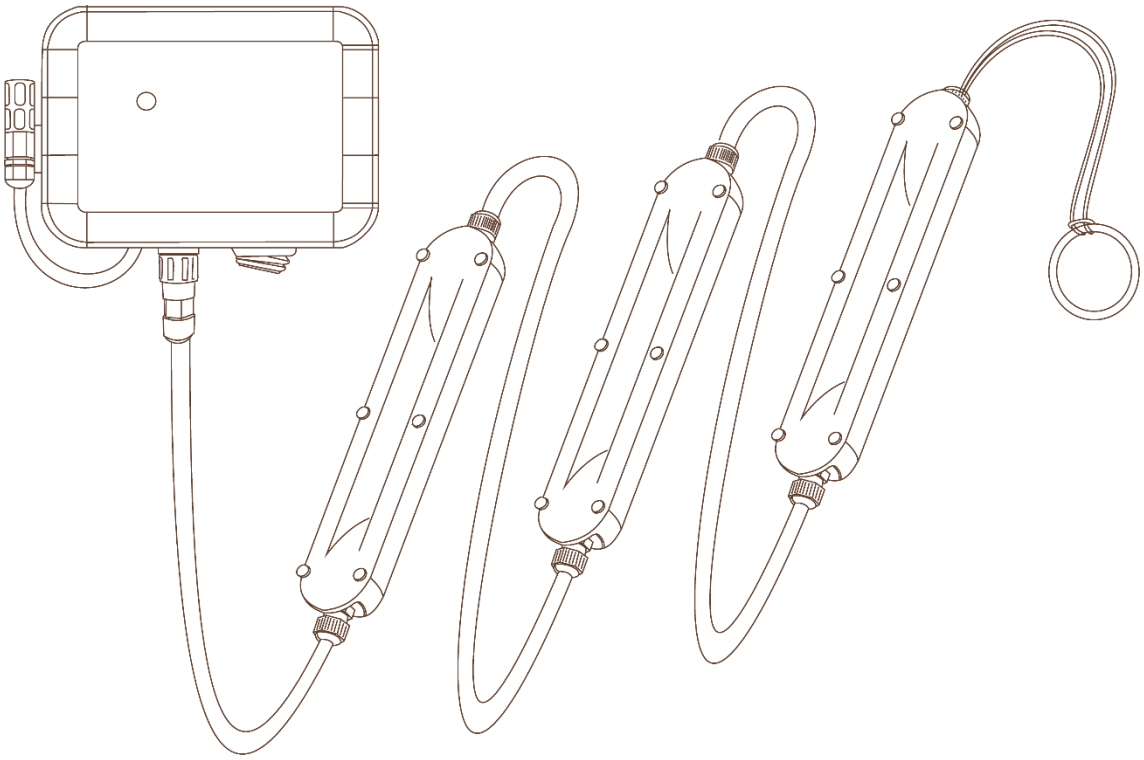
SMART WAREHOUSE DEVICE, TECHNICAL GUIDE



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1. Introduction

This guide explains the features related to the product Smart Warehouse Device and contains all the information necessary to perform the installation, use and maintenance of the Smart Warehouse Device.

It is recommended to read this manual carefully to understand the principle of operation of the equipment and reduce possible damage or malfunction of the system.

The information included in this document may be subject to change without notice and does not represent any commitment on the part of SGS. The information contained in this document is not exhaustive and is not intended to cover all specified situations.

Diagrams included in this manual are only for illustrative purposes, to help in a better understanding of the utilization processes.

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2. General and safety information

Please, read carefully this section before installing and using Smart Warehouse Device:

- In document, the term Smart Warehouse Device encompasses both the MTU and the RTU unit with their sensors.
- Please read carefully this document.
- NEVER submerge the device in any liquid.
- Keep the device in a dry place and away from any liquids that might spill.
- Smart Warehouse Device contains electronic components that are highly sensitive and can be accessed from outside; handle the device with great care and avoid hitting or scratching any of the surfaces.
- Do not let the electronic parts come into contact with any steel elements, to avoid injuries and burns.
- Do not remove any of the connectors.
  Check the product specifications section for the maximum allowed power voltage and amperage range and always use batteries that work within that range.
- SGS will not be responsible for any malfunctions caused by using the device with any batteries, power supplies or chargers other than those supplied by SGS.
- Keep the device within the range of temperatures stated in the specifications section.
- Do not connect or power the device with damaged cables or batteries.
- Place the device in a location that can only be accessed by maintenance operatives (restricted area).
- In any case, keep children away from the device at all times.
- If there is an electrical failure, disconnect the main switch immediately and disconnect the batteries.
- Check that the frequencies and power levels of the radio communication modules and the integrated antennas are appropriate for the location in which you intend to use the device.

- If Device needs to be returned, please send it completely dry and free from contaminants.

DO NOT TRY TO RECHARGE THE NON-RECHARGEABLE BATTERIES, IT MAY EXPLODE AND CAUSE INJURIES AND DESTROY THE EQUIPMENT. USE NON-RECHARGEABLE BATTERIES ONLY WITH DEVICES PROPERLY PREPARED. PLEASE DOUBLE CHECK THIS CONDITION BEFORE CONNECTING THE DEVICE

ALL OPERATORS SHOULD BE FAMILIAR WITH THE SAFETY PRECAUTIONS AND WARNINGS GIVEN IN THIS SECTION PRIOR TO ATTEMPTING TO OPERATE THE UNIT.

IF THE UNIT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

THE EQUIPMENT IS INTENDED USE IN WET LOCATION

3. Contact Information

In case of technical or commercial assistance, contact the following contact:

Table 1. Contact Information

COMPANY	SGS Española de Control S.A.
UNIT	IoT Competence Center
ADDRESS	C/Trespaderne 29 Edif. Barajas I. Barrio Aeropuerto Madrid, 28042
PHONE	+34 913 138 000
WEB	www.sgs.es

4. Device Description

The Smart warehouse device is capable of monitoring critical parameters in grain warehouses, such as: air temperature/humidity, air quality and stored grain temperature/moisture.

All data obtained is sent to a web platform via wireless communication, which can be Sigfox ™ or LoRa ™ depending on the application desired by the end user.

The whole device is shown in following figure:

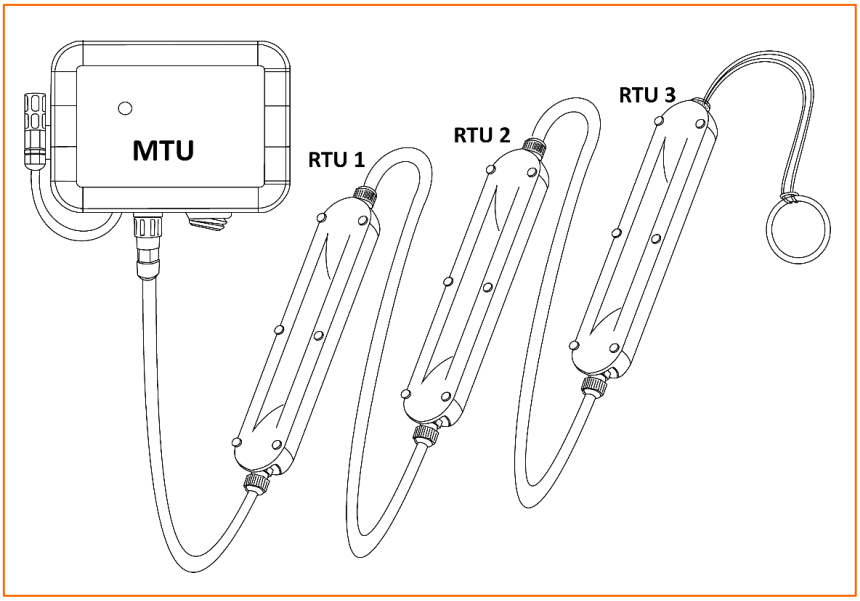


Figure 1.Smart Warehouse Device

4.1 General Specs

Table 2. Smart Warehouse Device Specs

SPECS	
RADIO	LORAWAN CM / SIGFOX ™ CERTIFIED *
FREQUENCY	EU868 / KZ864 / RU864
MAX OUTPUT POWER	+ 14 DBM ERP
COVERAGE	INDOOR (UPTO 3KM) / OUTDOOR (UP TO 7 KM)
BATTERY	REPLACEABLE AA BATERIES / 1.5 VDC
BATTERY LIFE	UP TO 2 YEARS
OPERATING TEMPERATURE	-15 TO 50 ºC
ENVIRONMENT RESISTANCE	IP65
MTU CASE DIMENSIONS	100 mm x 100 mm x 40 mm.
OPERATING RELATIVE HUMIDITY	0% to 80 %
MAX. INSTALLATION ALTITUDE ABOVE SEA LEVEL	Up to 2000 m

POLLUTION DEGREE	4

* Note that not all the devices have two radios. SigFox may not be included.

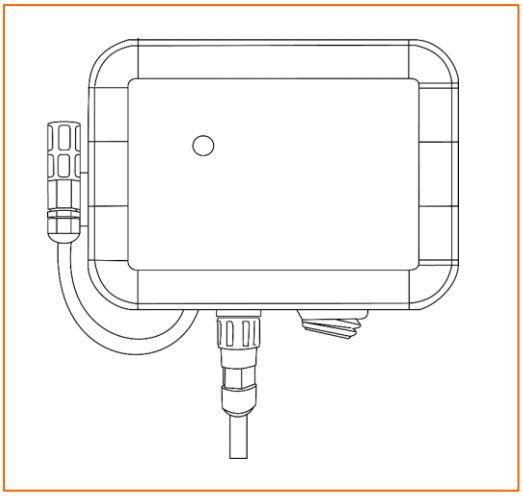


Figure 2.Illustration of MTU

4.2 MTU (Master Transmitter Unit) Specs

It is the main part of the device which is responsible for taking the measurements of the air (humidity, temperature and air quality -CO2-), as well as getting all the information from the RTU sensors and sending it wirelessly (LORA ™ / SIGFOX) * to the Cloud platform.

* Note that not all the devices have two radios. SigFox may not be included.

Next picture shows MTU and all of its elements:

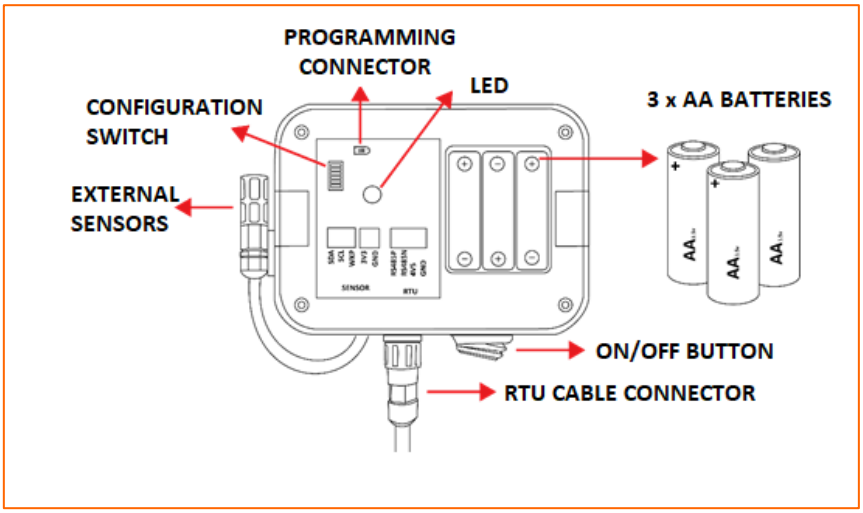


Figure 3. MTU and its components

- **Power Supply:** 3x AA batteries of 1.5Vdc.

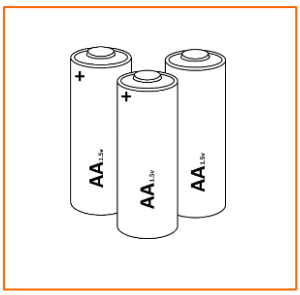


Figure 4. Batteries

- **LED:**
  - State Indicator: indicates the state of the battery and frame transmission.

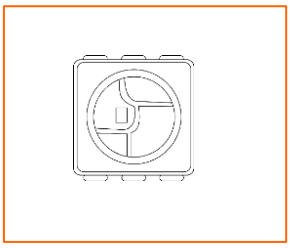
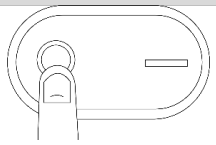
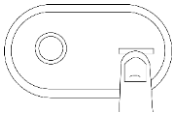


Figure 5.Led

- **ON/OFF Button:** To switch ON/OFF device.

Table 3.ON/OFF Button

POSITION	
OFF	
ON	

- **Programming Connector:** Used for uploading new firmware to the MTU [See Firmware Update Section].

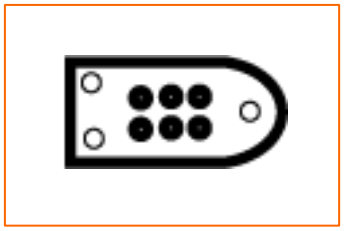


Figure 6.Programming Connector

- **MTU External Sensors:** Read Air Temperature, Humidity and CO_2.

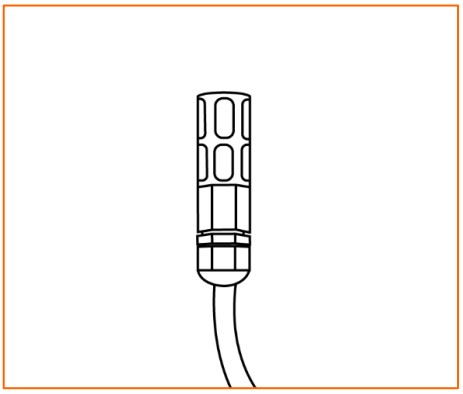


Figure 7.Air Sensor

- **Switch:** Internal switch with 6 positions for setting different configurations:
  - **Switch 1:** For selecting type of communications (LoRa / Sigfox) *.

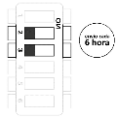
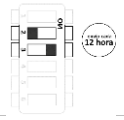
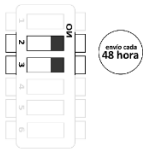
    * Note that not all the devices have two radios. SigFox may not be included.

Table 4. Communications Configuration

SW1	COMMUNICATIONS CONFIGURATION	
OFF	LoRa™	
ON	Sigfox™	

- **Switch 2 and Switch 3:** For configuring transmission interval.

Table 5.Interval Configuration

SW2	SW3	INTERVAL	
OFF	OFF	6 HOURS	
OFF	ON	12 HOURS	
ON	OFF	24 HOURS	
ON	ON	48 HOURS	

- **Switch 4:** configure the number of samples to be read after every frame transmission.

Table 6. Number of Samples Configuration

SW4	NUMBER OF SAMPLES
OFF	1
ON	3

- **Switch 5**: enable / disable CO_2 sensor.

Table 7.CO_2 Configuration

SW5	CO_2
OFF	disable
ON	enable

4.3 RTU (Receiver Transmitter Unit) Specs

There is three RTUs with a cable. This units get samples of stored grain temperature and moisture in three different heights.

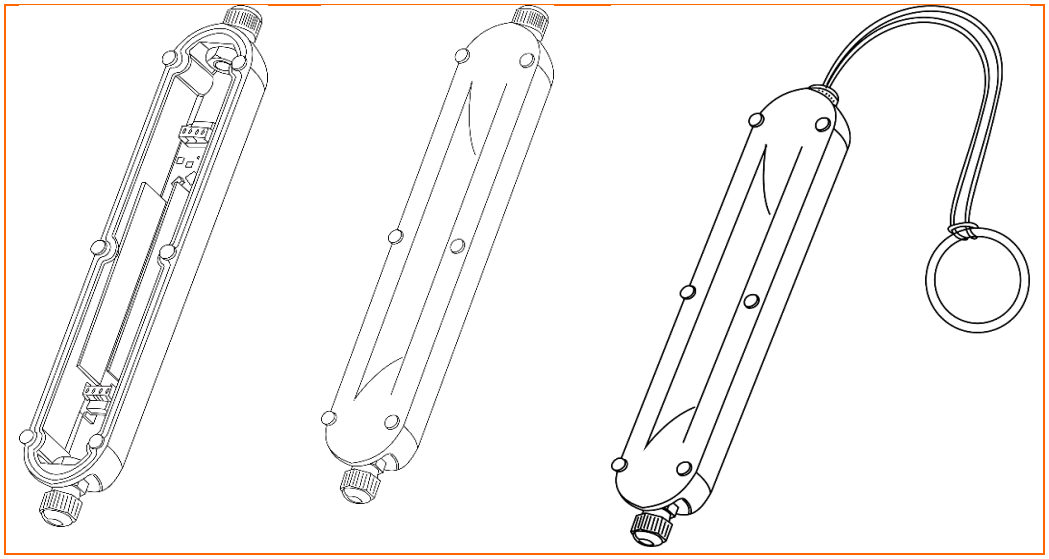


Figure 8.RTU Inside and Outside View

Note that the last RTU have a ring tied to a rope in order to install the device in the warehouse.

Every RTU has a sensor for getting grain temperature and moisture. The RTU sends data through RS485 interface.

6. Connections

For connecting RTUs to MTU a waterproof connector is used. Look at following diagram for more information:

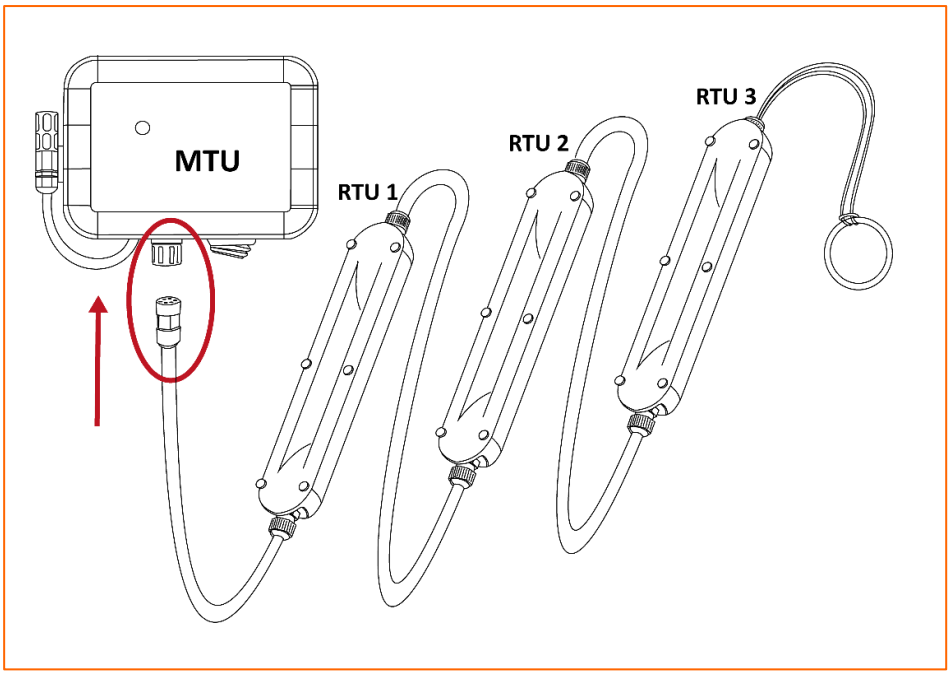


Figure 9.Connector for plugging in RTUs.

7. Operating Principles

Once the device has been installed in the area where the measurements are to be made, press the power button to switch on the device. After 2 seconds, the LED will flash for 10 seconds with a certain color depending on the battery level.

>70% **40% ~ 70%** **<40%**

Once the device starts, an initial sequence of frames is sent to the Cloud platform. These frames contain the first measurements of all the sensors and once the transmission is finished, the LED will flash in white color for 3 seconds.

The number of samples and the frequency of the measurements will depend on the configuration of the previous switches (2, 3 and 4) in the MTU.

8. The IoT Gateway

The gateway for getting data from Smart Warehouse Device is the LPN Indoor GW (model MTCAP), which is shown in following figure:

Figure 10.IoT Gateway

In following figure, the architecture required for getting data is shown:

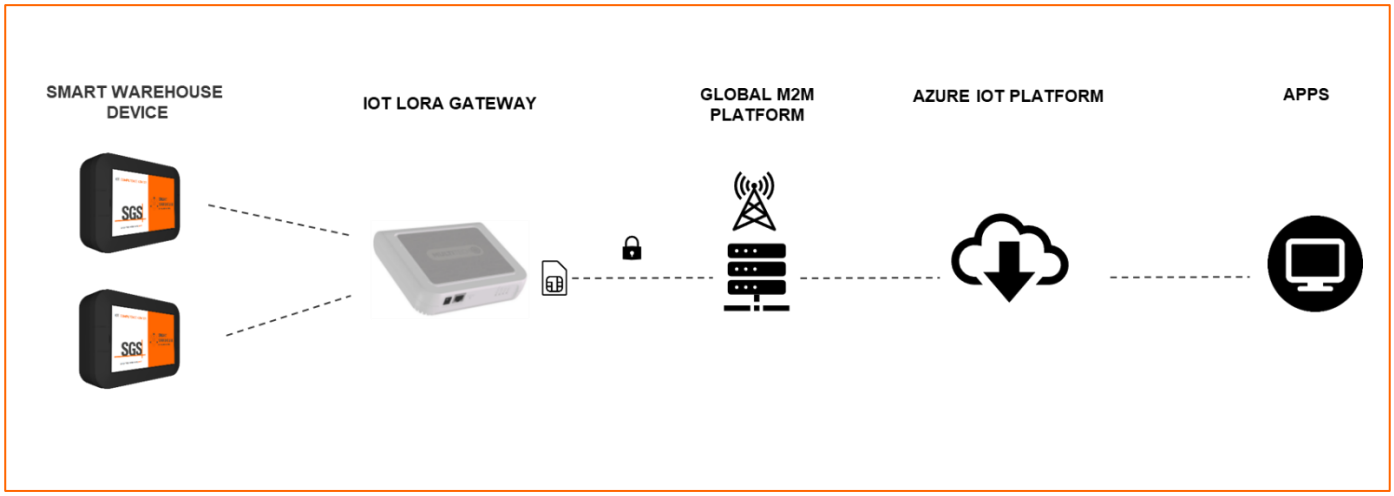


Figure 11.Architecture

The process is as follows:

- Smart Warehouse Device gets data from sensors every configured time.
- It sends data to IoT Lora Gateway.
- The IoT Lora Gateway sends data to ntw server through a secured connection.
- The NTW Server sends data to Azure Platform where data is analyzed.
- Processed data are shown to the final user in different applications.

9. Installation

The device is ready to be installed in grain warehouses. The process is as follows:

- A pipe with sensors is introduced into the grain:

Figure 12.Pipe into the grain

- The Smart Warehouse Device is located on the top of the pipe as is shown in following image:

Figure 13. Installed device

- The device covers an area of 8m of diameter and 350 Tons of grain:

10. Maintenance

The device needs to be checked periodically by qualified inspectors. These are the check points:

- LED: verify that the battery level is ok.
- Measurements Integrity: Be sure that values sent to the platform are between expected values.
- Connections: Be sure that connections between RTUs are in good conditions.
- Clean Sensors: Wipe any dirt present on the MTU sensors with a dry cloth. Make sure the device is not covered with any material.
- Batteries: Check the battery level.

Some recommendations in order to enjoy a longer useful life of the device:

- Handle device with care, do not allow it to drop or move roughly.
- Avoid placing the devices in areas reaching high temperatures that could damage the electronic components.
- Plug sensor probes only in their corresponding connectors.
- Do not use any type of paint on the device, it could affect the operation of connections and closing mechanisms.
- Do not store Device in places exposed to dirt and dust in order to avoid damage to electronic components.
- For cleaning, use a damp cloth, no aggressive chemical products.

11. Firmware Update

For updating the firmware is necessary to open the box/case. Due to this, it is necessary to carry out this process out of the grain, with no dust and humidity. Preferably in an indoor room.

It can be done with any programming device compatible with STM32 microcontroller. ST-LINK v2 programmer with TC2030-IDC-NL connector is recommended.

Program can be downloaded in following url:
https://www.st.com/en/development-tools/stsw-link004.html

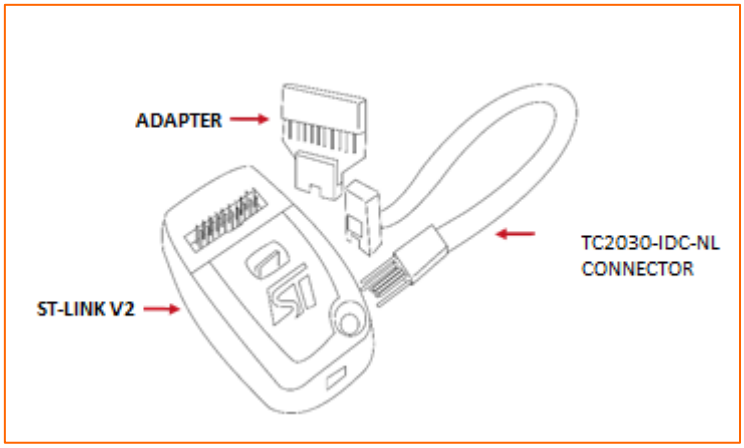


Figure 14.ST-LINK v2, adapter and TC2030-IDC-NL connector

The programmer is connected to the device through programming connector:

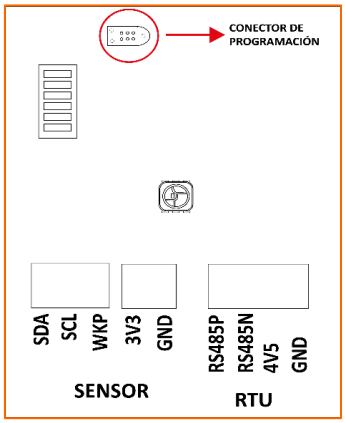


Figure 15.Programming connector in MTU

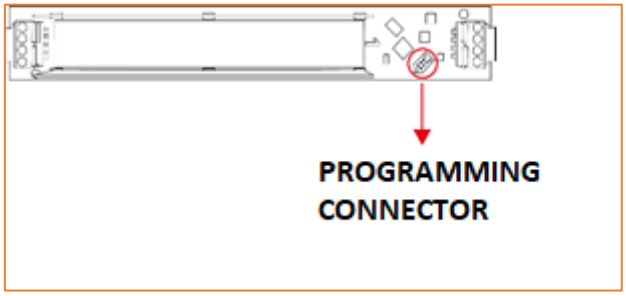


Figure 16.RTU programming connector

Once the software is installed and the programmer connected to the device:

1. Open STM32 ST-LINK Utility and connect the device:

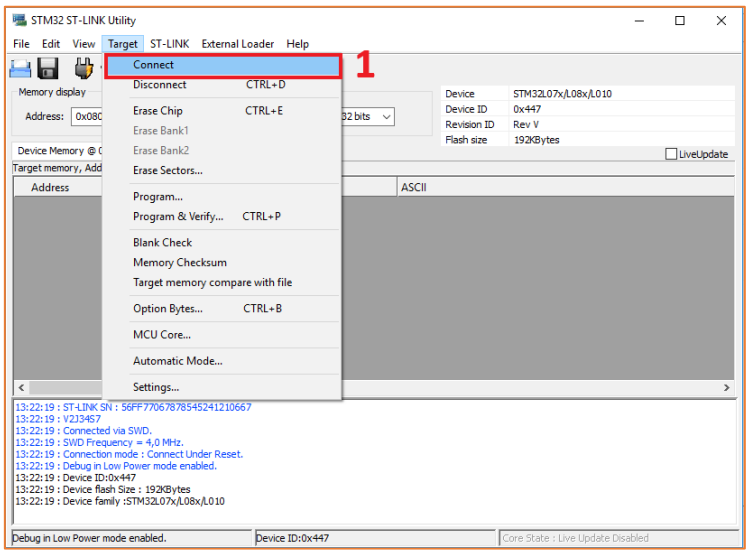


Figure 17. STM32 ST-LINK software tool

2. Once the device has been detected, click on the Program option:

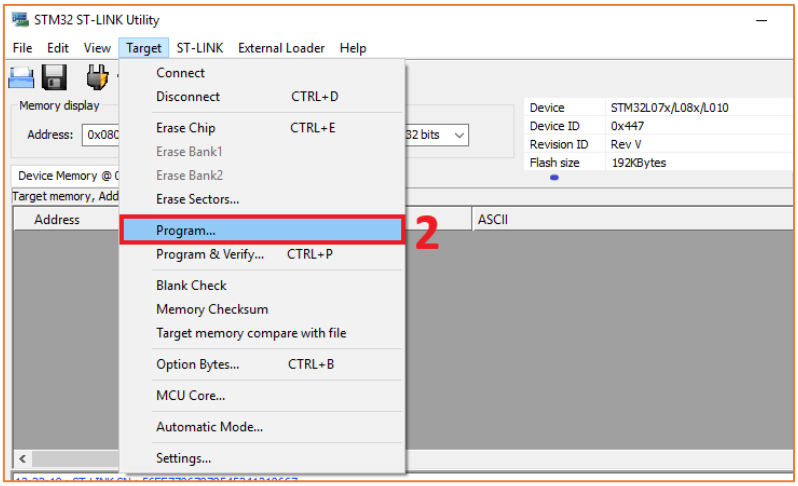


Figure 18.Programming

3. After that, the .bin/.hex file must be selected. Press start in the next window:

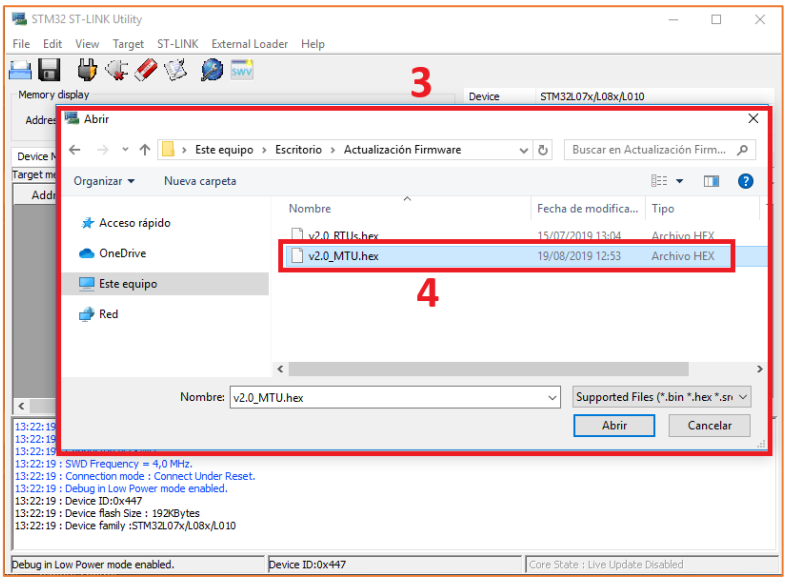


Figure 19.Select File

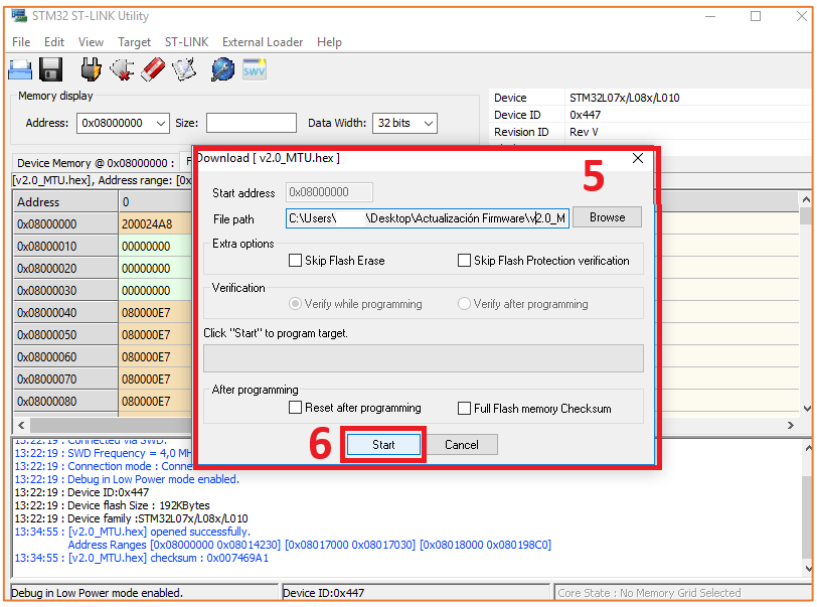
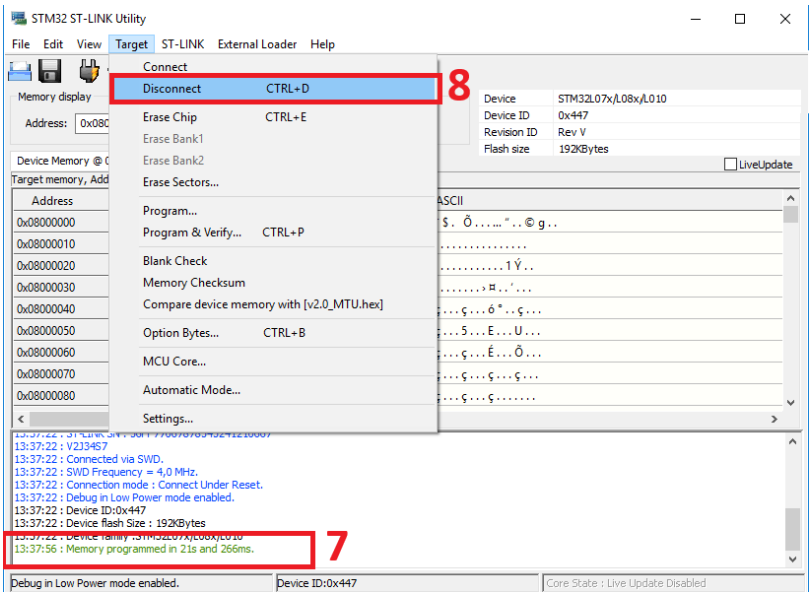


Figure 20.Press Start

4. Finally, it the update is successful, the message “Memory programmed” appears and you can disconnect the device.



IMPORTANT: DO NOT CLICK ON “CHIP ERASE”. THIS ACTION WILL ERASE CALIBRATION PARAMETERS STORED IN THE MEMORY. IF THIS HAPPENS, DEVICE WILL BE NEED TO BE SENT TO MANUFACTURER.

12. Problem Solutions

If you notice that the device is continuously restarting once the first samples have been sent, this is because there is no communication with the LoRa Gateway.

This problem can be solved by placing the Gateway closer to the devices.

13. Identification

Each device has a label on the front of the MTU and another on the back. In the back label will be the following fields:

- Model of the MTU
- Serial Number of the MTU
- LORA Id
- SIGFOX Address*.

  * Note that not all the devices have two radios. SigFox may not be included.
- Power Supply

Besides, the RTU cable is identified with another label with its serial number.

Figure 21.Front Label

Figure 22.Back Label

14. Certifications

14.1 LoRaWan EU

The product is in conformity with the essential requirements and other relevant requirements of the R&TTE Directive (1999/5/EC) and the 2002/95/CE Directive. The product is in conformity with the following standards and/or other normative documents:

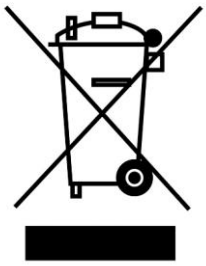
- Electro-Magnetic Compatibility:
  - UNE-EN 61326-1.
- Spectrum:
  - EN 300 220-1.
  - EN 300 220-2.
- Electrical Security:
  - UNE-EN 61010-1.

IMPORTANT: IT IS THE RESPONSIBILITY OF THE INSTALLER TO FIND OUT ABOUT RESTRICTIONS OF USE FOR FREQUENCY BANDS IN EACH COUNTRY AND ACT IN ACCORDANCE WITH THE GIVEN REGULATIONS. SGS DOES NOT LIST THE ENTIRE SET OF STANDARDS THAT MUST BE MET FOR EACH COUNTRY.

15. Waste and Recycling

This unit will never be thrown to the trash!

Ask local authorities for information about how to remove device not to contaminate the environment. Not respecting current regulations is subject to sanctions and measures established by law.



This product has the symbol for selective classification for Waste Electrical and Electronic Equipment (WEEE).

The crossed-out container symbol means that when the equipment has reached the end of its useful life, it must be handled in accordance with European Directive 2012/19 / EU so that it can be recycled or dismantled and minimize its impact on the environment.

The unit must be taken to the planned collection centers or to any competent recycling organization, and its treatment must be separated from that of urban and / or biological waste.

16. Version Control

Date	Version	Description
14/09/219	2.0	First Technical Guide
25/09/2019	2.1	Added technical information
26/09/2019	2.2	Added technical information
12/10/2019	2.3	Added programming manual
14/11/2019	2.4	Added Security Information
18/12/2019	2.5	Updated for Wet Locations
02/06/2020	2.6	New regions added

FCC Warning:
Please take attention that changes or modification 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.