Severn WLD™ User Manual

In this document

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Product and regulatory information

Disclaimer and warnings

Read this user manual before attempting to install the device. Failure to observe the recommendations included in this manual may be dangerous or cause a violation of the law. LAIIER will not be held responsible for any loss or damage resulting from not following the instructions of this user manual.

The device must not be dismantled or modified unless specified by LAIIER. The safety of this product is only guaranteed when it is used in accordance with its purpose.

The device must not be installed near a heat source or in damp conditions.

When the device is open, do not carry out any operations other than the ones set out in this document.

There is a risk of explosion if the battery is replaced by an incorrect type. The battery should be removed from the device if it is not to be used for an extended period. Otherwise, the battery might leak and damage the device. Never leave a discharged battery in the battery compartment.

Maintenance should only be carried out by qualified personnel.

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The Severn Board produces non-ionising radiation, please keep your distance if this might cause you harm.

There is a risk of explosion if the battery is replaced by an incorrect type. Contact LAIIER for more information about the battery needed.

Disposal

The device, including board and sensors, must not be disposed of with household or industrial waste. Please contact LAIIER to replace the device if you have a LAIIER Cloud subscription. If you haven't, please take it to a collection point designated for the recycling of electrical and electronic appliances. The device contains a battery, which must be disposed of separately.

FCC compliance statement

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.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by LAIIER could void the user's authority to operate the equipment.

ISED compliance statement

This device complies with ISED Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'ISDE Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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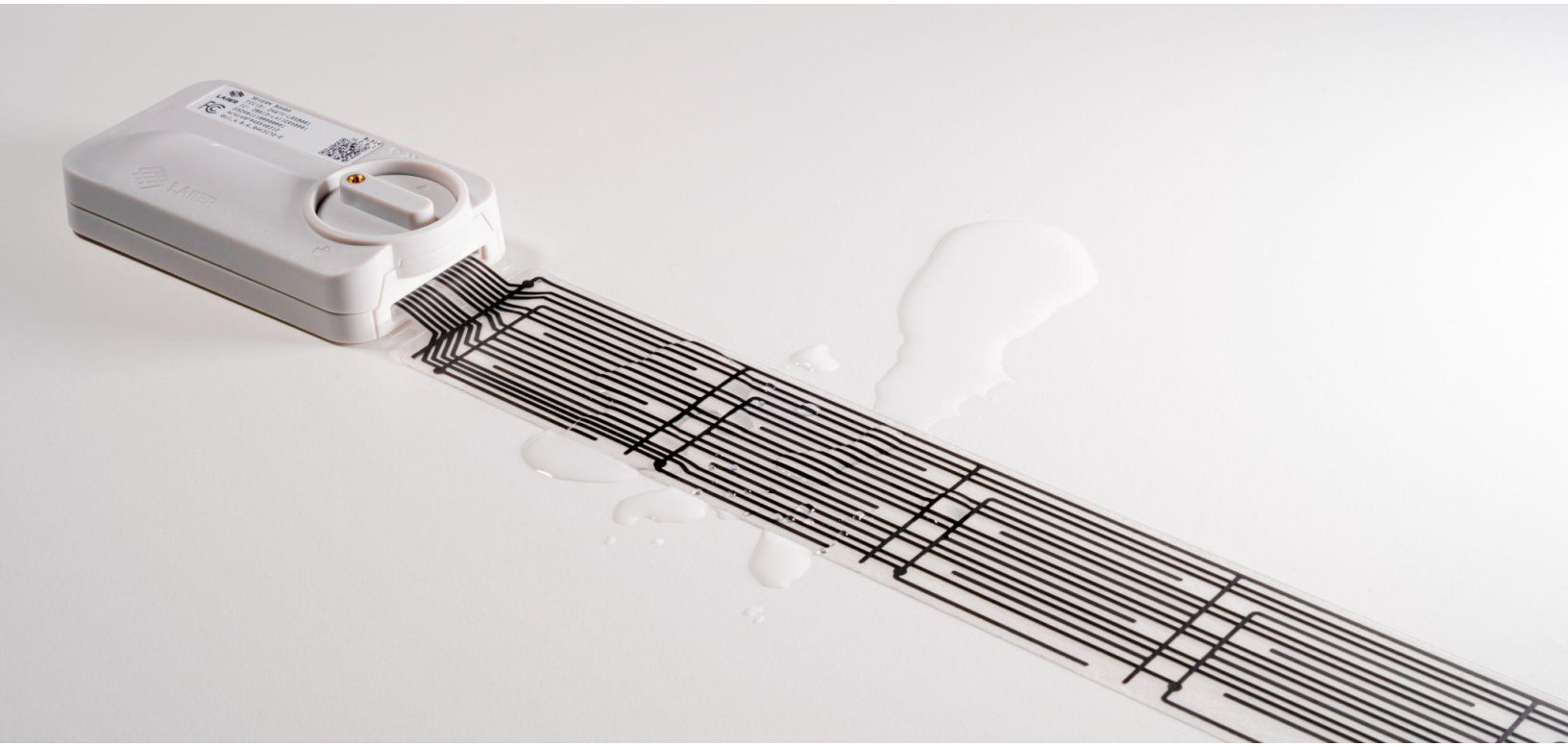
Introduction

Severn WLD™ is LAIIER's water leak detection device. The Severn WLD hardware connects to a printed sensor that is split into 12 sections or electrodes. Upon powering up with a single AA Li-SOCl2 cell battery, the device connects to the LoRaWAN® network via OTAA. After running through a self-test, the device enters its run mode.

Within the run mode, the device checks for water on each electrode every minute. It sends a regular or "heartbeat" uplink message by default every 4 hours via LoRaWAN. In its default mode, when it detects the presence of water on 4 or more electrodes, the device sends an emergency uplink message via LoRaWAN.

The threshold, the number of electrode segments that have to be wet to trigger an emergency message, and the regular message time interval can be changed via a LoRaWAN downlink message. The device also reports on its battery status and when its sensor becomes disconnected.

The Severn WLD device also contains a temperature sensor, to report the ambient temperature; and an accelerometer, to report whether the device has been moved.



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Technical specifications

Hardware dimensions	25 × 59 × 110 mm
Hardware weight	90g
Operating temperature range	20°C to 60°C
Humidity range	90%RH (non-condensing)
Battery type	AA Li-SOCl2 cell*
Operating voltage	3.6V
Peak current drawn	105mA
Active battery lifetime	6 years**
Enclosure	IP65
Mounting	Self-adhesive
Sensor dimensions	883 × 50mm
Sensitivity	Maximum resolution of 0.1ml of water
Wireless communication protocol	LoRaWAN 1.0.3 OTAA
LoRaWAN frequency plan	EU868, US915
Read range	Up to 2km***
Radio compliance	Canada, EU, UK, USA

* Using incorrect batteries can damage the device! If you are unsure, please **contact us**.

** The device has a 6-year battery life when operating at room temperature, a good distance from a LoRaWAN gateway, and when sending a regular message every 4 hours.

*** The surroundings of the device can influence the read range.

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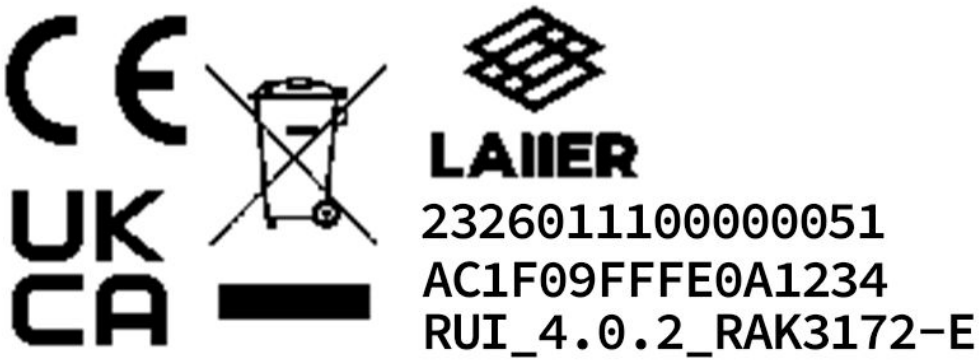
Label examples



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Electrode definition and sensor dimensions

Electrode definition

Each one of these sections is called an “electrode”. There are 12 electrodes on the sensor.

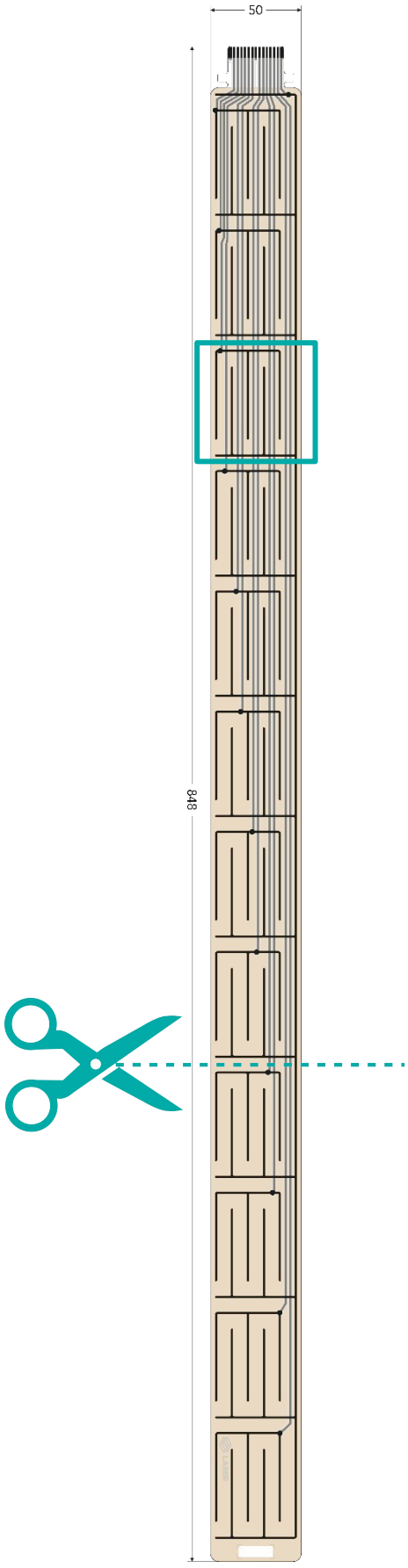
Sensor dimensions

All dimensions are in mm:
848mm long x 50mm wide

Trimming the sensor

You can trim the sensor by cutting the it just after one of the electrodes. An example cutting line is indicated here.

Please note that the device will not register that the sensor has been cut



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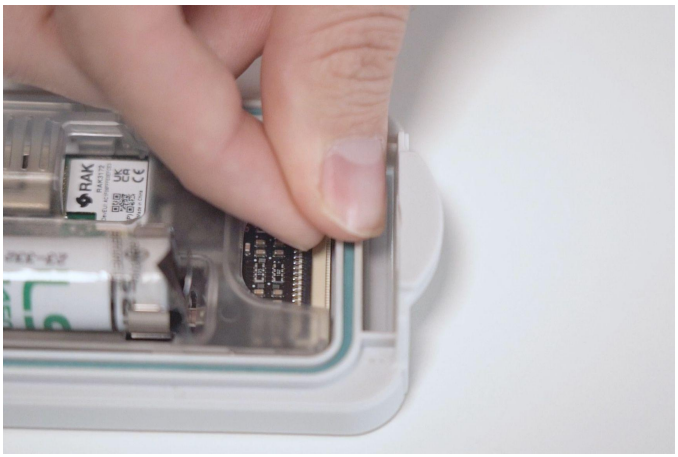
Attaching the sensor

For a video on how to attach a sensor to the device, please see: laiier.io/severn-wld-attach-sensor

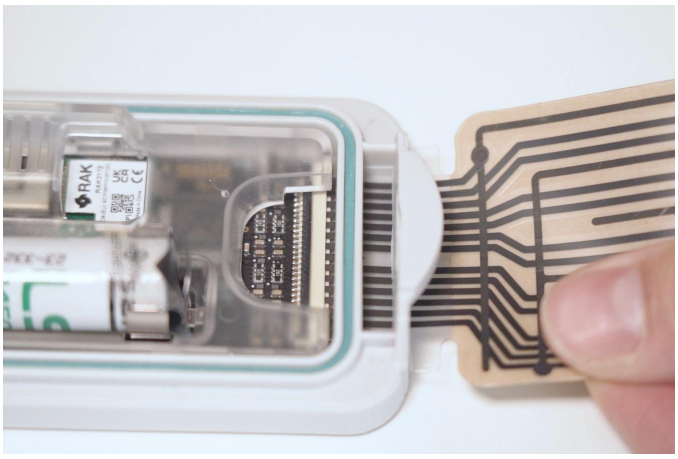
1. Open the enclosure by twisting the dial on the enclosure counter-clockwise towards the unlock symbol, and opening the hinged lid.

2. Open the connector, the beige part in the front of the device, by lifting the black lever of the connector upwards and insert the sensor with the print facing upwards.

   Insert the sensor fully, ensuring that both tabs either side of the sensor come into contact with outside of the device enclosure.



3. Close the connector by pushing down the black lever. Check that the sensor is properly connected by tugging it gently.



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When your sensor is connected, you can remove the battery safety tab. The LED of your device should then be flashing cyan and yellow, which means it is powering up.

Now close the enclosure lid and lock the device by twisting the dial clockwise so that the arrow points to the lock symbol, and set up your device on your software platform.

Best practices for installing your sensor

The Severn WLD can be installed in various locations to detect water leaks. But in order to ensure it is installed securely and to maximize effectiveness, we recommend some best practices:

- Install the sensor where a leak is most likely to occur: In order for the device to catch a leak as early as possible, it needs to be installed as close as possible to the source of a potential leak, for example, underneath pipes or appliances.

- Make sure the surface area is as clean as possible: For the sensor and the device to adhere to the surface, the surface mustn't be covered in debris or dust. We recommend going over the surface with a brush and a cloth.

- Avoid installing the sensor in areas with heavy footfall. While the sensor and device are long-lasting, any footfall risks either removing the sensor and device, or damaging the sensor. Therefore we recommend installing the sensor where it sees very little to no footfall.

- Avoid installing the sensor on fragile surfaces: While the adhesive on the sensor is designed to be repositionable, the adhesive on the device is fairly strong. We therefore recommend not installing the device on fragile surfaces, such as tiles, that could be damaged when the device is removed.

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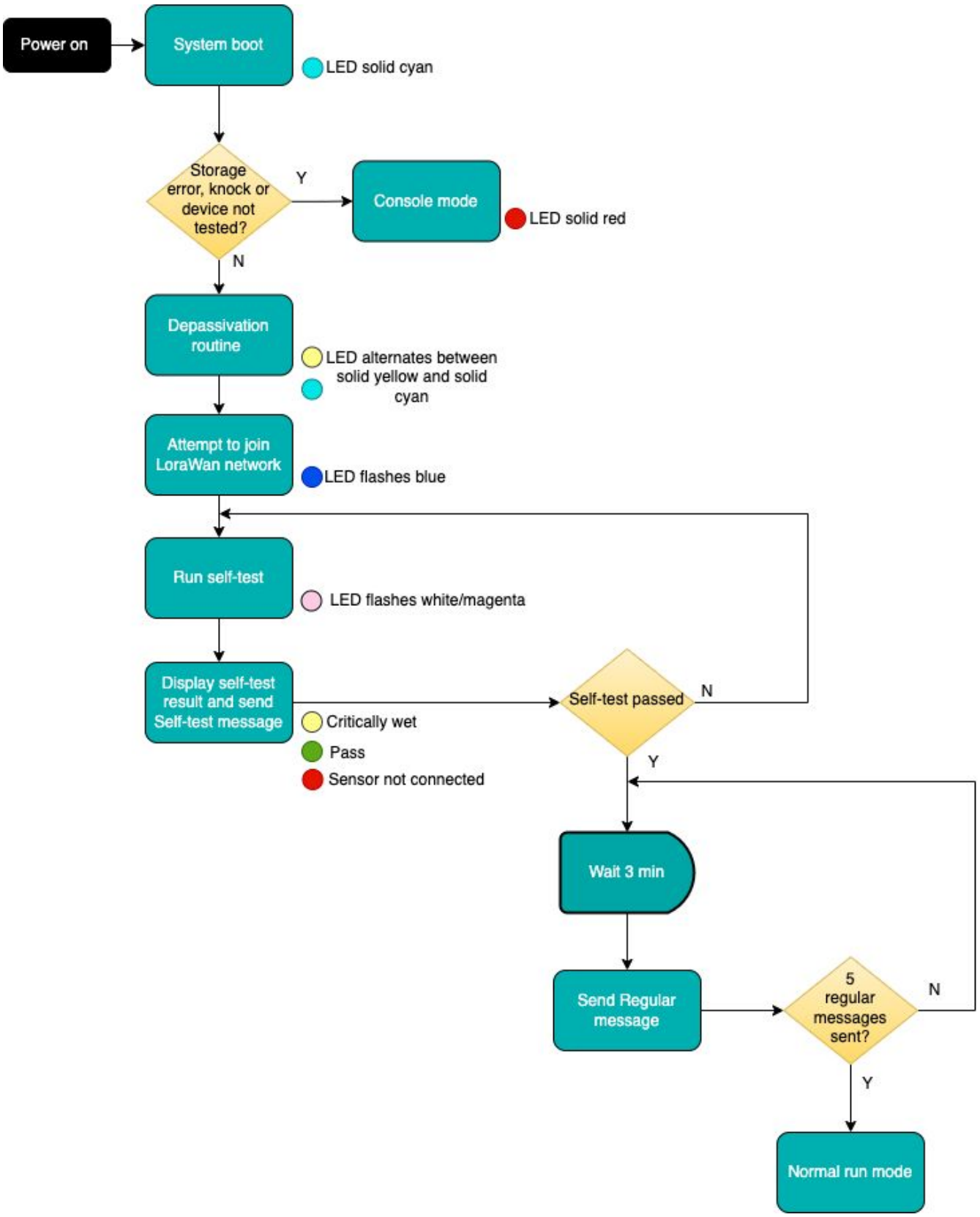
Board behaviour at start-up



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1. When powering the device up, the LED flashes cyan once.

2. A solid red LED indicates if there is a problem with the device, otherwise it continues its powering up procedure, where it will flash alternately between yellow and cyan.

3. The device will then attempt to connect to the LoRaWAN network, indicated by the LED flashing blue repeatedly.

4. Once the board has successfully joined the LoRaWAN network, the device runs a self-test, checking whether the sensor is critically wet. During the self-test, the LED flashes white/magenta.

5. Upon completion of the self-test, the results are displayed via the LED: yellow if the sensor is critically wet; green if the sensor isn't critically wet; red if the sensor isn't connected. The results are also sent as a self-test message. The self-test will re-run until it has been passed, which means less than the threshold of the electrodes are wet and that the sensor is connected correctly.

   Please note that the default threshold for critical wetness is 4, which is the number of electrode segments that have to be wet to trigger an emergency message (please review **Electrode definition and sensor dimensions** to clarify what an electrode is).

6. Once the device has passed the self-test, the device will send 5 regular messages via LoRaWAN every 3 minutes, in order to indicate its signal strength.

7. When 5 messages have been sent, the device enters its run mode.

You can run a self-test at any time by swiping a magnet across the device. For a video on how to do this, please see: **laiier.io/severn-wld-swipe-magnet**

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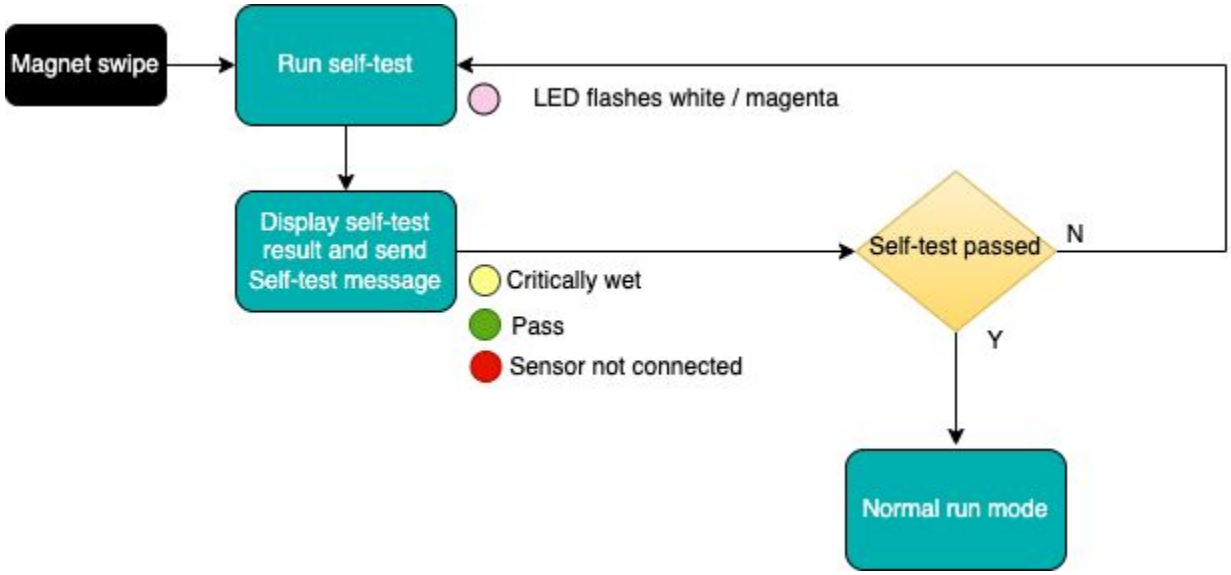
Board behaviour at magnet swipe



You can run a self-test at any time by swiping a magnet across the device. For a video on how to do this, please see: laiier.io/severn-wld-swipe-magnet

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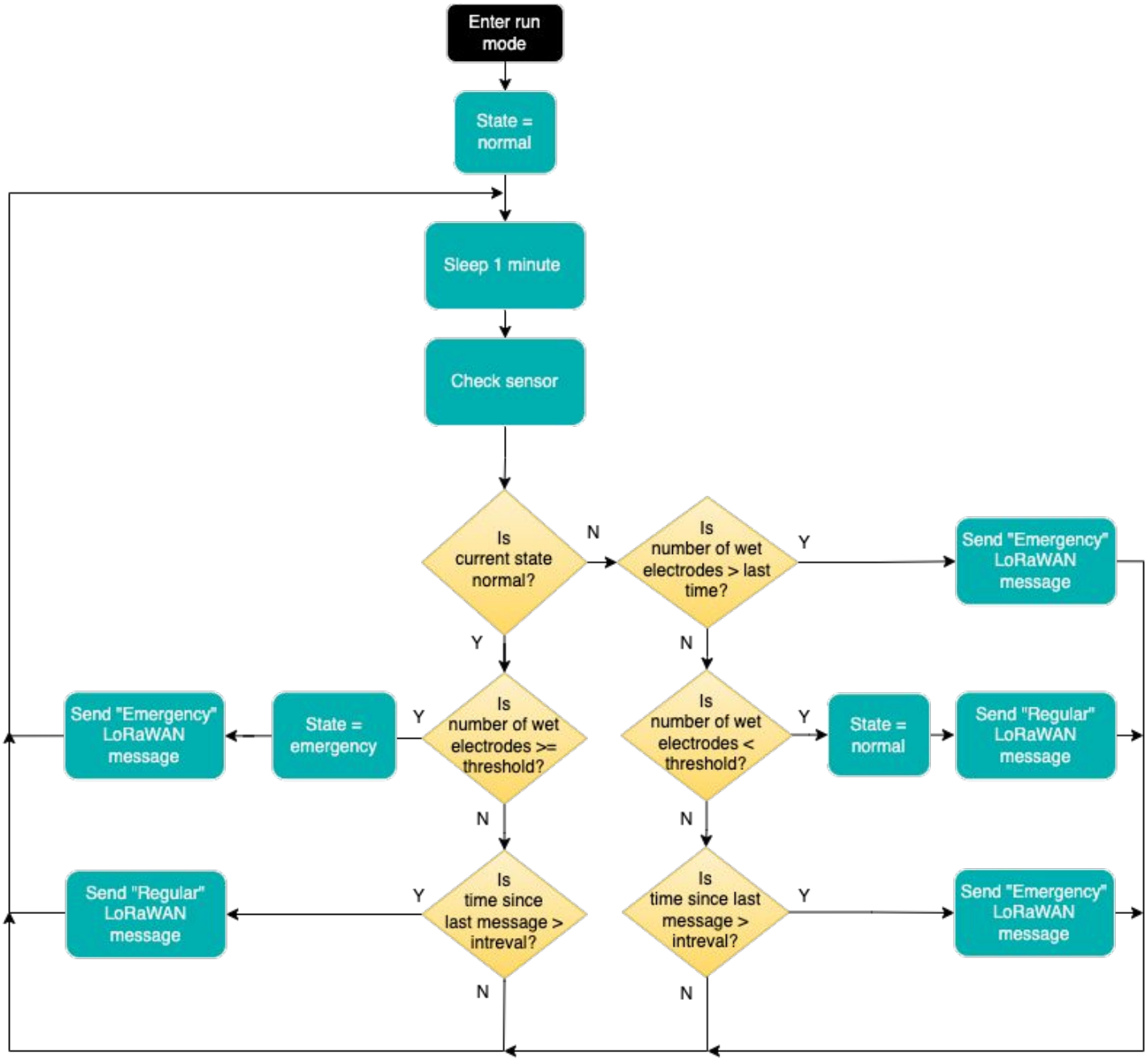
Board behaviour in run mode



When the device enters run mode, its state is set to normal, and it checks for the presence of water on each electrode every minute (please review **Electrode definition and sensor dimensions** to clarify what an electrode is). By default, 4 electrodes need to be wet for the device to sense a leak.

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1. If the device detects that 4 or more electrodes are wet, it will send an immediate emergency message via LoRaWAN. Otherwise, it sends a regular message via LoRaWAN every 4 hours.

2. After sending the emergency message and waiting for an additional minute, the device checks the sensor again. If more electrodes are now wet than at the previous check, the device will send another immediate LoRaWAN emergency message.

3. If the number of wet electrodes has decreased to below the threshold (in this case, below 4), then the device will exit its emergency state. It will send an immediate regular message via LoRaWAN and return to its normal state.

4. If the number of wet electrodes remains the same, the device will go back to sleep and repeat this procedure until 4 hours have passed. After 4 hours it will send an emergency message again as an update.

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LED guide

	Switching between cyan and yellow: The device is powering up
	Flashing blue: The device is connecting to the LoRaWAN network
	Flashing white/magenta: The device is running through a self-test, checking if the sensor is connected and if the sensor is critically wet
	Flashing green: Self-test passed, the sensor is connected and the sensor isn't critically wet
	Flashing yellow: The sensor is critically wet - please remove any water or residue from the sensor.
	Flashing red: The sensor isn't connected or connected properly - please re-connect or try to connect the sensor again.

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Payload encoding

The Severn WLD's payload has two profiles: 0 for the Severn WLD (1st generation) and 1 for the Severn WLD (2nd generation).

Uplinks

Startup message: port 100

Bytes	Bits	Value
0..7	0..7	Unit serial number as an unsigned 64-bit integer, big-endian
8	0..7	Firmware major revision as an unsigned 8-bit integer
9	0..7	Firmware minor revision as an unsigned 8-bit integer
10	0..7	Firmware patch revision as an unsigned 8-bit integer

Profile 0

Regular message: port 1
Emergency message: port 99
Self-test message: port 102

Bytes	Bits	Value
0	0..3	Sensor wetness status for electrodes 8..11 0 = dry, 1 = wet
	6	Self-test failed flag: 0 = pass, 1 = fail
	7	Critically wet flag: 0 = general operation, 1 = sensor wetness exceeds critically wet threshold
1	0..7	Sensor wetness status for electrodes 0..7: 0 = dry, 1 = wet
2	0..7	Accelerometer reading in x dimension (across narrow width of the device) as a signed 8-bit integer, 1 LSB = 1/63 g
3	0..7	Accelerometer reading in y dimension (along length of the device) as a signed 8-bit integer, 1 LSB = 1/63 g
4	0..7	Accelerometer reading in z dimension (along the height of the device) as a signed 8-bit integer, 1 LSB = 1/63 g

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5	0..7	Temperature inside the device in degrees Celsius as a signed 8-bit integer
6	0..7	Critical wetness threshold as an unsigned 8-bit integer - the number of electrode segments that have to be wet to trigger an emergency message - this can be set via a downlink message - see Downlinks section below
7..8	0..7	Regular message interval in seconds as an unsigned 16-bit integer, big-endian - this can be set via a downlink message - see Downlinks section below

Profile 1

Regular message: port 2
Emergency message: port 98
Self-test message: port 104

Bytes	Bits	Value
0	0..7	“Profile” identifier - allows different behaviours and message types to be configured on a unit, intended to be set via console or downlink message.
1	0..3	Sensor wetness status for segments 8..11: 0 = dry, 1 = wet
	4	Error in join flag: 0 = no error in join process, 1 = error in join process
	5	Sensor connected flag: 0 = absent, 1 = connected
	6	Self-test failed flag: 0 = pass, 1 = fail
	7	Critically wet flag: 0 = general operation, 1 = sensor wetness exceeds critically wet threshold
2	0..7	Sensor wetness status for segments 0..7: 0 = dry, 1 = wet
3	0..1	Accelerometer reading in x dimension (across narrow width of the device) as a signed 2-bit integer 0 = 0g, 1= 1g, 2 = -1g
	2..3	Accelerometer reading in y dimension (along length of the device) - 0 = 0g, 1= 1g, 2 = -1g
	4..5	Accelerometer reading in z dimension (along the height of the device) 0 = 0g, 1= 1g, 2 = -1g
	6..7	RFU:0

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4	0..7	Battery voltage: 1LSB = 10mV, offset by 1250mV resulting in 0..255 mapping to 1250mV to 3800mV
5	0..7	Temperature inside device in degrees Celsius as a signed 8-bit integer
6	0..3	MSBs of 12-bit unsigned, big-endian Regular message interval in minutes
	4..7	Critical wetness threshold as an unsigned 4-bit integer - the number of sensor segments that have to be wet to trigger an emergency message
7	0..7	LSB of 12-bit unsigned, big-endian Regular message interval in minutes
8	0..3	MSBs of 12-bit unsigned counter indicating the number of JoinRequest messages sent by device at startup before receiving a JoinAccept message
	4..7	RFU:0
9	0..7	LSBs of 12-bit unsigned counter indicating the number of JoinRequest messages sent by device at startup before receiving a JoinAccept message
10	0..7	RFU:0

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Downlinks

Profile 0

Basic config: port 103

This message sets parameters on the device.

Bytes	Bits	Value
0	0..7	Critical wetness threshold as an unsigned 8-bit integer - the number of electrode segments that have to be wet to trigger an emergency message - valid 1..255 (values above 12 disable emergency messaging)
1..2	0..7	Regular message interval in seconds as an unsigned 16-bit integer, big-endian - valid 60..65535

Profile 1

Basic config: port 105

This message sets parameters on the device.

Bytes	Bits	Value
0	0..3	MSBs of 12-bit big-endian Regular message interval in minutes - valid 1..1440 (24hrs)
	4..7	Critical wetness threshold as an unsigned 4-bit integer - the number of sensor segments that have to be wet to trigger an emergency message - valid 1..12 (values above 12 disable emergency messaging altogether)
1	0..7	LSBs of 12-bit big-endian Regular message interval in minutes - valid 1..1440 (24hrs)
2	0..7	Requested profile to set unit to as an unsigned 8-bit integer less than 2

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Example downlink messages

The Severn WLD's payload has two profiles: 0 for the Severn WLD (1st generation) and 1 for the Severn WLD (2nd generation).

Profile 0 messages

Remember to set the port to 103.

- Set the threshold to 1, and set the interval to 240 minutes: `013840`
- Set the threshold to 12, and set the interval to 240 minutes: `0C3840`
- Set the threshold to 4, and set the interval to 10 minutes: `040258`

Profile 1 messages

Remember to set the port to 105.

- Set the threshold to 1, and set the interval to 240 minutes: `10F001`
- Set the threshold to 12, and set the interval to 240 minutes: `C0F001`
- Set the threshold to 4, and set the interval to 10 minutes: `400A01`

TTN payload decoder

You can find our Severn WLD payload decoder for The Things Network at: laiier.io/severn-wld-ttn-payload-decoder

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Support

For a list of FAQs, please visit laiier.io/support/faqs/severn-wld

If you require any further support, please contact support@laiier.io

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