use this to provide DB-API communication and MQTT Core-API communication
- 6. We use digital certificates on our Servers in order to encrypt traffic to and from backend.
- 7. Each Back-end service runs on its own Docker container in order to prevent access from outside the VPC which resides in the same instance
- 8. We have enabled Cross Origin Resource Sharing which prevents http calls from resources other than these that we define (Dashboard)

5.2 Security Requirements

- 1. WPA2 must be enabled in access point (router)
- 2. MQTT over TLS uses port 8883 (needs to be open)

5.3 Elbis security best practice for IoT sensors and platform

Link for Download: https://elbis.gr/

5.4 Network Specifications

- Wireless network at 2,4GHz
- Technical Specifications. The device must be supporting AES encryption and the encryption protocol must be WPA-PSKII.
- For the appropriate installation our company suggests a site survey at first
- For the proper operation of the device, the power signal should be over -75dbi

For the orderly operation of the device our company suggests the network to be separate (create a new subnet) from the existing installation so any changes or alterations to be avoided.

Front End Dashboard

6 Front End Dashboard

6.1 Overview

Dashboard is our app that provides access to data collected by the sensors. Users can watch charts or raw data and can even download these data in CSV format. Also, users can display events in charts, for example they can see alarms either high or low, user events (user pressed a button), sensor connectivity events, in case a sensor's cable has been disconnected, and Internet Connectivity events which show if an S2W is connected to the internet. Users can see all their S2W devices in one place and can search for them and even apply filters based on device's type or online status. Furthermore, users can send settings to their devices. These settings might be sensor data dispatch interval, alarm limits, S2W device name, alarm delays, alarm hysteresis. Also, users can define who can receive notifications about alarms or any change of status (online/offline).

6.2 Dashboard Images

<	52W			8
G Home	Home			
A Sensors	Pome Dashboard 2 1 0 0			
	_	1 ^{Online}	•	0 With low battery
	Quick links		Latest news	
	My Sensors		The new web interface of S2W io has launched	15/09/2019
	Logout		Elbis is an exhibitor in Thessaloniki International Fair	2019 07/09/2019
Tops://doifinged.doi/2.0%.in				

Figure 8: Dashboard Homepage. In this page you can view all your sensors, connectivity status, battery status and temperature alarms.

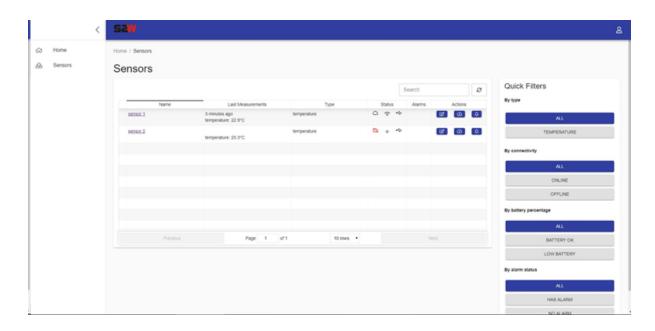


Figure 9: List of Sensors page. If you choose Sensors, you will be transferred to the main sensor page. Here, the user can view all the sensors with more than the basic information, e.g. when last measurement of temperature was taken, alarm limits and connectivity. At the right side of the page, you can view the quick filters that help you to categorize the sensors by different status..

<	52W		٤
Home Sensors	Home / Sensors / GMPp1M4 Sensor manual sensor		
Details Edit	Sensor details	Com	Current Status
Measurements	Alarms: No alarms		temperature
Q. Events	Sensor Type	temperature	30 40 50 60 70 20
	8	36511c8b-e5ac-4505-be85-2%c9650254	10 80 90
	Mac Address	00.00.00.00.00.00	-10 100
	Measure every (seconds)	wanted 60 (reported 60)	-20 -20 -20
	Send every (neasurements)	wanted 5 reported 5	23 °C
	Operational mode	wanted 8 reported 0	
	Aiam Enabled	warded toor reported true	
	Alarm Time Delay	wanted 8 reported 8	
	Firmware Version	106	

Figure 10: Sensor Details page

	<	52W		8
ନ କ	Home Sensors	Aann Time Delay	wated ported 0	
@ @	Details Edit	Firmware Version R551	105 T	
۵	Measurements	Power	*	
4	Events	Last status update	Saturday, October 26, 2019 9: 16 AM Monday, November 4, 2019 10: 36 AM	
		24 auguod 22 21 21 12/00 18/00 00/00	o ocioo 12'00 18'00 00'00	Pick a date Structure for a 10.44 End Date November 4th 10.44 End Date November 4th 10.44 End Date COAD DATA Findure chart Show connectively events Show connectively

Figure 11: Sensor Details page. Click on the sensor you want, to see all the details of the sensor (sensor type, measurement time, operational mode, alarm delay etc). At the right side of the page there is a temperature gauge where you can see the last measurement. Also, at the bottom of the page there is a temperature measurement chart. Pick a date and view the waveform chart.

	<	52W		8
ର କ୍ଷ	Home Sensors	Home / Sensors / GMPp1M4 / Edit Edit Sensor manual sensor		
0	Details Edit	Sensor name	Measurement configuration: temperature	C (1)
@ 4	Measurements Events	Nane manual sensor	Agen lov 12 Hyderecis lov	Alam high 45 Hysterelik high
		Ceneric sensor configuration	0 0xxys tor -30	0 Gaupe high 124
		Normal + Direg leaded 60		
		Training times 5 Common Alarm enabled		
		Autor delay 0		
L				

Figure 12: Edit Sensor page. By clicking on the Edit button, you can make a number of configurations, like sensor mame, time settings (sleep seconds, wakeup times) and measurement configuration (high alarm, low alarm, hysteresis, gauge limits).

Home	Home / Sensors / GMPp1M4 / Measurements						
Sensors	Measurements of manual sensor						
Details Edit	Pick a date text Date October 20th 10:45	Sensor readings					
Measurements				A EXPORT IN CSV			
Events	End Date November 4th 10:45	Record Date	e & Time			temperature	
	100000	04Nov2019 10.42.19		23			
	LOAD DATA	04/Nov/2019 10:42:12		22.9			
		04Nov2019 10.41.07		23			
		04/Nov/2019 10:40:05		22.9			
		04Nov2019 10:39:03		23			
		04/Nov/2019 10:38:01		23			
		04Nov2019 10:36:59		23			
		04Nov2019 10:36:53		23			
		04/Nov/2019 10:35.47		23			
		04/Nov/2019 10:34:45		23			
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Figure 13: Sensor's Measurements page. At this page, user can handle all the data measurements history and can export them at an excel or pdf file for analysis and back up.

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Figure 14: Sensor's Events page. At this page the user can view the events history of the sensor. By picking up the dates he wants, events like connectivity status or "wake up button pressed" will appear.

Application

7 Application

7.1 Description

The **S2W Sensors** application is available for free for both Android and iOS. You can download it from **Google Play Store** or **App Store**. You must create an account with your personal email and accept the confirmation.

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1. https://play.google.com/store/apps/details?id=io.s2w (Figure 15)

Figure 15

- 2. https://apps.apple.com/gr/app/s2w-sensors/id1474229047 (Figure 16)

Figure 16

For the instructions manual about the application please visit our website: www.elbis.gr

References

8 References

8.1 References

The links below include further details about the MCU, Temperature sensor and Application guidelines.

- Esp32-WROOM-32 Datasheet: https://www.espressif.com/sites/default/files/documentation/esp32wroom-32_datasheet_en.pdf
- DS18B20 Datasheet: https://www.alldatasheet.com/datasheet-pdf/pdf/230838/DALLAS/ DS18B20.html
- ELBIS official site: www.elbis.gr
- Elbis dashboard: https://dashboard.s2w.io/login