WIRGRID RF MODULE 169MHZ (ATEX)

INSTALLATION AND MAINTENANCE MANUAL

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HISTORY

Date	Modification	Author	Version
29/05/2015	Creation	MGI	1.0
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20/08/2015	Detailed LESENSE conf.	MGI	3.0
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09/01/2017	Modification of the reference [8]	LLO	3.3
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INDEX

OPEN MINUTES

Reference	Status	Description

REFERENCES

Reference	Document / link	Description
[1]	KLK_SPEC_ENDPOINT_lOCAL_TOOL _USER_GUIDE	Describes the user interface of the endpoint local installation and maintenance tool
[2]	KLK_DRD_Wirgrid-NFC_User_Guide	User Guide of the Kerlink Wirgrid NFC application
[3]	KERLINK_INSTALL_Wirgrid_Station	Installation manual of the Wirgrid Station
[4]	KLK_SPEC_AMR_CHAIN_SECURITY	Describes how security is addressed over the whole system (key management, protocols, …)
[5]	KLK_SPEC_AMR_HEADEND_DATA_I NTERFACE	Describes the webservice interface used by customer information system (IS) to retrieve endpoint collected data from headend database
[6]	KLK_SPEC_AMR_HEADEND_USER_I NTERFACE	Describes the graphical web interface of the headend
[7]	KLK_SPEC_openAMR_MBUS	Describes the application layer implementation of Kerlink Automated Meter Reading (AMR) application, in conformance with EN13757-3 and EN13757-4 European standards.
[8]	http://wikikerlink.fr/chaine-amr/	Kerlink Wiki of the AMR chain.
[9]	EN 60079-14	Explosive atmospheres. Electrical installations design, selection and erection
[10]	EN 60079-17	Explosive atmospheres. Inspection & Maintenance Of Installations In Hazardous Areas
[11]	EN 60079-19	Explosive atmospheres. Equipment repair, overhaul and reclamation

[12]	EN 60079-0:2012/A11:2013	Explosive atmospheres – Part 0: Equipment – General requirements
[13]	EN 60079-11 : 2012	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"
[14]	Directive 1999/92/EC	Directive 1999/92/EC of the European Parliament and the Council
[15]	Directive 94/9/EC	Directive 94/9/EC of the European Parliament and the Council

GLOSSARY

Abbreviation	Description
ABS	Acrylonitrile Butadiene Styrene
AES	Advanced Encryption Standard
AMR	Automatic Meter Reading
ATEX	ATmosphères EXplosives
EEPROM	Electrically Erasable Programmable Read-Only Memory
EGPRS	Enhanced GPRS
EIRP	Equivalent Isotropically Radiated Power
EMF	Exposure to Magnetic Fields
Endpoint	Hardware device connected to meter to collect consumption level and emitting regularly the data through RF local link
Endpoint Local Tool	Smartphone or PDA embedded application to perform endpoint installation and maintenance procedures
GPRS	General Packet Radio Service
GPS	Global Positioning System
HeadEnd	M2M Proxy which collects messages from all station and store them in database. It also provides Device Management capabilities for stations and endpoints
HLC	Hybrid Layer Capacitor
ID	Identity
IP	Internet Protocol
ISM band	Industrial, Scientific and Medical band (unlicensed band)
LAN	Local Area Network
LESENSE	Low Energy Sensor
LTE	Long Term Evolution (4G mobile network)
LoRa™	Long Range from Semtech

Meter	The meter to be collected connected to Kerlink Wirgrid RF Module 169MHz
Modem	RF hardware device connected or embedded to station receiving/emitting messages from/to endpoints
NFC	Near Field Communication
OTA	Over The Air
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
R/W	Read/Write
RX	Receive
SELV	Separated Extra Low Voltage
Station	Device which collects all endpoints messages under coverage and emitting them to HeadEnd
TX	Transmit
UMTS	Universal Mobile Telecommunications System (3G mobile network)
WAN	Wide Area Network
WMBUS	Wireless MBUS
3G	3rd generation of mobile network (UMTS)
4G	4th generation of mobile network (LTE)

INTRODUCTION

The Wirgrid RF module 169MHz is a compact energy autonomous device used to collect pulse information from a meter (water or gas) and send index values to a remote concentrator (Wirgrid Station) using 169MHz radio ISM band. With derogation to WMBUS standard, the device can take advantage of LoRa™ technology to enlarge communication range.

The Wirgrid RF module 169MHz position in a complete AMR chain is presented in the following figure:

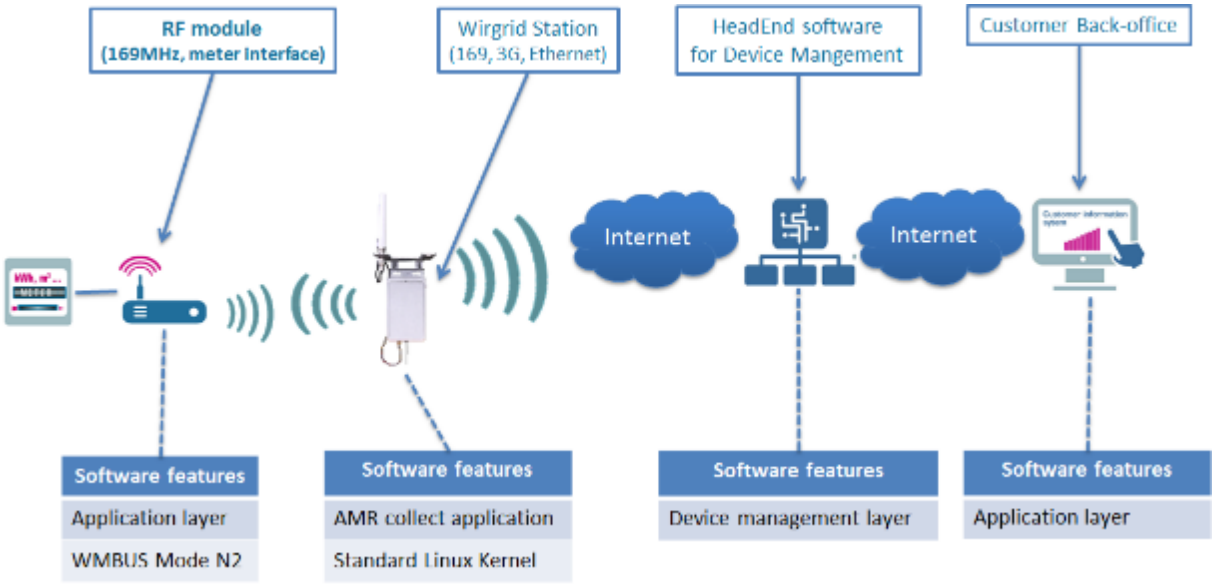


Figure 1: Wirgrid RF Module 169MHz in the AMR chain

This document provides guidelines to install the Wirgrid RF Module 169MHz and insert it in the AMR chain. It especially focuses on:

- Mechanical description of the Wirgrid RF Module 169MHz
- Interfaces with other AMR devices
- Mounting procedures
- Wiring to the meter
- Commissioning
- Maintenance onsite and over the air
- Troubleshooting in case of issue during the installation procedure

As stated above, the installation consists in inserting the Wirgrid RF Module 169MHz in the AMR chain. To achieve the installation, the installer needs to configure the Wirgrid RF Module 169MHz to be able to communicate with the other parts of the AMR chain.

For information, the different interfaces of the AMR chain are:

- Endpoint (Wirgrid RF Module 169MHz) local interfaces:
  - 4 wires cable to meter to collect index (pulse information)
  - Short range wireless link to be able to perform installation or maintenance operation (NFC)
- LAN interface: this interface links the Wirgrid RF Module 169MHz with the Wirgrid Station. It is based on WMBUS 169MHz. This protocol complies with E17Z standard.
- WAN interface: this interface links the Wirgrid Station with the Headend. It is based on Ethernet when available or wireless 3G networks. The communication protocol used Kerlink secured Wanesy protocol.
- Headend web user interface: This graphical web user interface is used to perform Device Management operation (firmware upgrade, configuration) and also monitor the system behaviour (statistics, alerts).
- Headend Data retrieval interface: This interface is used by customer back-office to retrieve the endpoints messages.

Indeed, the Wirgrid Station, the Headend and its interfaces have to be operational to complete the installation of the Wirgrid RF Module 169MHz.

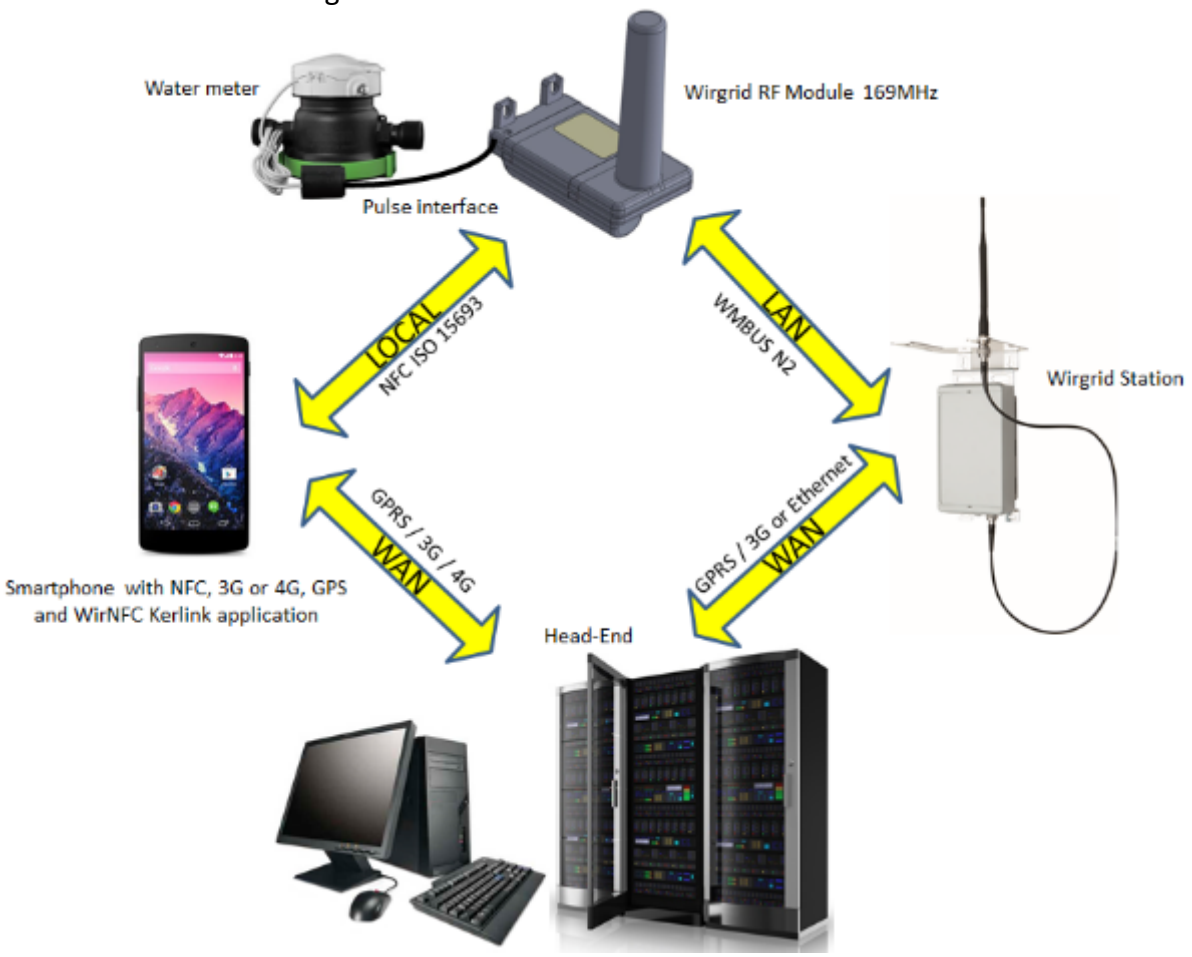


Figure 2: Wirgrid RF Module 169MHz interfaces in the AMR chain

Note:

Before starting the installation of the Wirgrid RF Module 169MHz, we strongly recommend to read the documents listed as references and especially:

- *Document [2].*
  It fully details the Wirgrid NFC application that is used for the installation. Some details are not repeated in the present document. Therefore, a good knowledge of the NFC application is a prerequisite before starting any installation.
- *Kerlink Wiki of the AMR chain [8].*
  It provides a good understanding of all the configurations parameters used by the Wirgrid RF Module 169MHz. Understanding the parameters, their role and impact is mandatory before being able to modify them.

1. Warnings

1.1 Only for ATEX version

The design of the installation, the selection of external equipment, the erection of the Wirgrid RF Module 169 ATEX, furthermore the inspection and maintenance shall be carried out only by experienced personnel, whose training has included instruction on the various types of protection and installation practices, the relevant rules and regulations and on the general principles of area classification according to the Directive 1999/92/EC of the European Parliament and the Council (see [14]).
Maintenance operations completed out of the hazardous area shall be also carried out by experienced personnel according to the Annex II of the Directive 94/9/EC of the European Parliament and the Council (see [15]). The Wirgrid RF Module 169 ATEX can't be repaired.
The personnel responsible of the installation, maintenance and inspection must insure the compatibility between the Wirgrid RF Module 169 ATEX and the hazardous zone it is intended to be installed, inspected or maintained.
If, at any time, there is a change in the area classification or if the apparatus is moved from one location to another, a check shall be made to ensure that the type of protection, apparatus group and temperature class, where appropriate, are suitable for the revised conditions.
This certification relies to European standards which define the level and the type of the necessary training and competence to the workers having to operate or being in relation to explosive atmospheres.

- EN 60079-14 - Selection and Installation (see [9])
- EN 60079-17 - Inspection and Maintenance (see [10])
- EN 60079-19 - Repair and Overhaul (see [11])

1.1.1 Equipment group

The Wirgrid RF Module 169 ATEX is a Group IIA apparatus, which is intended to be used in places other than mines.
It can be used in areas where an explosive atmosphere is likely to occur in normal operation and ensure a high level of protection.

1.1.2 Temperature classification

The Wirgrid RF Module 169 ATEX is a temperature class T3 apparatus that means that his temperature surface never exceeds 200°C.
Therefore, it can be used also as a T2 and T1 apparatus.

1.1.3 Hazardous zones

The Wirgrid RF Module 169 ATEX must not be used in areas in which an explosive atmosphere is present continuously, for long periods or frequently. Wirgrid RF Module 169 ATEX is intended to be used in places in which an explosive atmosphere (gas, vapours or dust) is likely

to occur in normal operation, occasionally or in places in which an explosive atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only. These areas are defined as zones 1 and 2.

1.1.4 Warnings

The marking "X" on the Wirgrid RF Module 169 ATEX label indicates that special conditions for safe use, must be met:

- Tamb: -20°C to +55°C. Do not use the device out of this temperature range
- Signals on meter interface:
  - Input: $U_i \leq 10V$; $I_i \leq 10\mu A$, $C_i \approx 0$; $L_i \approx 0$
  - Output: $U_O \leq 5.5V$; $I_O \leq 21\mu A$; $C_O \leq 1000\mu F$
- WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS

1.1.5 Preventing electrostatic charging hazard

The ABS plastic used in the Wirgrid RF Module 169 ATEX enclosure is a material with a surface resistance greater than 10^9 Ω, which does not prevent from electrostatic charge. Charged insulators give brush discharges that could ignite flammable vapours and gases.

The user must ensure that the equipment is not installed in a location where it may be subjected to external conditions that might cause a build-up of electrostatic charges on non-conducting surfaces.
Here are below some recommendations to avoid this:

WARNINGS:

- Prevent unintentional contact with a dry cloth
- Wipe the surface with a damp cloth only
- Do not handle in potentially explosive atmosphere unless people are grounded through conductive or dissipative footwear and flooring
- Do not mount the unit in the dust flow
- Avoid dust deposits

1.2 REACH

The Wirgrid RF Module 169MHz contains a polyurethane resin providing waterproof resistance. This resin was produced as a result of polymerisation between a prepolymer and a hardener. The prepolymer does not contain any hazardous substance according to the REACH directive. The hardener contains several hazardous substances that were listed according to the REACH directive. Safety data sheet of the hardener can be provided on demand. Note that the mixing ratio by weight (prepolymer/hardener) is 100/30. The resin quantity is less than 100g, so the hardener quantity is less than 23g.
However, as a result of polymerisation, the resin is considered as stabilised and inert.

For that reason, the Wirgrid RF Module 169MHz is exempted from registration and evaluation, as it causes no risks to human health neither to the environment.

1.3 Transport

The Wirgrid RF Module 169MHz embeds:

- A Lithium Thionyl Chloride (Li-SOCI2) cell which contains 0.96g of lithium metal.
- A Hybrid Layer Capacitor which contains 0.01g of lithium metal.

Therefore, the Wirgrid RF Module 169MHz contains less than 1 gram (0.97g) of Lithium metal. In accordance with the United Nations "Model Regulation on the Transport of Dangerous Goods" it is declared as non-restricted to transport that is non-assigned to Class 9.

1.4 Heat

Due to the presence of a battery and the polyurethane resin inside, do not disassemble, heat above 100°C or incinerate the Wirgrid RF Module 169MHz. If not, there is a risk of fire, emission of CO and CO2 gas, explosion and burn hazard.

1.5 EMF

The radiated output power (average EIRP on the duration of 6 minutes) of the Wirgrid RF Module 169MHz is lower than the max exposure levels defined in the standard EN 62311. Then, the transmitter of the Wirgrid RF Module 169MHz complies with the basic restrictions listed in the Recommendation 1999/519/CE.

1.6 Duty cycle

According to the ERC Recommendation 70-03 annex 2, the Wirgrid RF Module 169MHz, must have a limited access to the 169.400 MHz – 169.475 MHz spectrum. The allowed duty cycle is limited to 10%. This basically means that transmissions are limited to 36 seconds per hour. In the nominal configuration, the duration of the RF transmissions are significantly below this limit. However, a bad usage of the configuration parameters (either by local configuration or OTA configuration) could lead to overrule the limit. Kerlink declines any responsibility if the 10% duty cycle requirement is not met.

1.7 Receiver category

The Wirgrid RF Module 169MHz is considered as a category 2 receiver, according to EN 300 200-1 classification.
Therefore, it cannot be used in any system that could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property.

1.8 Safety during the installation

The Wirgrid RF Module 169MHz may be sometimes installed in harsh environment. Check the local legal regulatory and/or guidelines that apply to the specific environment for the installer security. Take care especially of lone worker situations.

2. Product description

2.1 Views

Several views of the Wirgrid RF Module 169MHz are presented below:

Figure 3: Views of the Wirgrid RF Module 169MHz

2.2 Mechanical characteristics

Here are main mechanical characteristics:

Item	Value
Casing material	ABS
Size (L x l x H)	103mm x 60mm x 130mm
Weight	~200g
Degree of protection	IK06
Casing color	Black
Resin	Polyurethan Semi rigid
Resin quantity	~100g
Recommended screws	M6
Centre distance between screws	36mm

2.3 Interfaces / cables

2.3.1 LAN

The Wirgrid RF Module 169MHz has an integrated antenna located in the tube (see location in Figure 3). This antenna allows the RF communication with the Wirgrid Station, according to the specification detailed in § 3.3.

2.3.2 NFC

The Wirgrid RF Module 169MHz embeds a NFC EEPROM allowing NFC configuration via the local configuration tool (smartphone). The NFC interface is compliant to the specifications described in §3.4.
The NFC antenna is internal and located beneath the sticker. A specific logo (see Figure 4) points the centre of the NFC antenna. The NFC antenna of the local configuration tool must be positioned just above the logo of the Wirgrid RF Module 169MHz to ensure the best NFC communication between both devices.
The NFC logo and its position on the sticker are detailed hereafter:

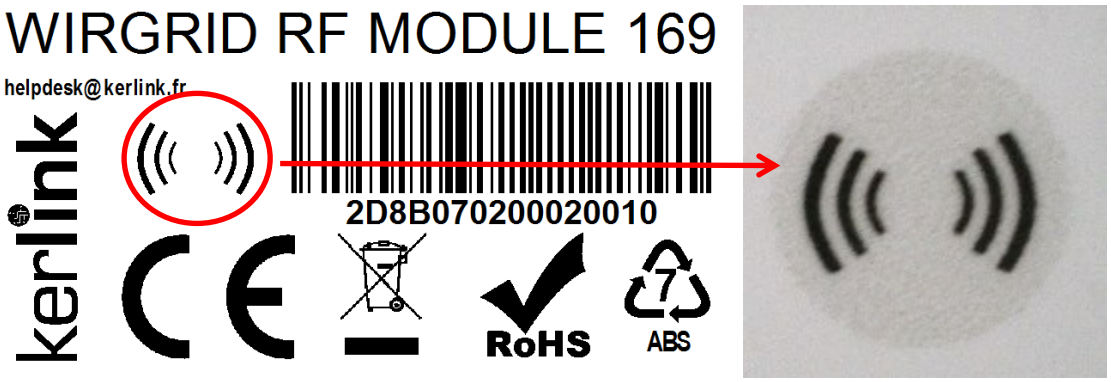


Figure 4: NFC antenna logo

2.3.3 Meter

The connection to the meter is done through a 4 wires cable: Ground, Pulse, Flow direction and Tamper.
Kerlink uses a Phoenix Contact cable for the meter interface. Beware of the core colours before wiring the Wirgrid RF module 169MHz to the meter.
The allocation of the wires is described in the following table:

Wire	Phoenix Contact SAC-4P-1,0-PUR/0,25 F-KL
Ground	Black
Tamper	Blue
Pulse	White
Flow direction	Brown

The technical specifications of the cable are detailed in §3.5.

3. Technical specifications

3.1 Environmental conditions

The Wirgrid RF Module 169MHz is intended to be used in the following conditions:

Item	Value
Operating temperature range	-20°C to + 55°C
Storage temperature range*	+15°C to + 25°C
IP rating	IP68
Flammability	UL94-V0
Environmental resistance	Oil Ultraviolet

*: storage temperature range impacts the auto-discharge of the internal battery. Out of the specified range, especially above +30°C, the auto-discharge will increase and compromise the duration life of the Wirgrid RF Module 169MHz.

3.2 Standards conformance

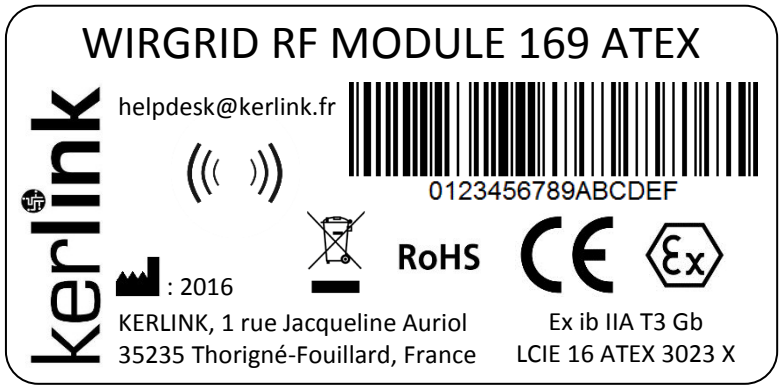
The Wirgrid RF Module 169MHz is compliant to the following standards:

EMC	EN 301 489-1
	EN 301 489-3
Radio	ERC/REC 70-03
	Directive R&TTE 1999/5/EC
	EN 300 220-1
	EN 300 220-2
EMF	Directive 1999/519/EC
	EN 62311
Safety	EN 60950-1
WMBUS	EN 13757-3
	EN 13757-4
	AFNOR E17Z
Misc	REACH (EC Regulation 1907/2006)
	RoHS (2011/65/EU)

3.2.1 Only for ATEX version

The Wirgrid RF Module 169 ATEX is CE ATEX certified by complying with the directive 94/9/EC and the standards EN 60079-0 (2012) + A11 (2013) and EN 60079-11 (2012).
ATEX EC Examination Type Certificate Number: LCIE 12 ATEX 3023 X

The corresponding marking and certifications numbers are indicated below:



3.3 Radio characteristics

The main characteristics of RF interface are:

Item	Value
RF link	Bidirectional Half-duplex
Protocol layer	AFNOR E17Z
Frequency range	169.400MHz to 169.475MHz
Channel spacing	12.5KHz
Number of channels	6
Supported modes	WMBUS N2 Meter (a, b, c, d, e, f)
	LORA 341bps (SF7, BW=7.8KHz, CR=4/5)
RF antenna type	Internal Monopole Omnidirectional
Antenna gain	-5dBi
Output power (conducted)	+24dBm nominal Adjustable from +2dBm to +25dBm
EIRP	~ 100mW nominal
Receiver noise figure	~ 5dB
Receiver dynamic range	-20dBm to -135dBm with AGC
Sensitivity @ 10% PER in N2 mode (a,b,e,f)	-118dBm
Sensitivity @ 10% PER in N2 mode (c,d)	-120dBm
Sensitivity @ 10% PER in LORA 341 mode	-135dBm
RSSI accuracy	+/-3dB from -60dBm down to sensitivity
Adjacent channel rejection	> 60dB for N2 modes > 100dB for LORA 341 mode
Blockers rejection @ 2MHz	> 70dB for N2 modes > 95dB for LORA 341 mode
Blockers rejection @ 10MHz	> 80dB for N2 modes > 100dB for LORA 341 mode

3.4 Local interface (NFC)

The main characteristics of NFC interfaces are:

Item	Value
Contactless standard	ISO 15693
Frequency	13.56 MHz
R/W distance	up to 30 mm
Wake-up on NFC detection	Yes
Energy harvesting	EEPROM only*
Password protection	Yes

*: NFC interface can provide access to last recorded information even if the Wirgrid RF Module 169MHz CPU is out of order (battery end of life for example).

Note:
NFC interface has been validated with several standard Android smartphones:

- *Samsung : Galaxy S3, Galaxy S4, Galaxy S5*
- *LG : NEXUS 5, G-2*

3.5 Meter interface

Meter interface has the following characteristics:

Item	Value
Number of wires	4
Description of the signals	Ground Pulse Flow direction Tamper
Conductor section	AWG24
Core wrap	PVC
Cable diameter	4.4mm
Outer sheath material	Polyurethan
Cable length	1m nominal Different length can be provided on demand (1m to 3m)
Meters types supported	Open drain transistor switch Reed switch Any open/close switch type
Counter type	Dual sampling

Maximum pulse frequency	8Hz nominal Configurable up to 250Hz
Minimum pulse width	35ms nominal Configurable down to 10ms
Maximum voltage to avoid damage	10V
Maximum current provided by the pull-up resistor	4uA
Min Open Impedance of the meter	1M ohms
Max Closed Impedance of the meter	10K ohms
Max capacitance of the meter	1nF

***Note**: For the Wirgrid RF module 169 ATEX, warnings detailed at the paragraph 1.1 must be considered.*

The meter interface is considered as a SELV circuit regarding the IEC 60950-1. Before connecting a meter, make sure the above specifications are met to avoid any hazard.

The smart metering hardware block includes two main configuration profiles to match various counter types. Indeed, additionally to classic pulse counter, an advanced pulse counter is used by default. It allows sampling input pulses and direction.
It provides 2 main advantages:

- Power consumption optimization (the pulse module is powered only on sample times)
- Advanced glitch filtering (more than few ms)

3.6 Power supply and autonomy

The Wirgrid RF Module 169MHz embeds an internal battery which is able to provide supply during the whole duration life of the device.
Here are the main characteristics of the supply:

Item	Value
Battery voltage	3.6V
Battery capacity	3.6Ah
Current drain @ 3.6V in transmit mode @ +24dBm	< 250mA
Current drain @ 3.6V in transmit mode @ +14dBm	< 65mA
Current drain @ 3.6V in receive mode	< 12mA
Current drain @ 3.6V in counter mode	< 10uA
Battery life in the following use case: - **Mode: WMBUS N2 (c, d)** - **Transmit mode @ +24dBm** - **4 transmissions per day (counting)** - **1 transmission per week (supervision or configuration)** - **1 maintenance per year on site via NFC**	> 15 years

Note:

The Wirgrid RF Module 169MHz embeds a 0.75A fuse to protect it against overcurrent or short circuit. The characteristics are provided below:

Fuse characteristics	*Value*
Reference designator	*F3*
Type	*Very fast acting*
Ampere rating	*0.75A*
Max voltage rating	*125V*
Manufacturer	*LITTELFUSE*
Part Name	*0453.750.MRL*
Kerlink code	*KLK01890*

See also §7.2.5 for more information.

4. Mounting

***Note**: For the Wirgrid RF module 169 ATEX, warnings detailed at the paragraph 1.1 must be considered.*

The Wirgrid RF Module 169MHz can be easily mounted in three different ways:

- Wall mounting with M6 screws (not provided)
- Vertical tube mounting with polyamide cable ties (not provided)
- Horizontal tube mounting with polyamide cable ties (not provided)

These different configurations are detailed here after.

4.1 Tools

The following tools are needed do perform the mounting and the installation of the Wirgrid RF Module 169MHz:

- Smartphone Android (LG Nexus 5 for example) including the following features:
  - 3G or 4G or WiFi network supported
  - NFC ISO 15693 (NFC-V)
  - GPS
  - Kerlink Wirgrid NFC application installed
- Cordless Combination Drill with masonry drill bits
- M6 Countersunk Head Pozidriv screws
- Expansion wall plugs for M6 screws
- Pozidriv Screw driver for M6 screws with 100mm blade length
- Weather resistant polyamide cable ties (width < 5mm and length > 250mm)
- Cable tie gun

***Note:** M6 screws and cables ties can be used alternatively, depending on the mounting configuration (see § 4.2, 4.3 and 4.4).*

4.2 Wall mounting

The following tools are needed do perform the mounting and the installation of the Wirgrid RF Module 169MHz on a wall:

- Cordless Combination Drill with masonry drill bits
- M6 Countersunk Head Pozidriv screws
- Expansion wall plugs for M6 screws
- Pozidriv Screw driver for M6 screws with 100mm blade length.

***Note:** centre distance between screws is 36mm.*

An example of wall mounting is presented hereafter:

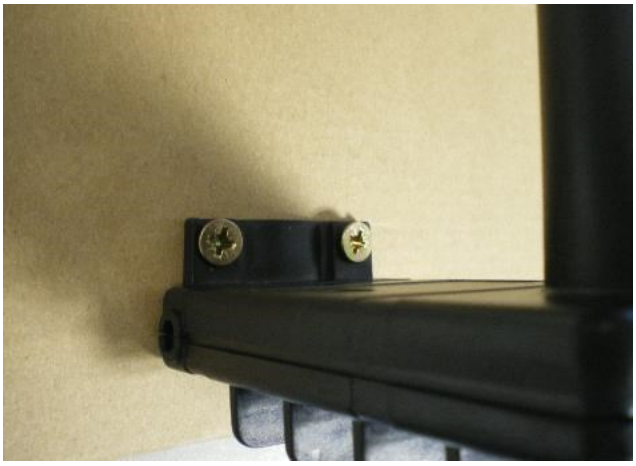


Figure 5: Example of wall mounting

4.3 Vertical tube mounting

The following tools are needed to perform the mounting and the installation of the Wirgrid RF Module 169MHz on a vertical tube:

- 1 weather resistant polyamide cable tie (width < 5mm and length > 250mm)
- Cable tie gun

Follow the following steps:

- Position the Wirgrid RF Module 169MHz on the vertical tube
- The cable tie must be inserted in the M6 holes
- Position the locking part and the tail of the cable tie out of the top area of the Wirgrid RF Module 169MHz. If not, it would be difficult to put the smartphone on the Wirgrid RF Module 169MHz for the NFC connection.
- Tighten the cable tie with the cable tie gun
- Cut the unnecessary tail of the cable tie

An example of vertical tube mounting is presented hereafter:

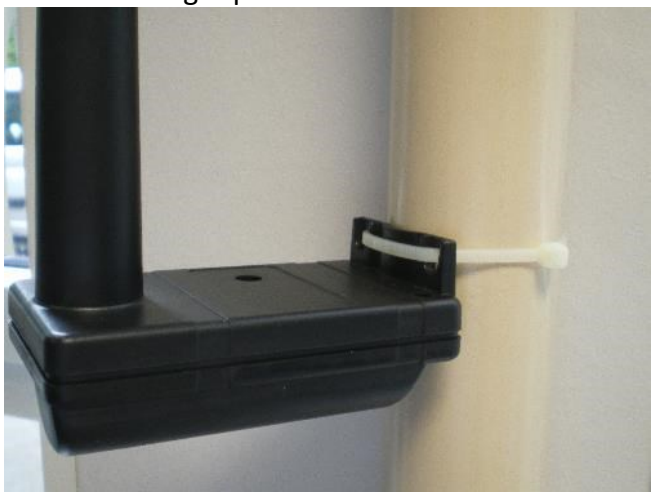


Figure 6: Example of vertical tube mounting

4.4 Horizontal tube mounting

The following tools are needed do perform the mounting and the installation of the Wirgrid RF Module 169MHz on a horizontal tube:

- 2 weather resistant polyamide cable ties (width < 5mm and length > 250mm)
- Cable tie gun

Follow the following steps:

- Position the Wirgrid RF Module 169MHz on the horizontal tube
- Position the cable ties in the 2 recesses of the Wirgrid RF Module 169MHz
- Position the locking part and the tail of the cable tie out of the top area of the Wirgrid RF Module 169MHz. If not, it would be difficult to put the smartphone on the Wirgrid RF Module 169MHz for the NFC connection.
- Tighten the cable ties with the cable tie gun
- Cut the unnecessary tail of the cable tie

An example of horizontal tube mounting is presented hereafter:

Figure 7: Example of horizontal tube mounting

4.5 Antenna considerations

The position of the Wirgrid RF Module 169MHz and its antenna is a key point in the performance of the AMR chain. A poor position could cause significant attenuation of the RF signals and make the system not functional. Therefore, the position and the orientation of the Wirgrid RF Module 169MHz must be chosen carefully to offer the best performance.
Some recommendations are provided hereafter:

- Orientation:
  - The antenna must be kept vertical, in the nominal position of the Wirgrid RF Module 169MHz.

- The antenna side of the Wirgrid RF Module 169MHz must be oriented to the Wirgrid Station (see Figure 8) to have the better gain. The other positions may be possible but the antenna performance may be a little bit lower.

- Metal plate, metallic parts:
  - Performance of the antenna is degraded due to metal parts in the close area.
  - Avoid any metal part within a 20cm radius hemisphere around the antenna. Metal parts at the bottom of the Wirgrid RF Module 169MHz can be acceptable.
  - If the Wirgrid RF Module 169MHz is mounted in a water pit, avoid installing it, too close to the metallic lid. If the lid of the pit is made of plastic, the Wirgrid RF Module 169MHz can be installed on the top of the pit, close to the lid.
- Height / ground effect:
  - The ground has a significant impact on the RF signal attenuation. The closer to the ground the Wirgrid RF module 169MHz is, the higher will be the attenuation.
  - When possible, install the Wirgrid RF module 169MHz as high as possible from the ground (2 meters is ideal)
  - If the Wirgrid RF Module 169MHz must be installed in a water pit, then install it as high as possible, close to the lid. However, beware of the metal parts as explained before! See Figure 8.
- Wall mounting:
  - The Wirgrid RF Module 169MHz has a wall mount system for M6 screws. This system avoids the antenna to be too close to the wall it is mounted on. Therefore the antenna performance is not degraded by the wall.
  - When installing the Wirgrid RF Module 169MHz, avoid having the antenna too close to another wall, or any obstacle, unless it is mounted on.
- Multipath fading:
  - Sharp angles, reflective material, diffractive materials may generate multipath fading between the Wirgrid Station and the Wirgrid RF Module 169MHz, degrading the reception substantially. Usually, this phenomenon cannot be avoided because it is mainly dependant on the environment. If the RSSI is very low compared to the expected value, this may be due to multipath fading.
  - Moving the Wirgrid RF Module 169MHz by a few 10 cm may change the conditions of propagation and optimize the RSSI. In harsh environments, several positions could be tested to find the better one.
- Meter interface: the cable between the meter and the Wirgrid RF Module 169MHz should be guided such as it does not go close to the antenna. Avoid also creating any loop with the cable, close to the Wirgrid RF Module 169MHz enclosure.

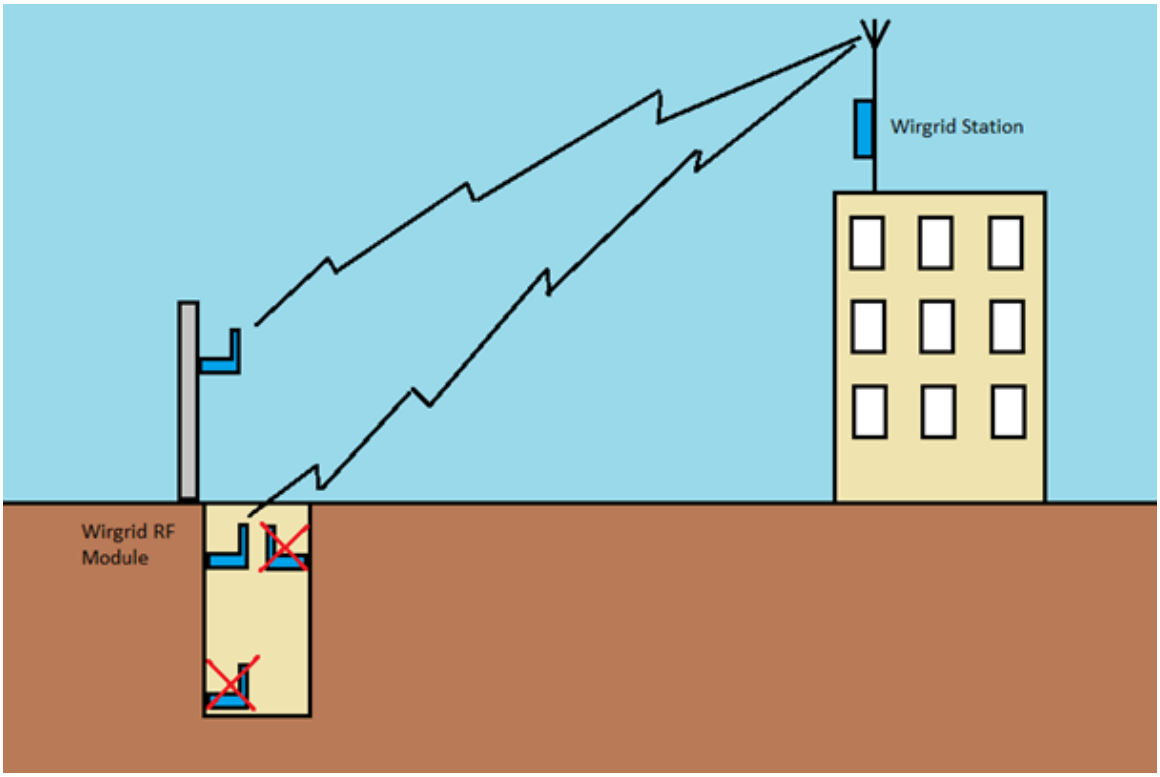


Figure 8: Optimized position of the Wirgrid RF Module 169MHz

5. Wiring

***Note**: For the Wirgrid RF module 169 ATEX, warnings detailed at the paragraph 1.1 must be considered.*

The connection between the meter and the Wirgrid RF module 169MHz is done through a 4 wires cable. This operation can be done during production upon customer specific request. If not, the connection has to be done on field by the installer. A waterproof mini-connector (not provided by Kerlink) could be used for that purpose. An example is presented below (contact Kerlink to obtain product reference):

Figure 9: waterproof mini-connector example

Any other waterproof connector could be used for that purpose. However, if the connection has to be done on site by the installer, make sure that the operation is easy enough and can guaranty the waterproof requirement. Soldering or any complicated tooling should be avoided for that purpose.
Before connecting the meter cable to the Wirgrid RF Module 169MHz cable through the waterproof adapter, check what are signals available on the meter side and the colour of the core for each signal.
The description of the Wirgrid RF Module 169MHz cable is detailed in §2.3.3, especially the colours of cores.
Make sure to connect the right signals on each side. The colours of cores on meter side and Wirgrid RF Module 169MHz side may be different. Beware of that to avoid swapping wires!

Some meter may have only 3 wires (or 2 wires), instead of 4. Then, the missing wires are obviously not connected on the Wirgrid RF Module 169MHz side. Two wires (or 2 signals) are mandatory:

Wire	To be connected (Yes/No)
Pulse	Yes (always)
Flow direction	Yes if available on meter side, No if not available
Tamper	Yes if available on meter side, No if not available
Ground	Yes (always)

Note: *if flow direction and / or tamper are not available on meter side, then the "LE SENSE" parameters have to be updated to reflect this. See § 6.2.6 for further details.*

Note: *The meter interface is considered as a SELV circuit regarding the IEC 60950-1. Before connecting a meter, make sure the specifications detailed in §3.5 are met to avoid any hazard.*

6. Commissioning

6.1 Prerequisites

6.1.1 Material

In order to enable the Wirgrid RF Module 169MHz and insert it in the AMR chain, the installer must have:

- An Android Smartphone (LG Nexus 5 for example) including the following features:
  - Android API level 14 (Ice Cream Sandwich) or higher
  - 3G or 4G and WiFi capabilities
  - NFC ISO 15693 (NFC-V)
  - GPS
  - Wirgrid NFC application installed, configured and settings completed.
- Good GPS reception
- GPRS / EGPRS/3G/4G networks are available

6.1.2 Wirgrid NFC application

Wirgrid NFC application must be installed on the Andoid smartphone before starting the installation of the Wirgrid RF Module 169MHz.
Installation of the Wirgrid NFC application is detailed in document [2]. It is not described or repeated in the present document. Follow the instructions to install properly the application, configure it, adjust settings, manage permissions and create the requested folders for firmware upgrades, log files and traces.

6.1.3 Users

The Wirgrid NFC application is designed to be used by two kinds of users:

- Administrator: has access to all configurations, all settings and all operations.
- Fitter: has no access to configurations, very limited access to settings (RF diagnosis only) but has access to all operations.

Therefore, the fitter must ensure that the administrator has properly configured the application and set the settings before starting any installation.

Configuration and settings (except RF diagnosis) are not detailed in this document. See [2] for further details.

6.2 Installation

The installation procedure is performed via the NFC Local interface tool (smartphone) compliant to the § 6.1.1 description. Kerlink provides an Android application (Wirgrid NFC Kerlink) validated on several smartphones equipped with native NFC feature.
During the installation, the user supplies to the Wirgrid RF module 169MHz the necessary data to make it functional. The Wirgrid NFC application can also, depending of the configuration,

communicates with the server (Headend) during the installation to inform about the installation.

6.2.1 Power supply

The Wirgrid RF Module 169MHz embeds an internal battery which is able to provide supply during the whole duration life of the device. Hence, the Wirgrid RF Module 169MHz is already power supplied when delivered by Kerlink. In order to save current and not compromise its duration life until the installation, the Wirgrid RF Module 169MHz is configured in a sleep mode (storage mode). It will be wake-up during the 6.2.2 phase.

6.2.2 Installation with the headend

In order to use the headend for the installation, the "Headend mode" in the settings must be activated and the headend information must have been set during the initialization (see § 6.1.2).

To install the Wirgrid RF Module 169MHz and pair it with the meter, follow the procedure below:

- Launch "Wirgrid NFC Kerlink" application
- Enter "login" and "password"
- Go into the "Install" menu
- Select the "Install" tab
- Check on the display that the Headend is used for the installation (see Figure 10)

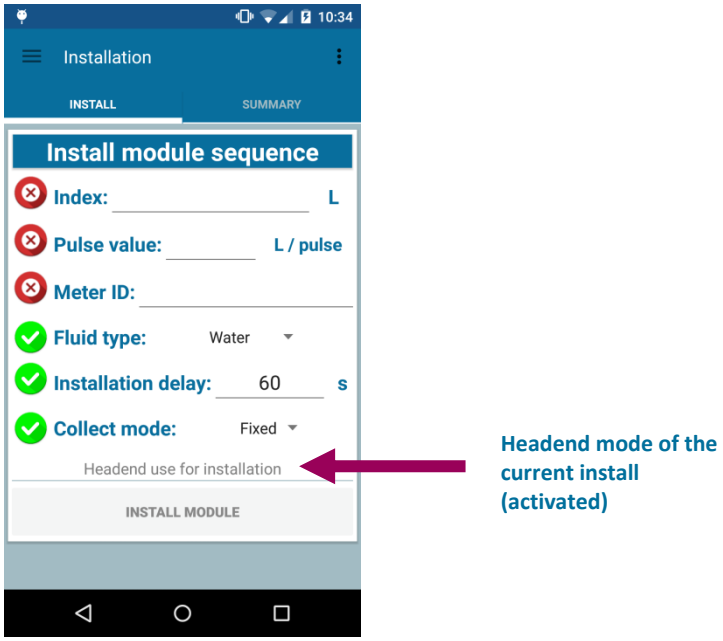


Figure 10: Headend use for installation label

- Check what the missing parameters (in red) are and the parameters that are already filled in (in green) among *Index*, *Pulse value*, *Meter id*, *Fluid type*, *Installation delay* and *Collect mode*. Fill in all the missing parameters until all are green.
  Enter "Index" value, "Pulse value" and "meter ID"
  Modify "Fluid type", "Installation delay" and "Collect mode" if necessary
- Once all the parameters are filled-in, the "Install module" button becomes available. If one parameter is missing, the "Install module" button is not available (see Figure 11).

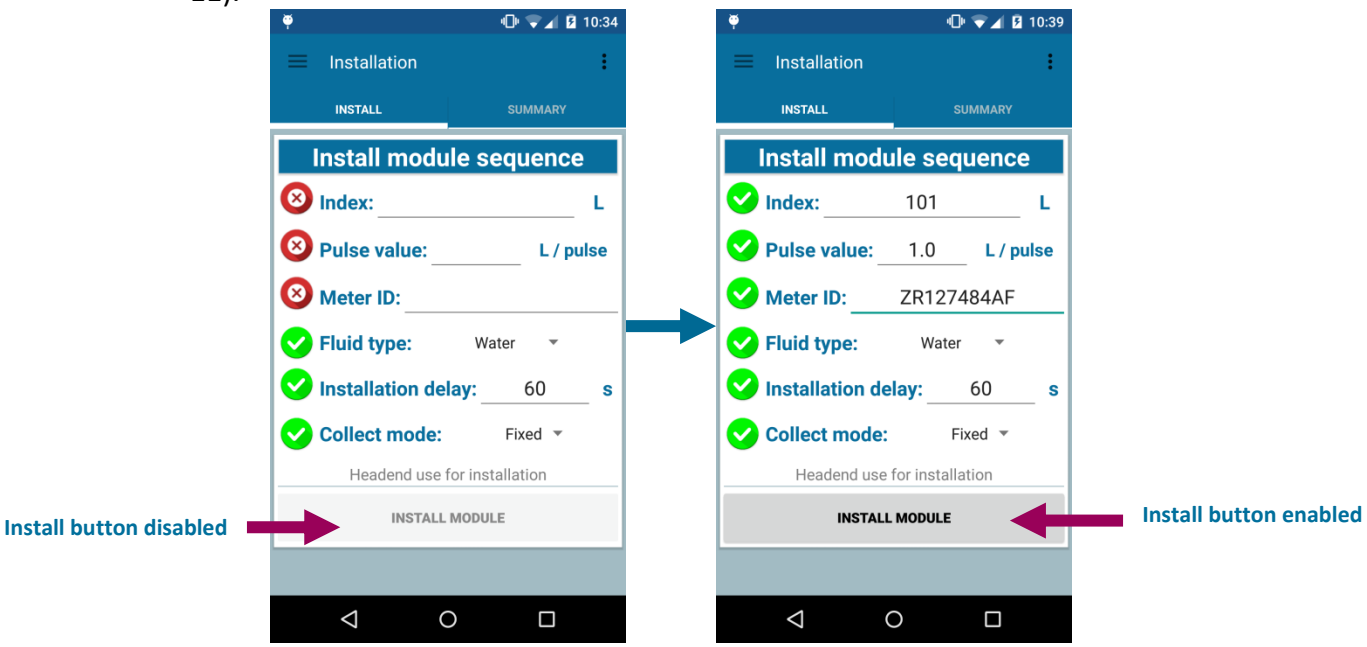


Figure 11: Installation user input

- Press the "Install module" button.
- Place the smartphone above the NFC logo of the Wirgrid RF module 169MHz.
- The Wirgrid RF module 169MHz receives the NFC request and the application execute these following steps:
  - Acquire GPS position (optional)
  - Declare the installation on the server (mandatory)
  - Wait the installation delay
  - Check on the server if the installation has been received by stations (optional).
    Note: *the status of each step is provided by icons (see Figure 12).*
- It is then possible to get the information about the stations that have received the installation message by pressing the button "Get station details" (see Figure 12).

Figure 12: Installation procedure

Note :

In some cases, it may occur that the installation failed due to a server declaration failure for instance (see Figure 13). The Wirgrid RF Module 169MHz is started but the declaration has not been done. The declaration is buffered and can be declared later. When buffered declarations are finally declared on the server the user is warned with a notification (see Figure 14 and Figure 15).

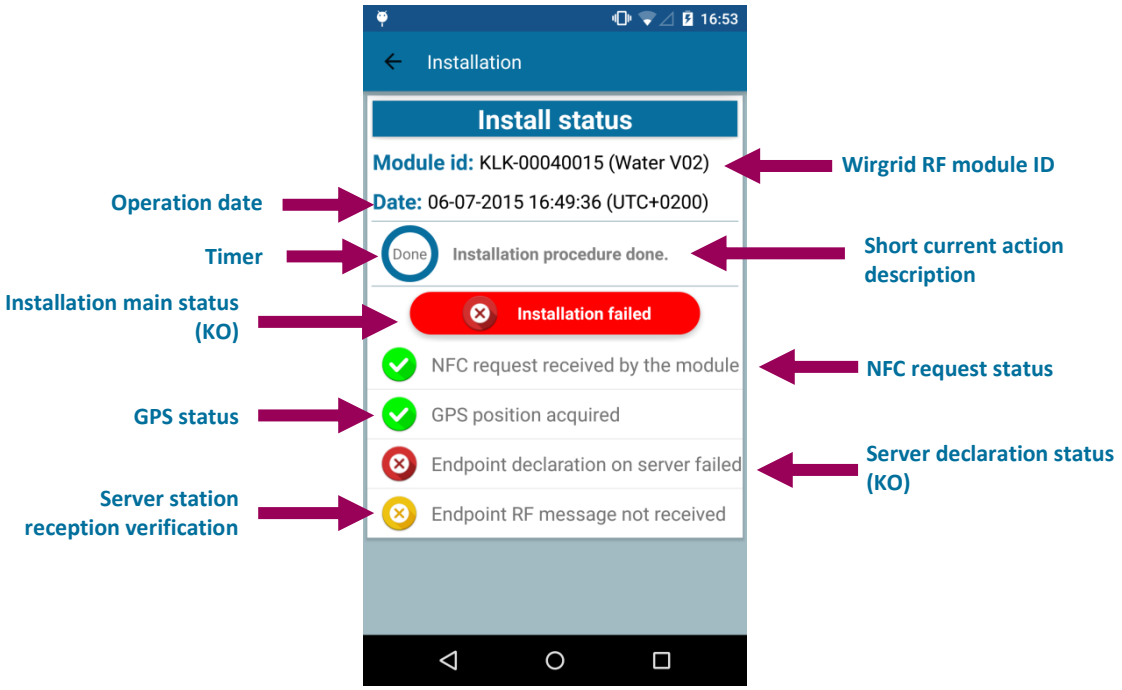


Figure 13: Installation failure (Server declaration failure)

Figure 14: Notification icon (lollipop)

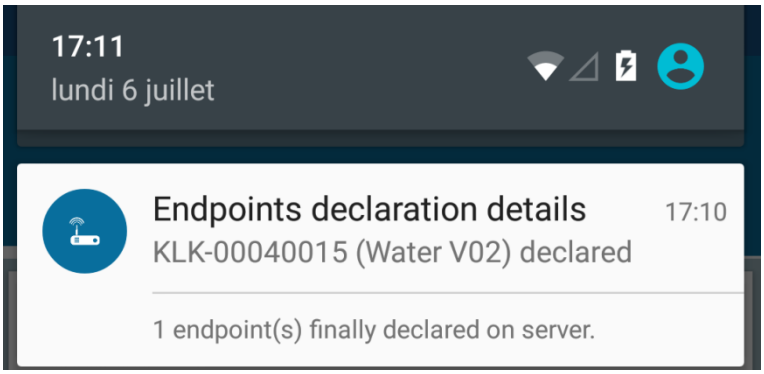


Figure 15: Notification menu with Wirgrid NFC notification (Lollipop)

6.2.3 Installation without the headend

In order to not use the headend for the installation, the "Headend mode" in the settings must be deactivated (see § 6.1.2).

To install the Wirgrid RF Module 169MHz and pair it with the meter, follow the procedure below:

- Launch "Wirgrid NFC Kerlink" application
- Enter "login" and "password"
- Go into the "Install" menu
- Select the "Install" tab
- Check on the display that the Headend is not used for the installation (see Figure 16)

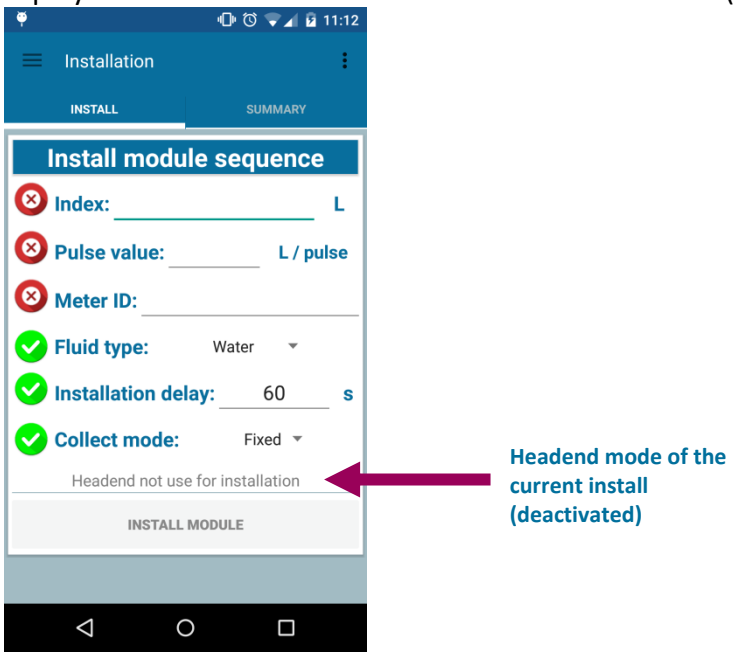


Figure 16: Headend not use for installation label

- Check what the missing parameters (in red) are and the parameters that are already filled in (in green) among *Index*, *Pulse value*, *Meter id*, *Fluid type*, *Installation delay* and *Collect mode*. Fill in all the missing parameters until all are green.
  Enter "Index" value, "Pulse value" and "meter ID"
  Modify "Fluid type", "Installation delay" and "Collect mode" if necessary
- Once all the parameters are filled-in, the "Install module" button becomes available. If one parameter is missing, the "Install module" button is not available (see Figure 17).

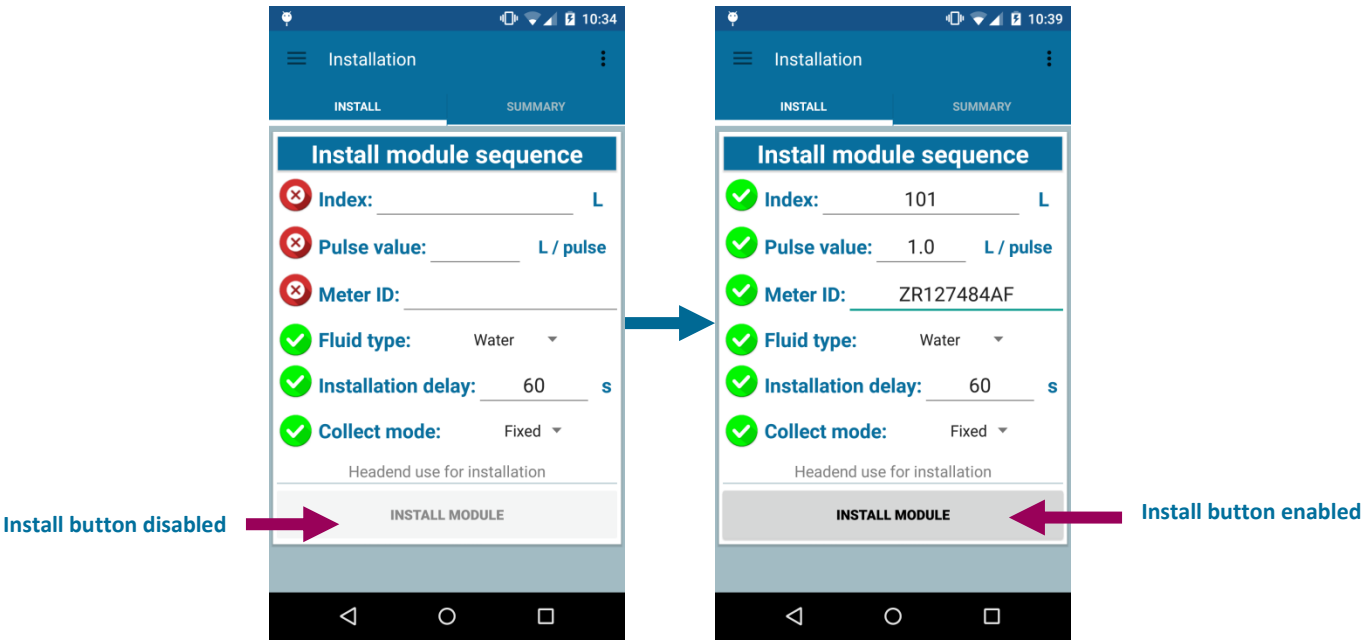


Figure 17: Installation user input

- Press the “Install module” button.
- Place the smartphone above the NFC logo of the Wirgrid RF module 169MHz.
- The Wirgrid RF module 169MHz receives the NFC request and the installation is completed (see Figure 18).

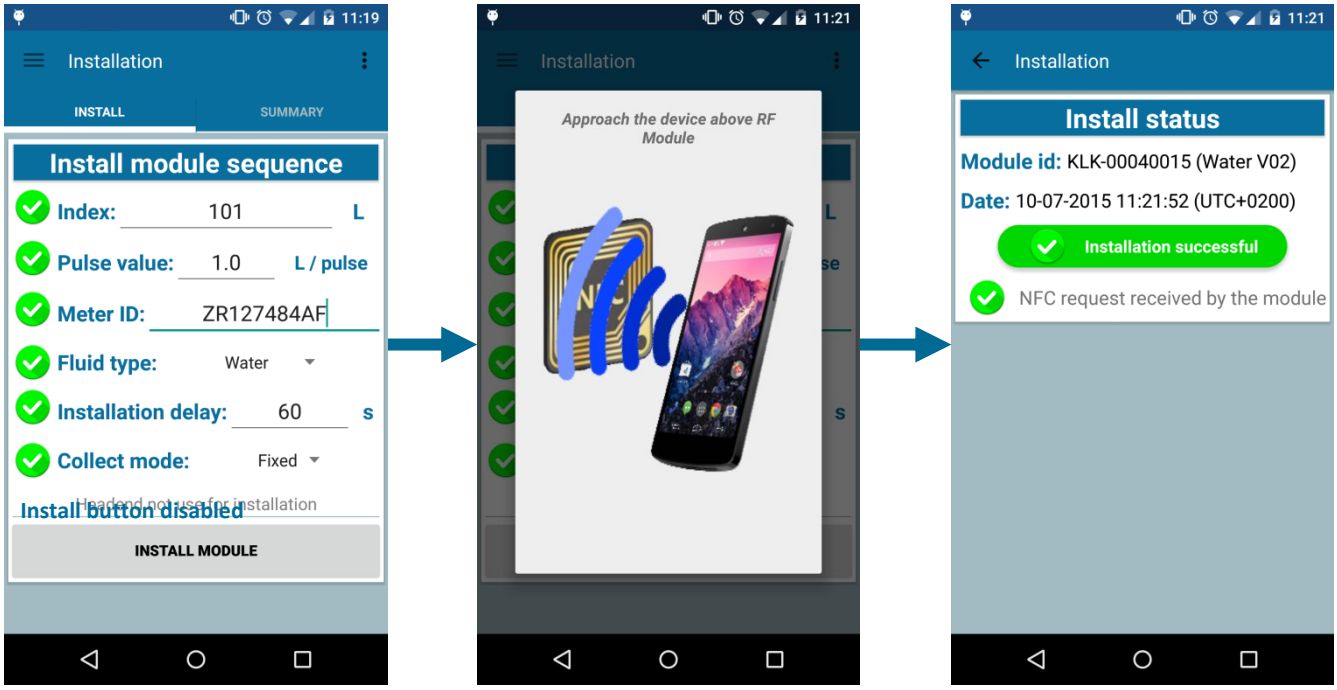


Figure 18: Installation with no headend operation

6.2.4 Summary

The "Summary" tab in the "Install" menu allows the fitter to access the information of the previous installed Wirgrid RF module 169MHz. The details of an installation can be obtained by clicking on one item of the list.

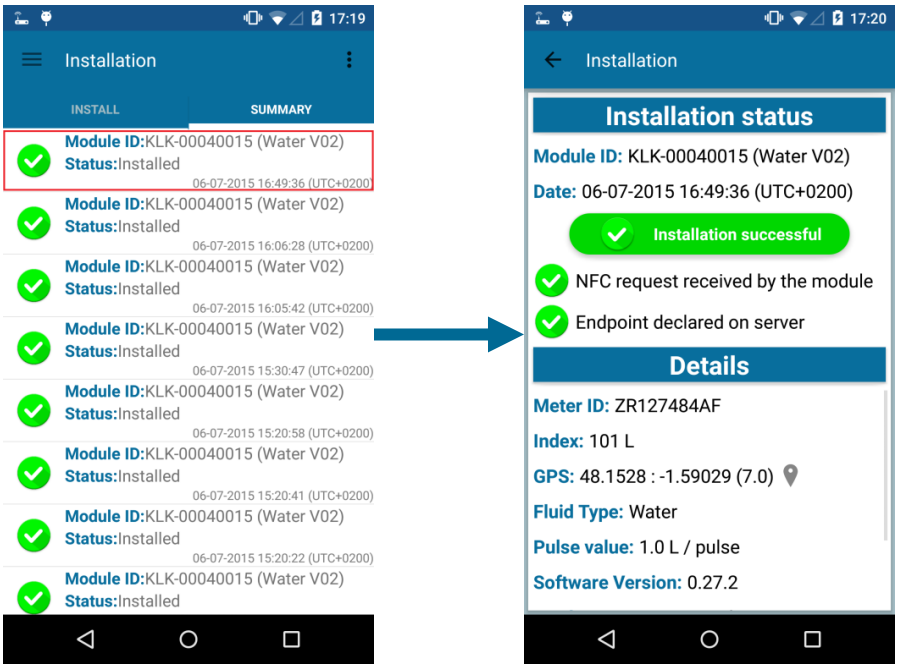


Figure 19: Summary get details

Note: *it is also possible to get the position of the Wirgrid RF Module 169MHz displayed on Google Maps by clicking on the GPS position icon (see Figure 20).*

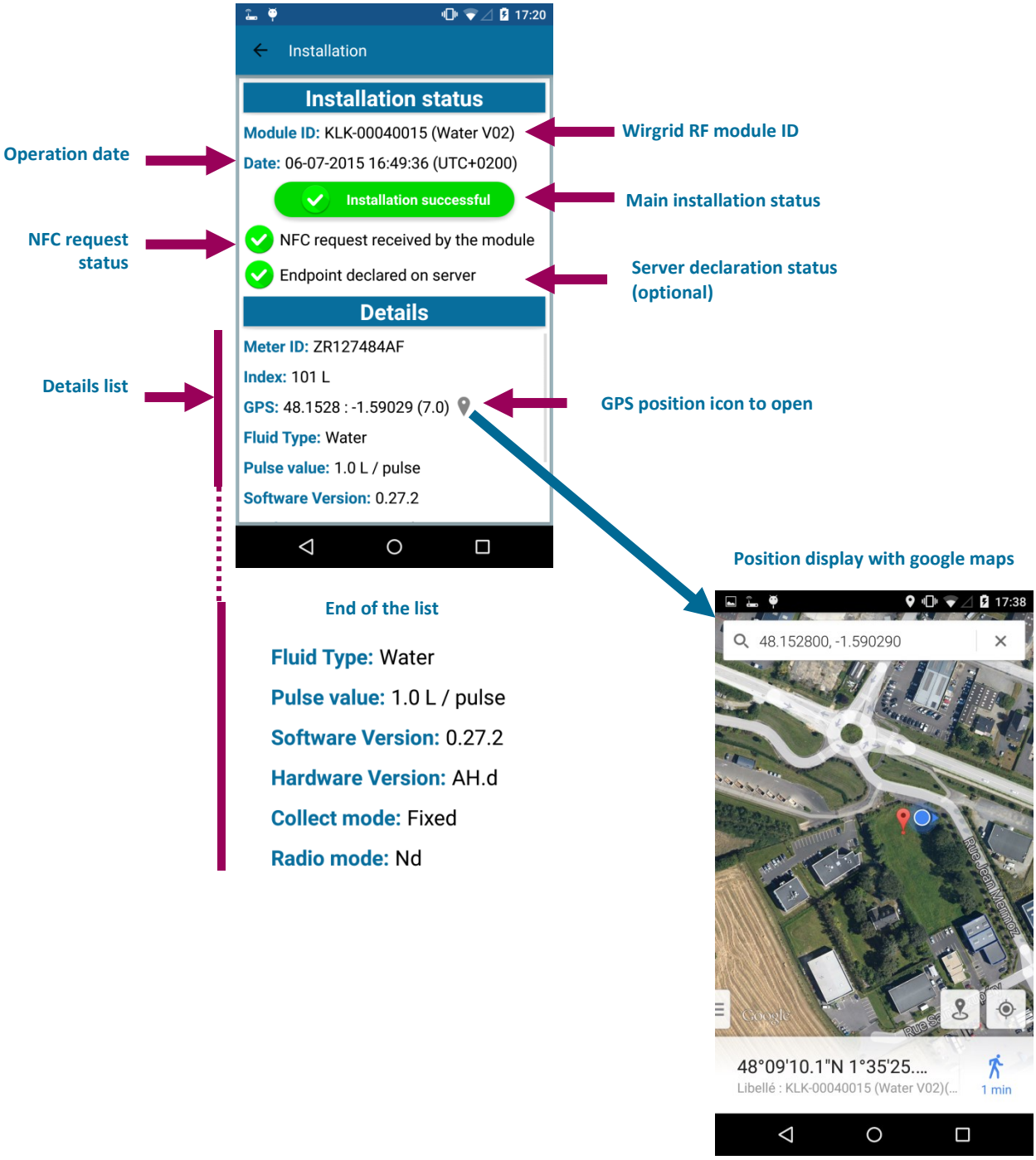


Figure 20: Summary details screen description

6.2.5 Local configuration

Depending on the water meter to be connected to the Wirgrid RF Module 169MHz, it may be necessary to modify some initial configuration parameters. This operation should be avoided in general but may occur in few occasions, especially for the "LE SENSE" parameters (see § 6.2.6). Special care must be taken to avoid wrong parameters that may cause the Wirgrid RF Module 169MHz to not operate properly!
Local configuration can be done manually using NFC local interface (Wirgrid NFC application) at any time, during installation stage or during a maintenance operation.
Every local access is logged inside the device for traceability.
The parameters can be modified through 2 different manners:

- Every parameter individually: use of the "Configuration" menu of the Wirgrid NFC application (see § 7.1.2)
- All parameters together: use of the "Firmware update" menu of the Wirgrid NFC application (see § 7.1.7)

6.2.6 "LE SENSE" configuration

The smart metering hardware block of the Wirgrid RF Module 169MHz includes two main configuration profiles to match various counter types. Indeed, additionally to a classic pulse counter, an advanced pulse counter is used by default. It allows sampling input pulses, direction and tamper.
The parameter used to select the counter mode is "pcount_type" and can be set to following values:

- **0x00**: None
- **0x01**: Pulse Sample
- **0x03**: Pulse Sample Direction
- **0x05**: Pulse Sample Watch
- **0x07**: Pulse Sample Direction Watch
- **0x08:** Continuous Pcount
- **0x0A**: Continuous Pcount Direction
- **0x0C**: Continuous Pcount Watch
- **0x0E**: Continuous Pcount Direction Watch

"Continuous Pcount" means using the simple pulse counter block.
"Pulse Sample" means using the advanced pulse counter.
"Direction" and "Watch" must be used respectively if "direction" and "tamper" information are available on meter interface (see § 5).

The simple pulse counter does not need any configuration.

Regarding the advanced pulse counter, the picture below explains how pulses are sampled:

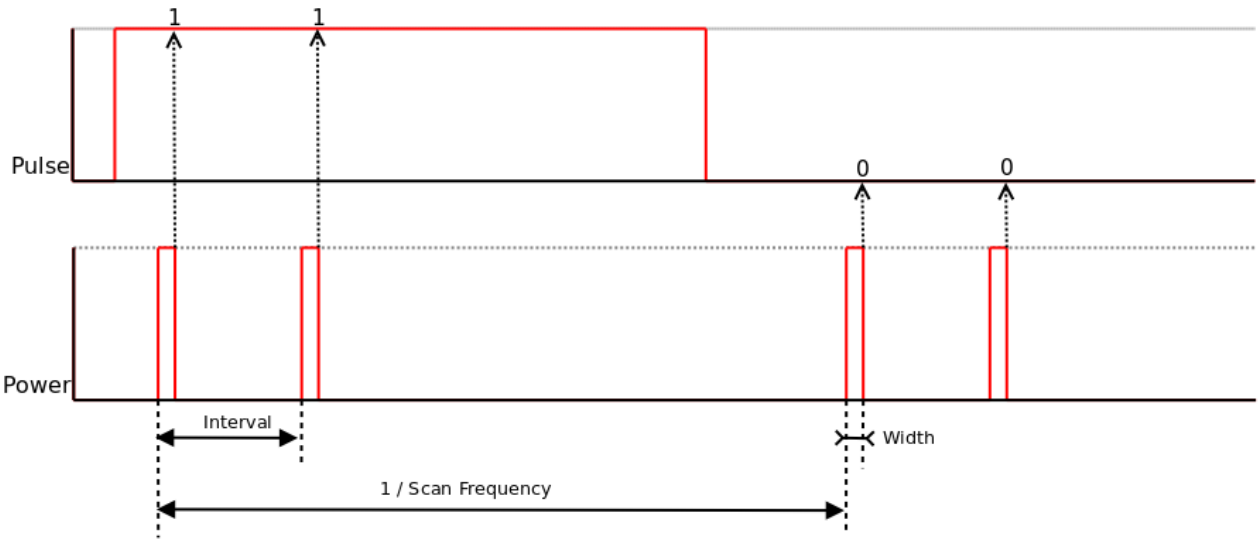


Figure 21: Advanced pulse counter sampling

Depending on the meter interface characteristics, the parameters of this advanced pulse counter may be changed.
Note: *changing these parameters will impact directly the current consumption in counter mode and therefore the duration life of the product.*

Three main characteristics must be taken into account: glitch filtering, pulse duration and power duration as detailed in the next paragraphs.

6.2.6.1 Glitch filtering

The advanced glitch filtering feature allows filtering large glitches (between 1 and 100ms) that may occur on the meter interface.
For each measurement, 2 samples are taken and the result of these 2 samples must be the same to validate the measurement point as illustrated on following chronogram:

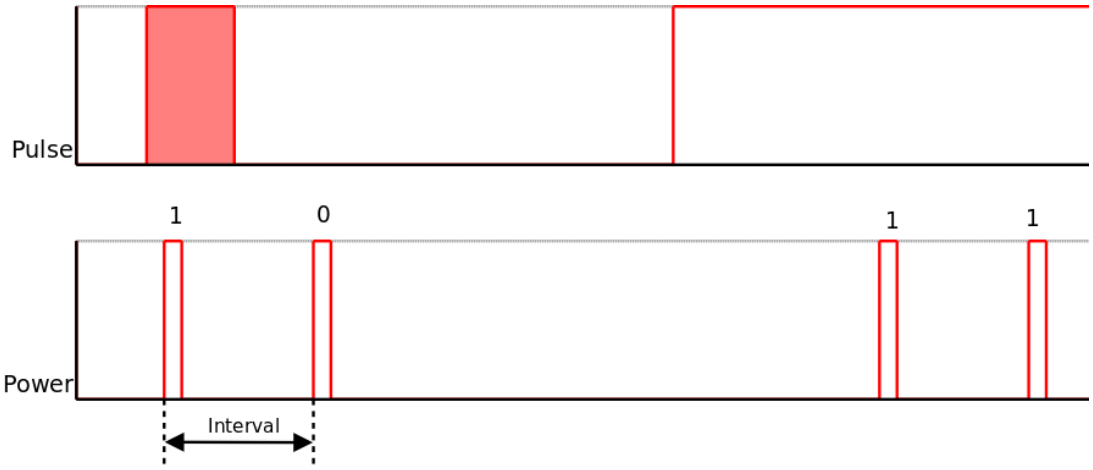


Figure 22: Advanced pulse counter glitch filtering

The parameter “Sample interval” is used to define the delay between these two samples for each measurement. It does not impact current consumption.
By default, this delay is set to 15ms. It must be adjusted according to pulse duration.
Note: *About 20% of pulse duration is generally a good setting.*

6.2.6.2 Pulse duration

The parameter “Scan frequency” must be set according to the pulse duration of the meter interface.
This frequency must be an integer set between 10 and 1000 Hz.
“Scan frequency” must be quicker than pulse duration. ($F_{scan} > 1/T_{pulse}$)
Be careful: *this frequency impacts significantly the continuous current consumption.*
In order to get the best trade-off, without missing pulses, the following formula can be used:

F_{scan} = 1000 / (min_pulse_duration_in_ms - 1)

For example, for a 65ms pulse duration, the parameter “Scan frequency” is set to 1000 / (65-1) = 15.6 = 16 Hz

6.2.6.3 Power duration

By default, for each sample, the meter interface is powered (excited) 2ms before the measurement. This value (“Sample width”) is suitable with a meter interface compliant with § 3.5.
If a different type of meter is used (not recommended!) with additional capacitance or with a longer cable, for instance, then the sampling signal waveform could be impacted such that the pulses could not be detected. In this case, the parameter “Sample width” should be increased to retrieve the pulse detection.
Note: *increasing the parameter “Sample width” impact directly the current consumption in counter mode and therefore the duration life of the product.*

6.2.7 Clock management

In case the Wirgrid RF Module 169MHz had stayed for a long period in storage mode, it may occur that a clock synchronisation is required.
This operation can be managed OTA by the headend (see § 7.3.2) as a periodic task but could be also done via the Wirgrid NFC application (see procedure in § 7.1.6).
Kerlink recommends to have this clock management managed OTA by the headend.

7. Maintenance

7.1 Onsite maintenance through the local configuration tool

7.1.1 Index management

Index is set during the installation phase (see § 6.2.2) but it is possible to manage the index later on, during the whole Wirgrid RF Module 169MHz life. The Wirgrid NFC application allows the fitter, or operator, to either read the index (get index) or to either modifies the index (set index).

7.1.1.1 Get index

To read the index of the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the “Index” menu
- Select the “Get Index” tab
- Press the button “Read module index” to start the “get index” operation
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Status of the operation, index value and pulse value are displayed on the screen as follows (Figure 23):

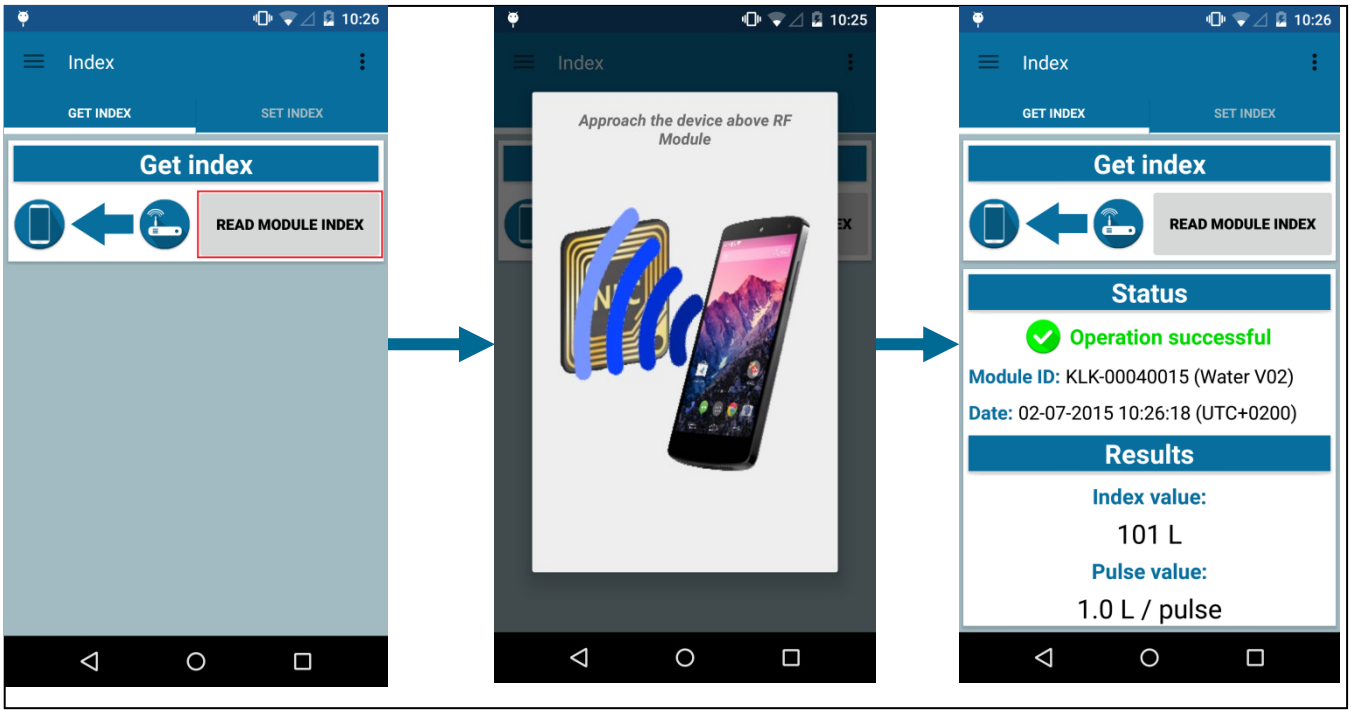


Figure 23: Get index operation

7.1.1.2 Set index

To modify the index of the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the “Index” menu

- Select the "Set Index" tab
- Set the index value *(index to set)* that is wanted in the product
- (Optional) Check the pulse value checkbox and set a pulse value if you want to set a new pulse value during the operation.
- Press the button "Set module index" to start the set index operation.
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Status of the operation, index value and pulse value are displayed on the screen as follows (Figure 24):

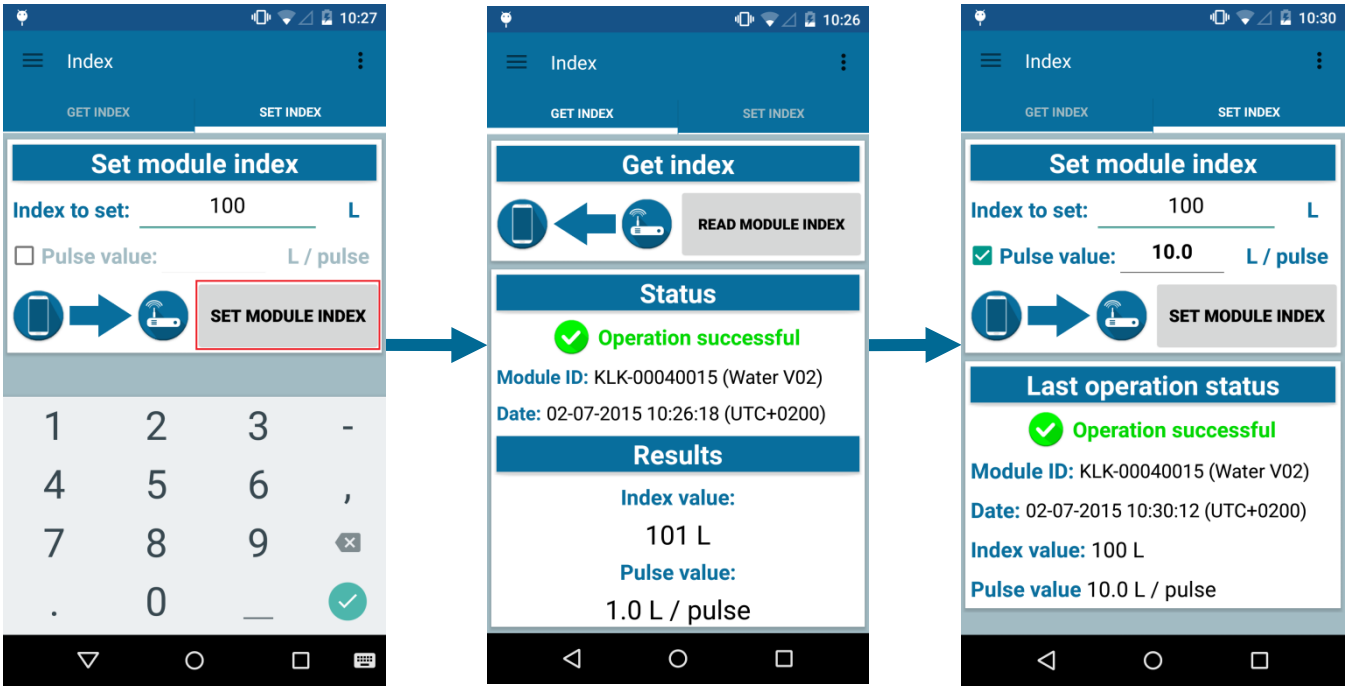


Figure 24: Set index operation

7.1.2 Local reconfiguration

An initial configuration of the Wirgrid RF Module 169MHz is completed in the factory by Kerlink. The configurations parameters can be modified after or as part of the installation (see § 6.2.5, § 6.2.6 and § 6.2.7) but it is also possible to reconfigure the parameters later on, during the whole Wirgrid RF Module 169MHz life.
The Wirgrid NFC application allows the fitter, or operator, to either read the parameters or to either modify the parameters (write).

Be careful: *modifying the configuration parameters impacts the operation of the Wirgrid RF Module 169MHz. Wrong parameters may cause the Wirgrid RF Module 169MHz to not operate properly! The fitter or operator must fully understand the role and impact of each parameter. Kerlink strongly recommends reading and fully understanding Kerlink Wiki of the AMR chain [8] before starting reconfiguration of the Wirgrid RF Module 169MHz.*

Every local access is logged inside the device for traceability.

Note: *the update of configuration parameters can be also done via a "configuration file" as des cribbed in the "Firmware update" operation (see § 7.1.7).*

7.1.2.1 Read configuration parameters

To read the Wirgrid RF Module 169MHz configuration parameters, follow the procedure below:

- Go into the "Configuration" menu
- Select the "Read configuration" tab
- Press the "Add" button to add a new parameter to read
- Select a parameter in the list
- Scroll the list among "Identification, RF, LAN, Time, Scheduler, Measurement, NFC, Log, Status, Servicing, Le sense, Power, Mobile Readout, LoRaMac and System" to find all the parameters
- Repeat the operation above until all the wanted parameters to be read are selected
- Press the "Read parameter(s)" button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Status of the operation, parameters list and values are then displayed on the screen as follows (see Figure 25).

Note: *It is possible to clear the current parameters list by pressing the "Remove all" button.*

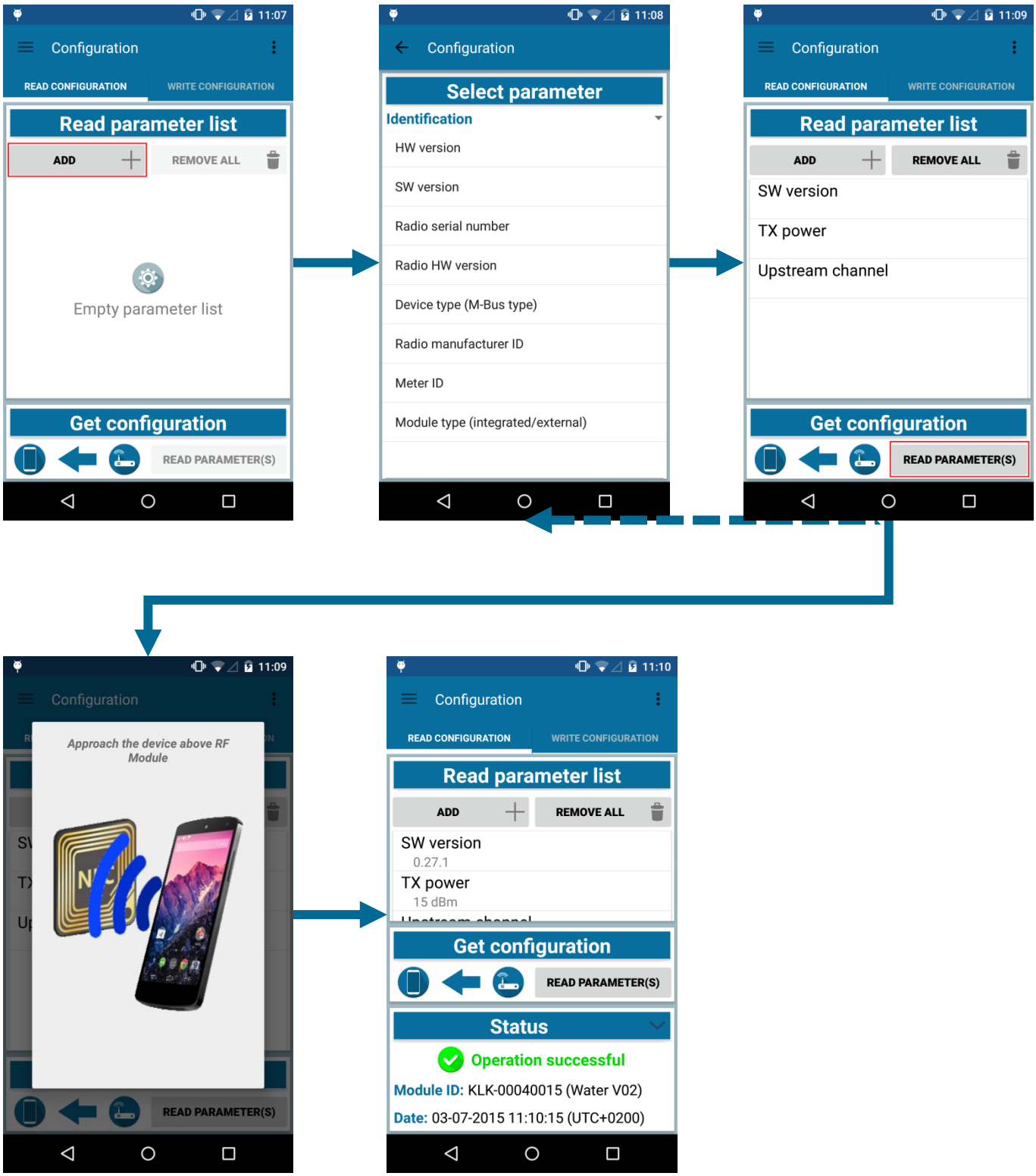


Figure 25: Read configuration operation

7.1.2.2 Modify configuration parameters

To reconfigure the Wirgrid RF Module 169MHz parameters, follow the procedure below:

- Go in the “Configuration” menu
- Select the “Write configuration” tab
- Press the “Add” button to add a new parameter to set
- Select a parameter in the list
- Scroll the list among “Identification, RF, LAN, Time, Scheduler, Measurement, NFC, Log, Status, Servicing, Le sense, Power, Mobile Readout, LoRaMac and System” to find all the parameters
- Set the value of each parameter and press the “Add” button
- Repeat the operation above until all the wanted parameters to be modified are set
- Press the “Apply parameter(s)” button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Status of the operation, parameters list and values are then displayed on the screen (see Figure 26).
- To get details of the write parameters operation, press “Show details” at the bottom of the screen (see Figure 27).

Note: *It is possible to clear the current parameter list by pressing the “Remove all” button.*

Note: *The configurations of the “LE SENSE” and “Time” parameters are detailed in § 6.2.6 and § 6.2.7.*

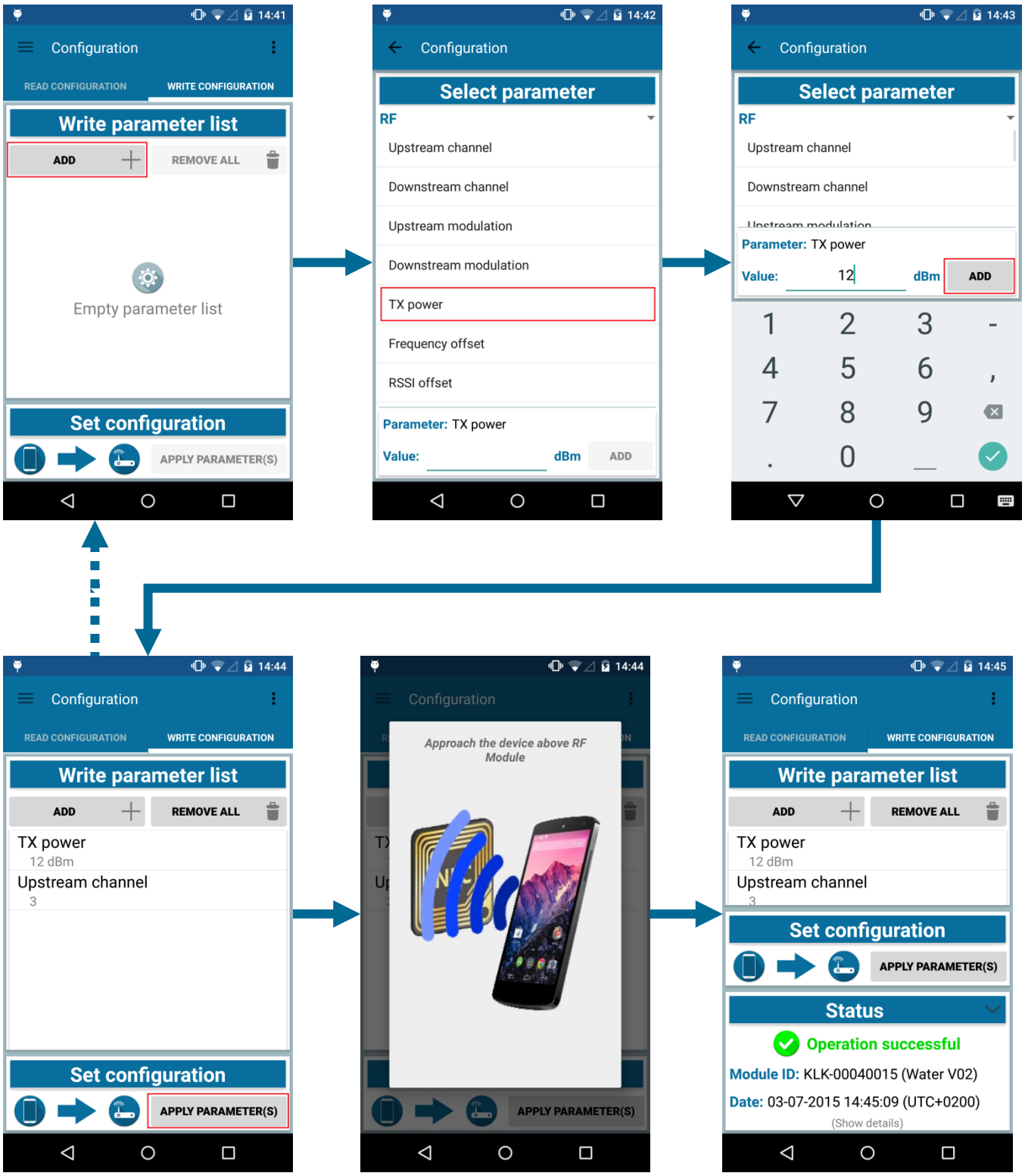


Figure 26: Write configuration operation

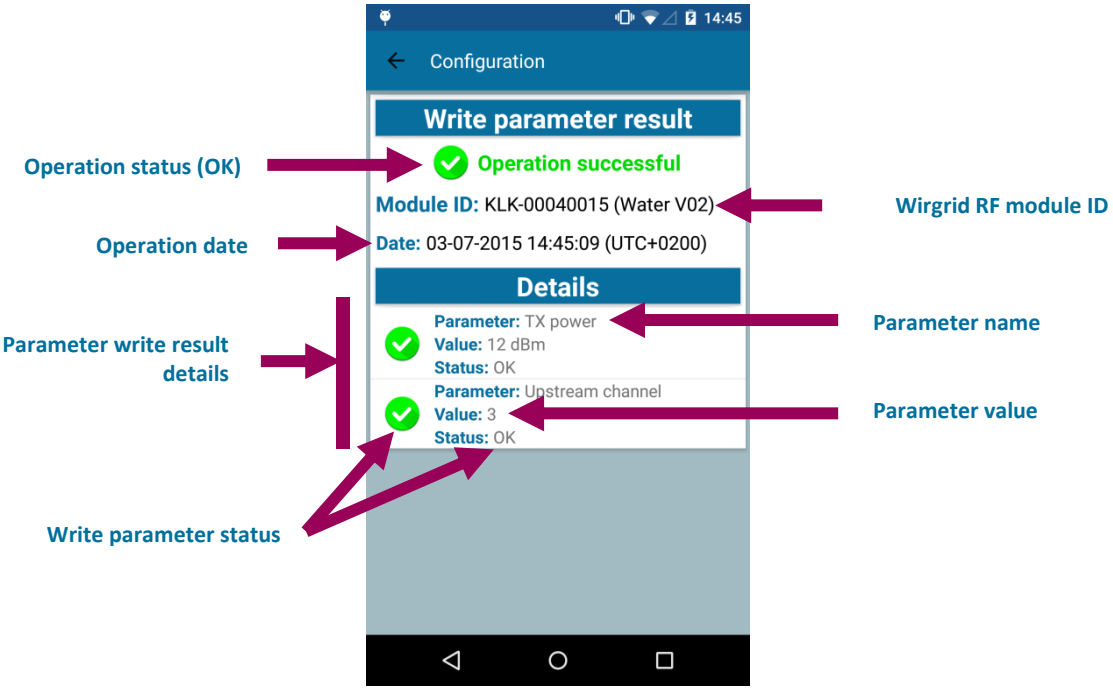


Figure 27: Show parameter write operation details screen

7.1.3 RF Diagnosis

The NFC application enables ping and pong messages between the Wirgrid RF Module 169MHz and the Wirgrid Stations in the coverage area. It allows then to check if the RSSI of the signals (Stations and Wirgrid RF Module 169MHz) are those expected or not. This is then a good troubleshooting tool as detailed in § 8.2.

In this operation, the Wirgrid RF module 169MHz sends a broadcast message to its network, and any station in coverage range responds to the Wirgrid RF module 169MHz which stores the 3 best stations information (based on the best RSSI uplink value). The user is then able to retrieve this information.

The following information are stored by the Wirgrid RF Module 169MHz :

- Station ID (3 best stations max)
- RSSI Up (message received by the station)
- RSSI Down (message received by the Wirgrid RF Module 169MHz)
- Reception time (message received by the Wirgrid RF Module 169MHz)

7.1.3.1 "RF diagnosis delay" default value

The RF diagnosis operation has a "RF diagnosis delay" parameter. This delay corresponds to the time between the press button launch and the operation effectiveness. This delay allows for instance the fitter or operator to get out of the pit, close the pit before the RF diagnosis to avoid any perturbation of the RF signals. The delay must be then adjusted depending on the use case.

A default value of the “RF diagnosis delay” can be set. Later on, when using the RF diagnosis operation, the pre-set value will be proposed to the operator.

To set the “Default RF diagnosis delay”, follow the procedure below:

- Go into the “Settings” menu
- Select “Default RF diagnosis delay”
- Set the value (minutes and seconds)
- Press “OK”
- Check on the screen that the new value was taken into account.

7.1.3.2 RF diagnosis operation

To enable the RF diagnosis of Wirgrid RF Module 169MHz, follow the procedure below:

- Go in the “RF Diagnosis” menu
- Change the “Delay before diagnosis” value or keep default value (see 7.1.3.1)
- Press the “Start diagnosis” button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Wait the end of the countdown timer (go outside the pit if needed). The RF diagnosis status is then displayed on the screen once finished (see Figure 28).
- Press the “Retrieve result” button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz again
- At the end of the operation, a new page is displayed on the screen with the operation status and the status of the received messages (see Figure 29).

Note: *the best station is displayed first. The best station is the station which has the best RSSI up.*

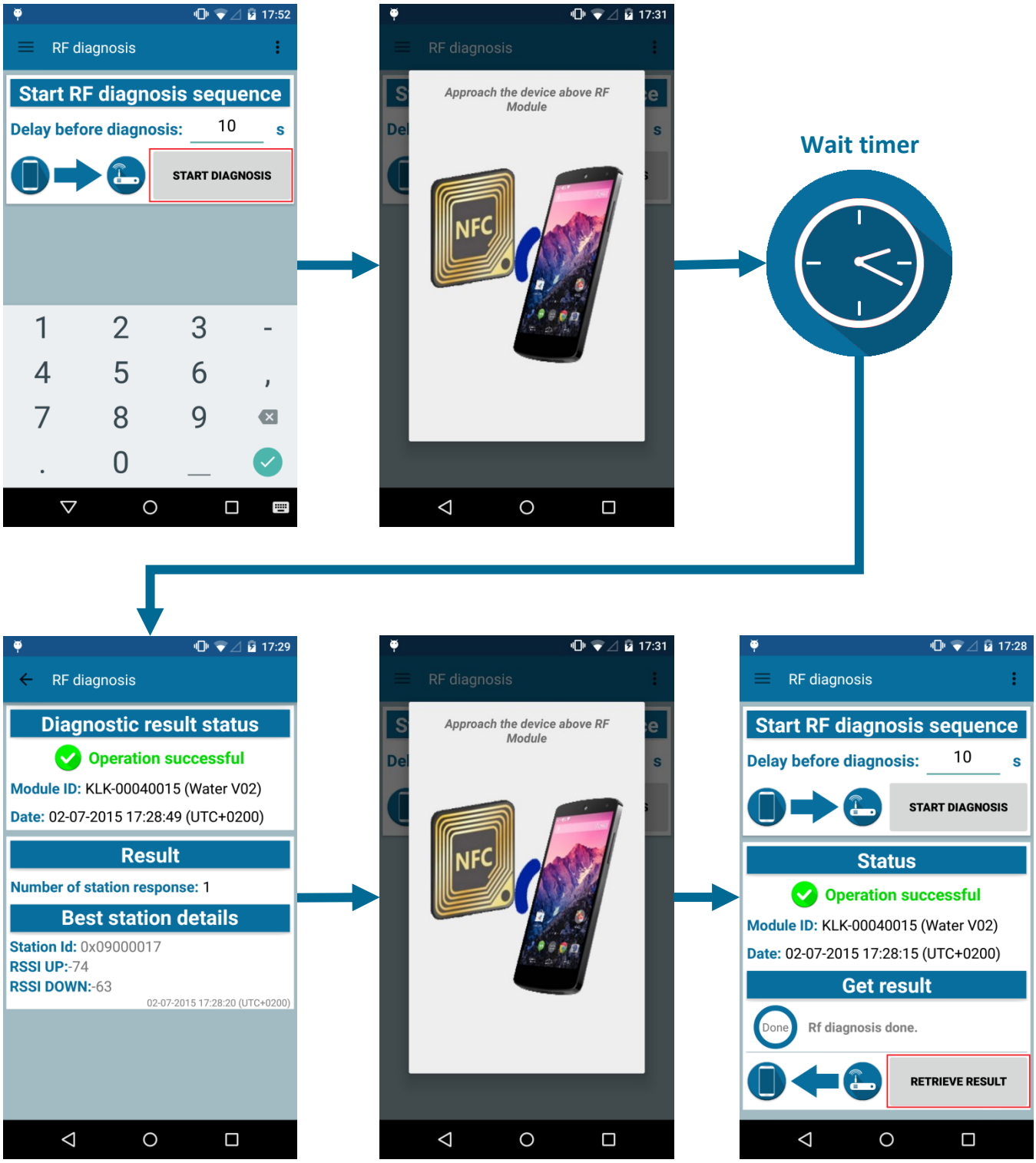


Figure 28: RF Diagnosis operation

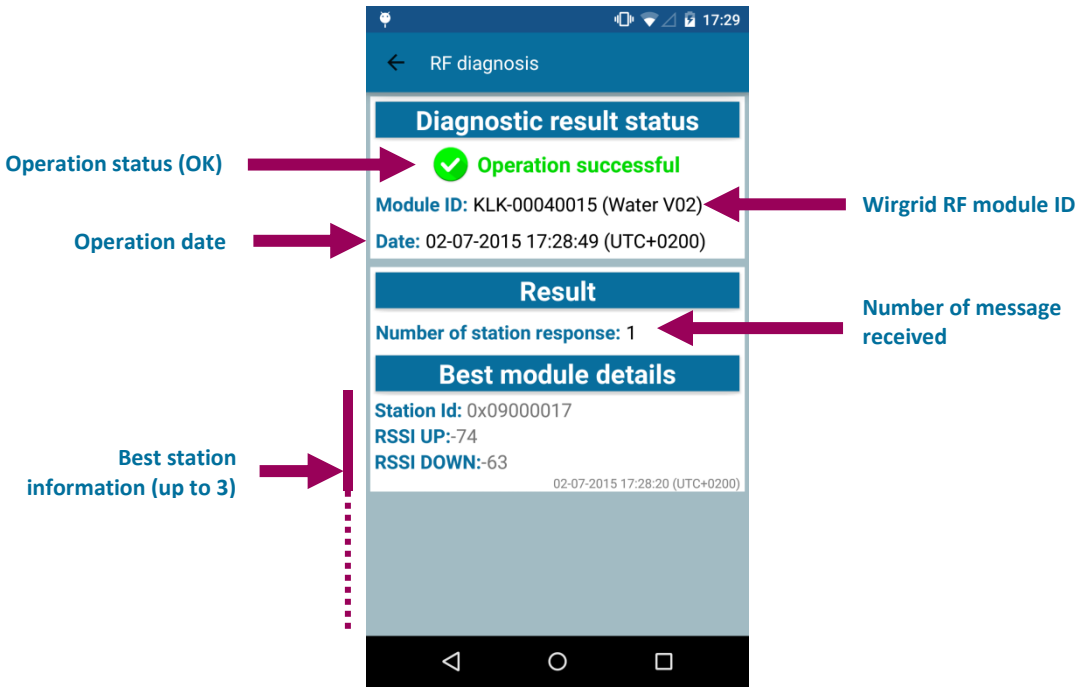


Figure 29: RF Diagnosis / retrieve results

7.1.4 Retrieve static data

Some data are stored periodically in the NFC EEPROM of the Wirgrid RF Module 169MHz. They are then always available, including after the end of life of the product (battery out of order for instance).

Here is a summary of the static data available:

- Static data information : timestamp of last business data
- Identification : Module type, meter ID
- RF : upstream channel, downstream channel, upstream modulation, downstream modulation, calibration values (frequencies, power), number of TX bytes, number of RX bytes, RSSI
- LAN : keys IDs, installation delays, number of CRC errors, number of nwkKeys and appKey errors, Reed Solomon corrections and uncorrections, …
- Time : production timestamp, clock drift offsets, EPOCH year
- Scheduler : Daily period, Measurements steps, Measurement windows, status frames, periodic tasks, ...
- Measurement : index, timestamp, pulse value, sensor alarms, leak parameters, ...
- NFC : Nb NFC exchange, nb error mobKey
- Log : latest SW update
- Status : current, low power, reboot counter, watchdog, overflow, leakage, …
- Servicing : installation date and information, Number of installation request received, SW update version and size

- LE sense (pulse interface) : pcount type, scan frequency, sample width, sample interval, direction inversion.
- Power: battery capacity, battery used, battery remaining, battery age, low battery threshold, battery loss, standby current, index reading current, local interface current, Tx current, Rx current, periodic task current.
- Mobile Readout: mode, radio modulation, radio channel, tx power, tx period, rx delay, rx duration, mute duration.

To retrieve static data of the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the “Static Data” menu
- Press “Static data extraction” and wait during the extraction
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- At the end of the operation, the result is displayed on the screen with the operation status and extracted static data are available in list and sorted by category (see Figure 30). Scroll the list among “Static data information, Identification, RF, LAN, Time, Scheduler, Measurement, NFC, Log, Status, Servicing, Le sense, Power and Mobile Readout” to find all the available data.
- Static data can be saved in a .txt file. Press the “save” icon, enter a filename and press “Save”.

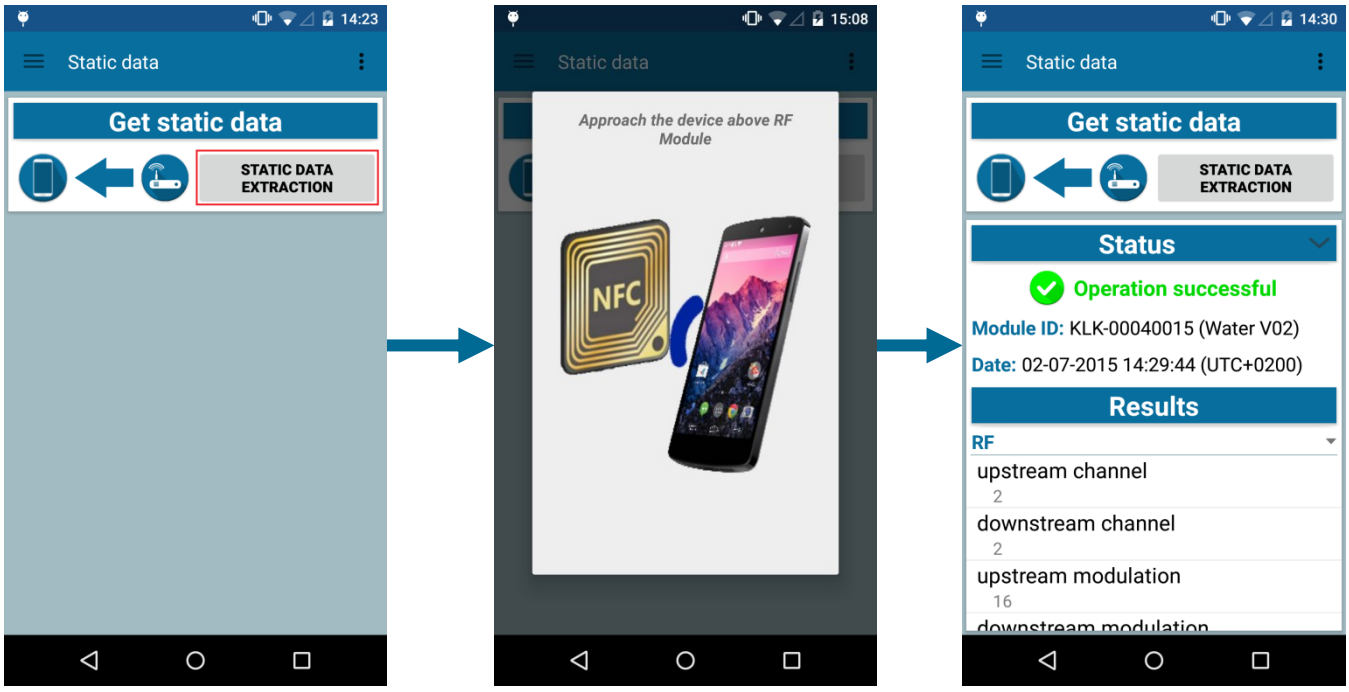


Figure 30: Static data extraction

7.1.5 Retrieve Log file

The NFC application allows retrieving LOG data of the Wirgrid RF Module 169MHz. The Wirgrid RF Module 169MHz has to be functional to run this application.
The log files are an excellent troubleshooting tools to understand unexpected behaviours (see § 8.4).

To retrieve LOG file of the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the "LOG extraction" menu
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Press the "Start extraction" button and wait during the extraction

Note: *the extraction may be long (several minutes) due to the size of the log data and the slow NFC bit rate.*

- Once completed the extraction, the log data displayed on the screen (see Figure 31).
- Log data can be saved in a .txt file. Enter a filename and press "Save". The file is saved in the external storage in the folder /Wirgrid-NFC/LogFile/

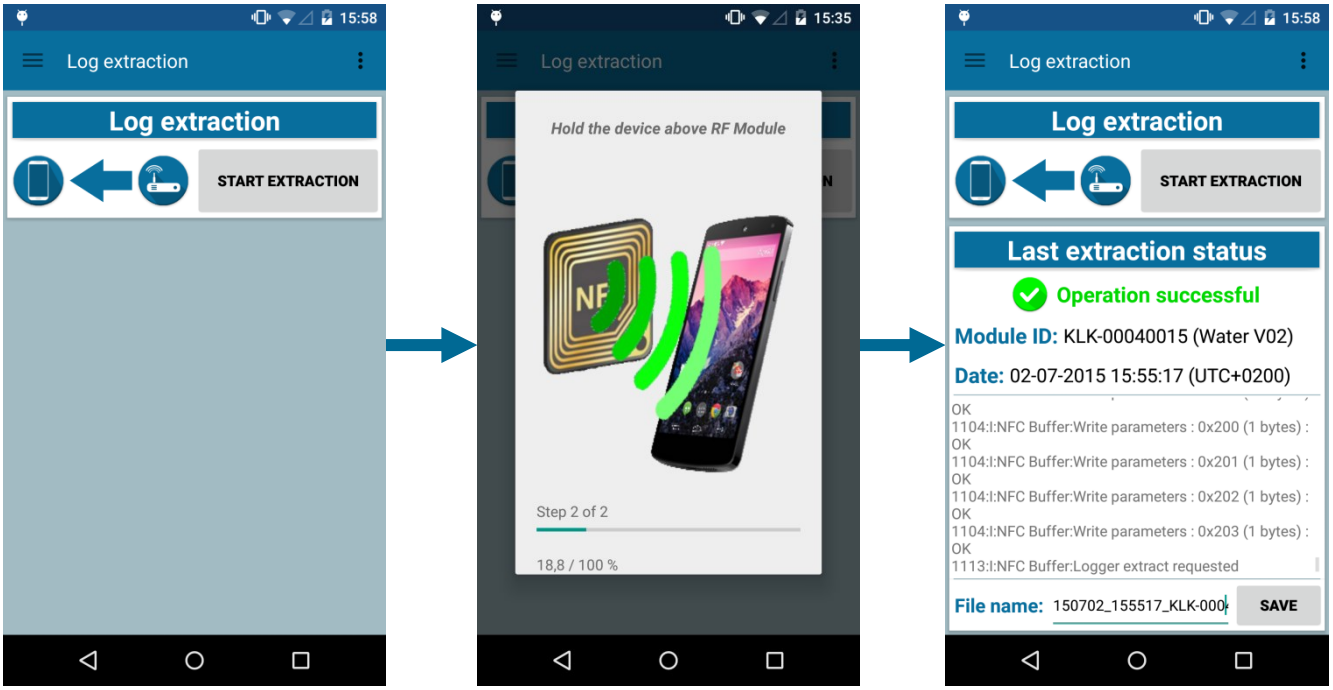


Figure 31: Log extraction operation

7.1.6 Clock management

Clock management is generally an automated process managed by the AMR chain. However, it may occur that for unexpected reason that the Wirgrid RF Module 169MHz is no longer synchronized via this automated process. This can be done manually via the Wirgrid NFC application. The fitter or operator can read the Wirgrid RF Module 169MHz time but also can modify it through synchronisation with the Android device time.

7.1.6.1 Read clock

To read the clock of the Wirgrid RF Module 169MHz, follow the procedure below:

- Go in the “Clock management” menu
- Press the “Read Module time” button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- The status of the operation, the Wirgrid RF Module 169MHz date and delta with Android device time are displayed on the screen (see Figure 32).

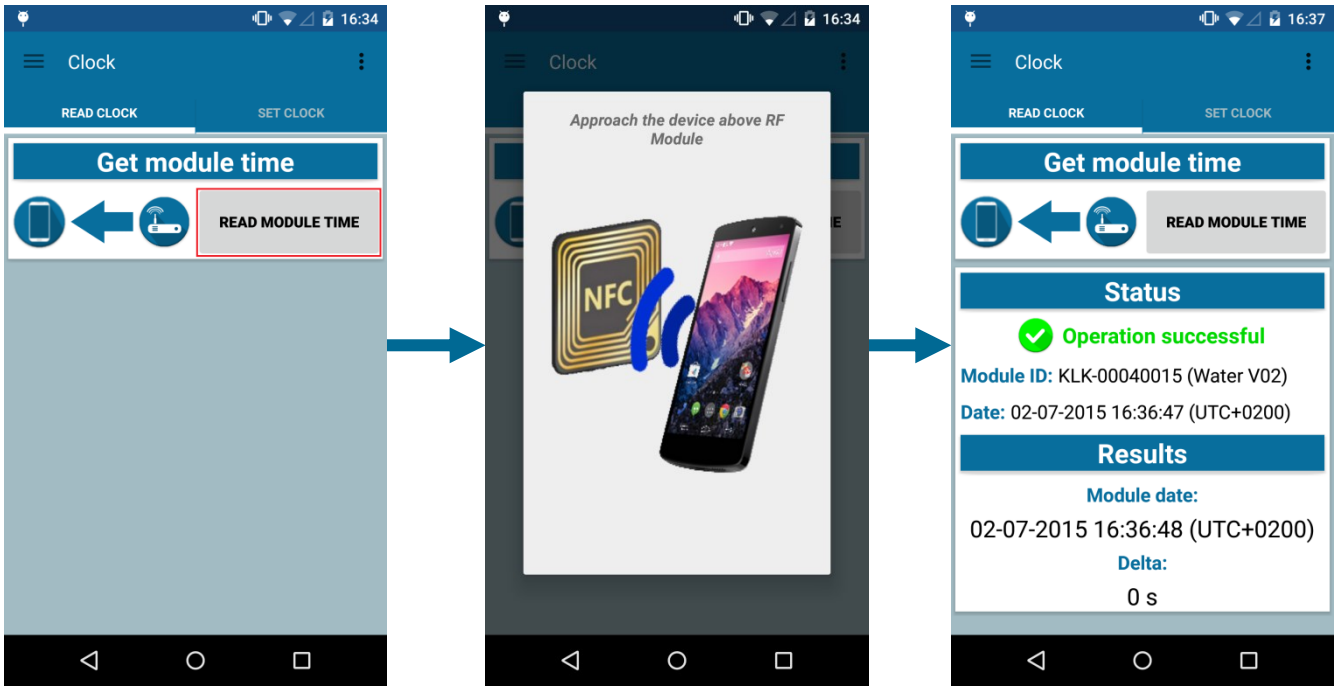


Figure 32: Read clock operation

7.1.6.2 Set clock

To synchronise the clock of the Wirgrid RF Module 169MHz with the Android smartphone time, follow the procedure below:

- Go in the “Clock management” menu
- Press the “Synchronize Clock” button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- The status of the operation, the Wirgrid RF Module 169MHz date and the applied delta with Android device time are displayed on the screen (see Figure 33).

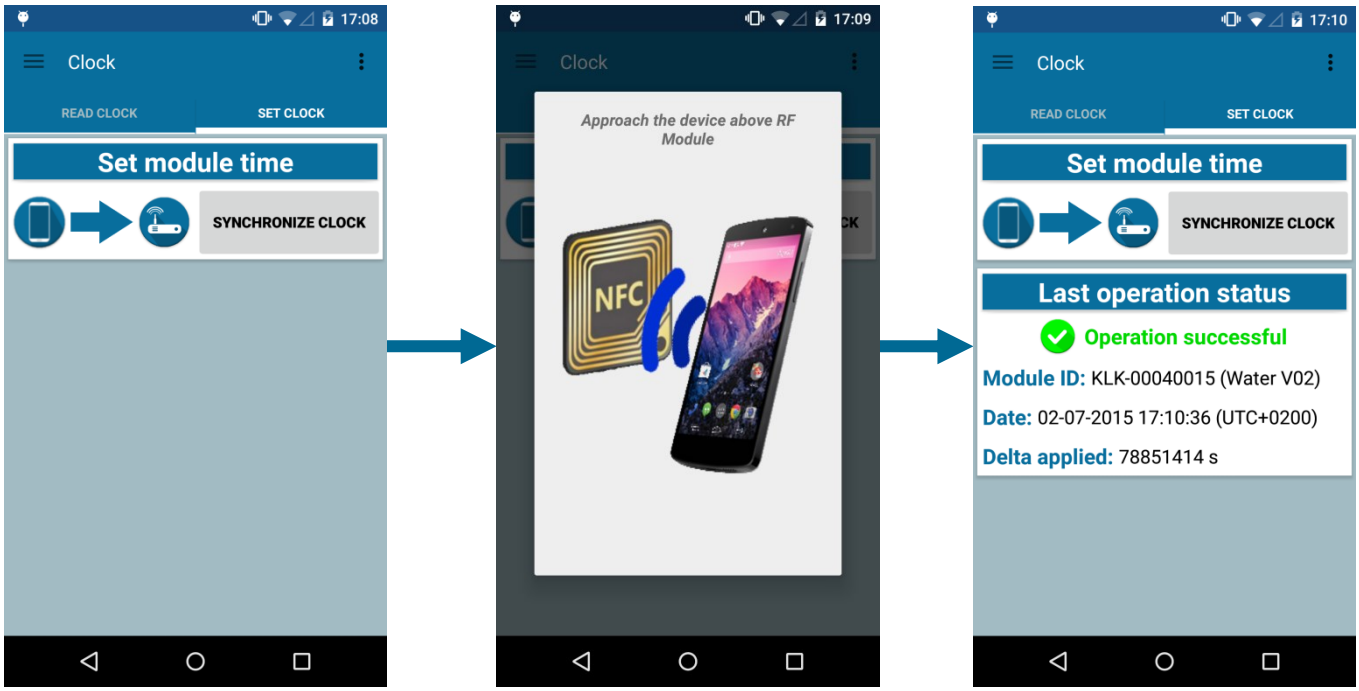


Figure 33: Set clock operation

7.1.7 Firmware upgrade

Firmware upgrade can be either done manually with the Wirgrid NFC application, either over the air (see § 7.3.1).

Be careful: *upgrading the firmware impacts the operation of the Wirgrid RF Module 169MHz. Wrong versions of firmware or configuration file (initial or final) may cause the Wirgrid RF Module 169MHz to not operate properly!*

Note: *the firmware upgrade operation may be long (several minutes) due to the size of the firmware and the slow NFC bit rate.*

7.1.7.1 Read version

Before upgrading the firmware, it may be necessary to check the current version of the Wirgrid RF Module 169MHz software.
To read the firmware of the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the “Firmware update” menu
- Select the “Version” tab
- Press the “Read versions” button.
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- The current firmware and configuration versions are then displayed on the screen (see Figure 34).

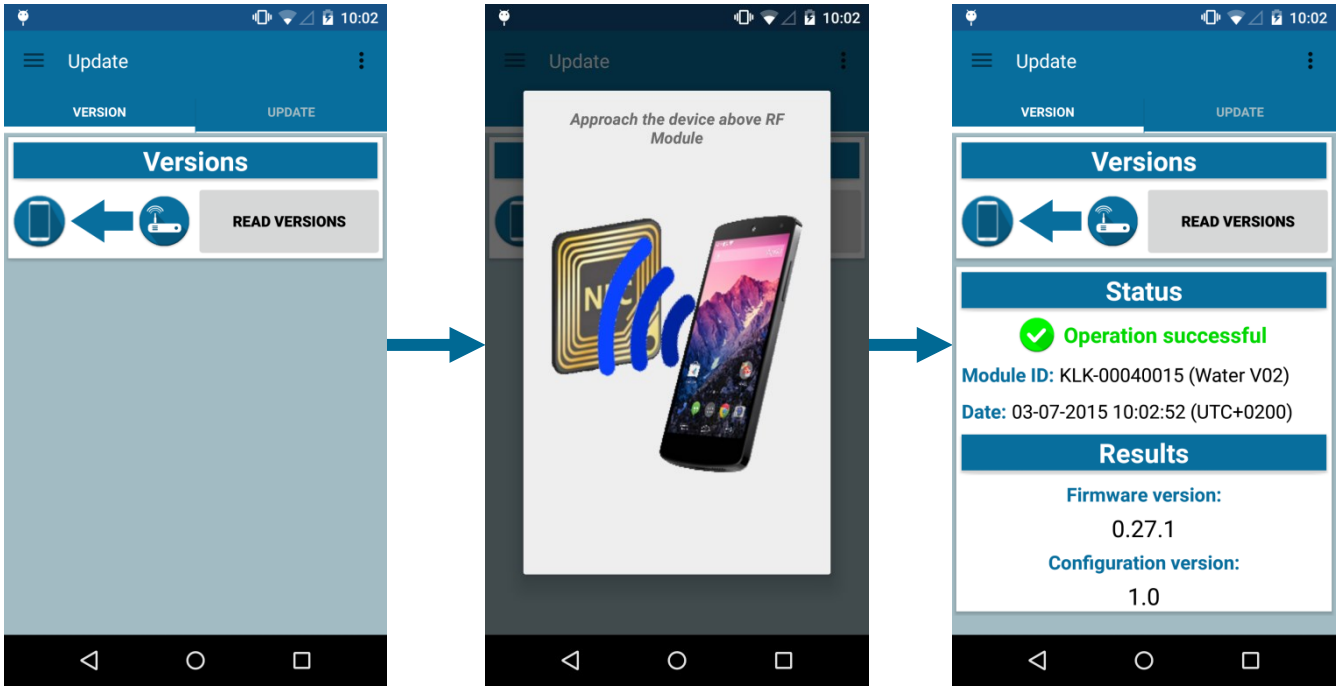


Figure 34: Update get version operation

7.1.7.2 Upgrade operation

Upgrade is done via 2 kinds of upgrade files:

- Firmware file with the extension .kbin
- Configuration file with the extension .kcnf

Both files must be placed into the /Wirgrid-NFC/FirmwareUpdate folder of the external storage of the Android device in order to be available for the application.

To upgrade the firmware of the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the “Firmware update” menu
- Select the “Update” tab
- Press the “Choose file” button.
- Select a file from the list (firmware or configuration file).
- Press the “Start update” button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
  Note: *A firmware update can be long due to the slow NFC bitrate (up to several minutes for a firmware file).*
- At the end the operation, the status of the update is displayed on the screen (see Figure 35)
- Repeat the same operation for the second file (configuration file or firmware file) if needed.

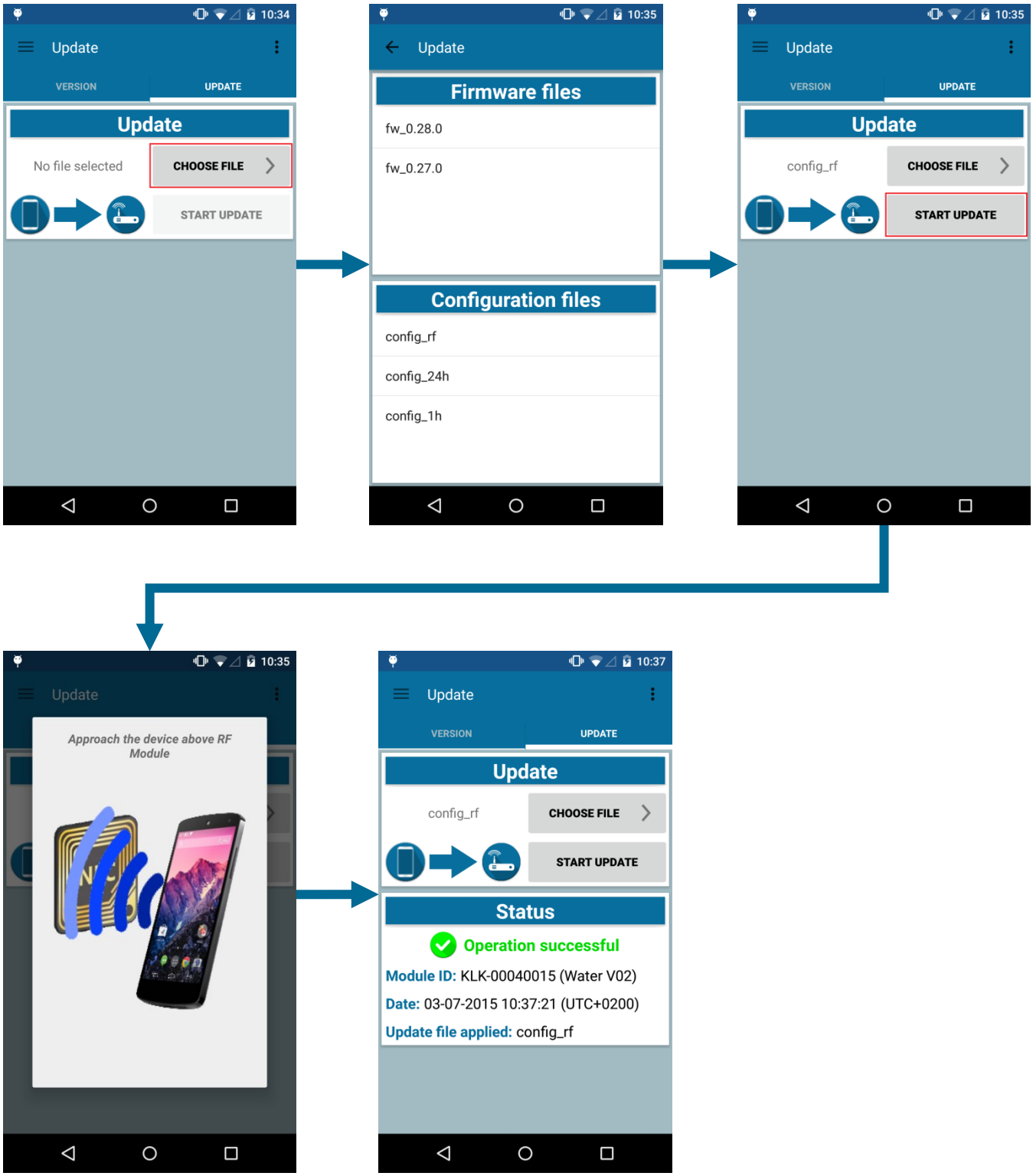


Figure 35: Update operation

7.1.8 Removal

The NFC application allows the removal of the Wirgrid RF Module 169MHz from the AMR chain. At the end of this operation, the Wirgrid RF Module 169MHz will be back to its storage state.

7.1.8.1 Uninstall operation with Headend

In the next procedure, it is assumed that the "Headend mode" is activated i.e. the communication to the server (Head-end) is required to uninstall the Wirgrid RF Module 169MHz from the AMR chain.

To uninstall the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the "Uninstall" menu
- Select the "Uninstall" tab
- Press the "Start uninstall" button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Once the Wirgrid RF module 169MHz has received the NFC request, the application communicates with the server to declare the removal
- Once completed, the status of the removal is displayed on the screen (see Figure 36).

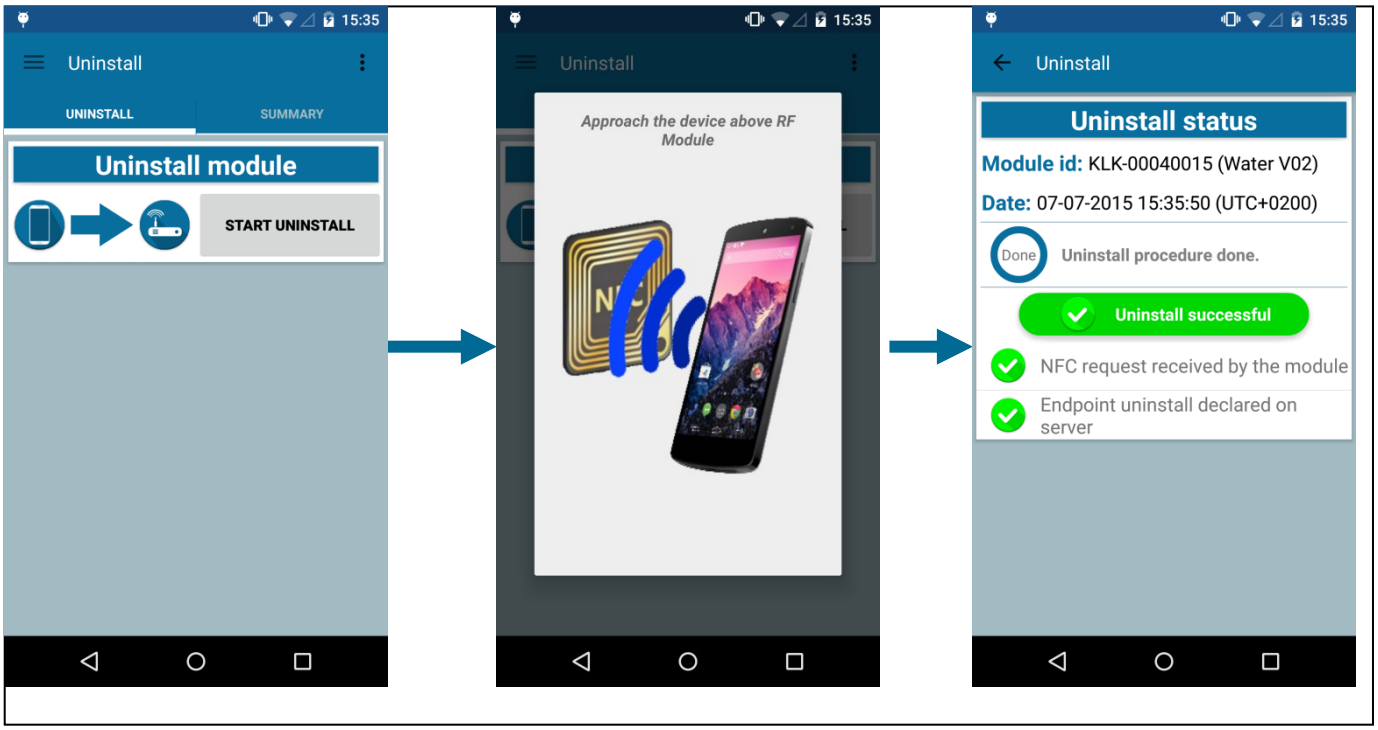


Figure 36: Uninstall operation

Note: *In some cases, the Wirgrid RF Module 169MHz may have changed its mode to the storage state but the declaration of the Wirgrid RF module 169MHz uninstall could not been done (see Figure 37). The declaration is then buffered and can be declared later. When buffered declarations are finally declared on the server the user is warned with a notification (see Figure 38 and Figure 39).*

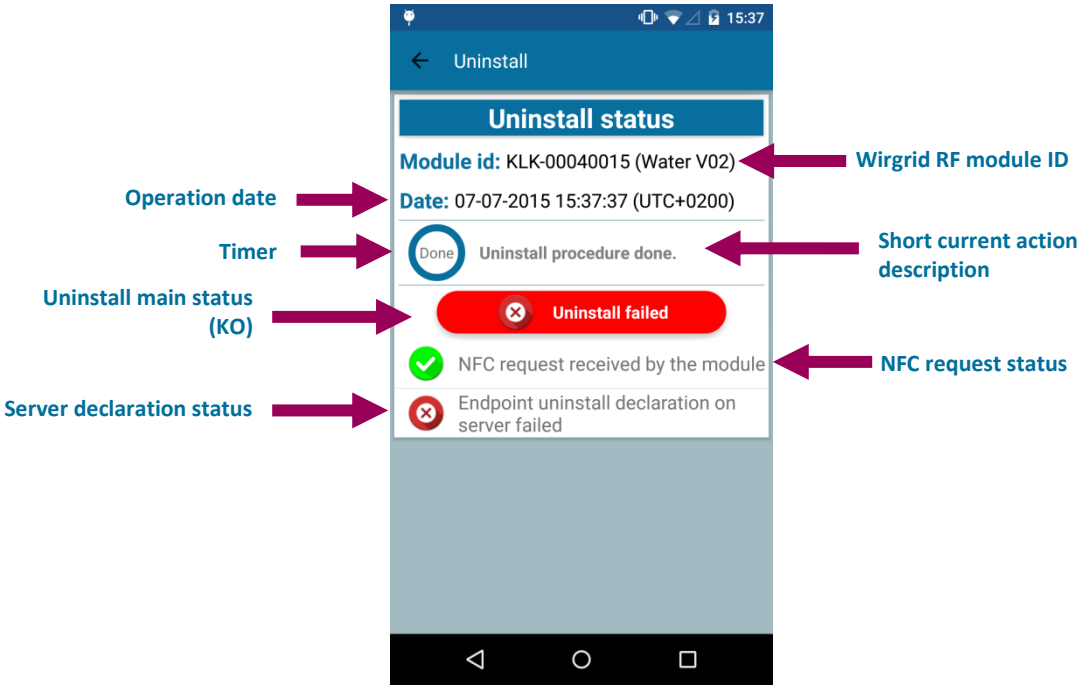


Figure 37: Uninstall failure (Server declaration failure)

Figure 38: Notification icon (lollipop)

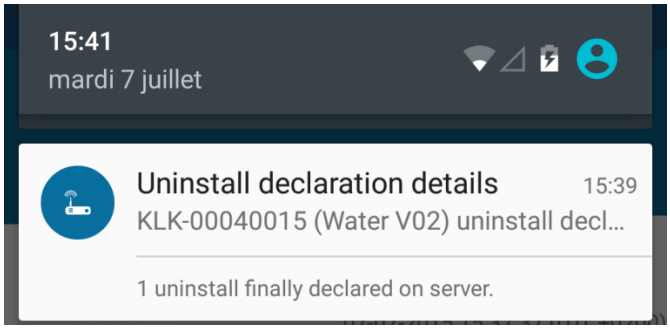


Figure 39: Notification menu with Wirgrid NFC uninstall notification (Lollipop)

7.1.8.1 Uninstall operation without Headend

If the “Headend mode” is deactivated in the settings, the procedure is almost the same as with headend, except that no declaration to the server is required.

To uninstall the Wirgrid RF Module 169MHz, follow the procedure below:

- Go into the “Uninstall” menu
- Select the “Uninstall” tab
- Press the “Start uninstall” button
- Place the Smartphone close to the NFC antenna of the Wirgrid RF Module 169MHz
- Once completed, the status of the removal is displayed on the screen (see Figure 40).

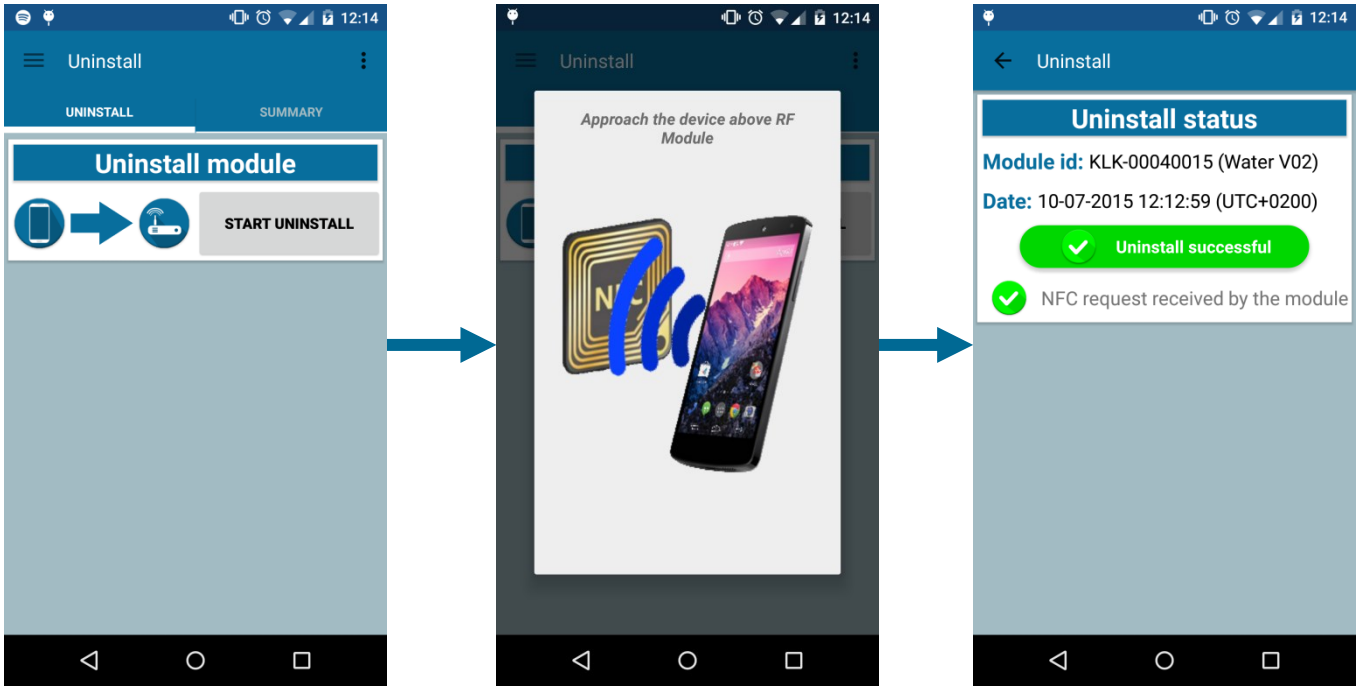


Figure 40: Uninstall operation with no headend communication

7.1.8.2 Summary

The “summary” tab in the “Uninstall” menu allows the operator to access information about the previous removal of Wirgrid RF module 169MHz. The details of a removal can be obtained by clicking on every item of the list (see Figure 41).

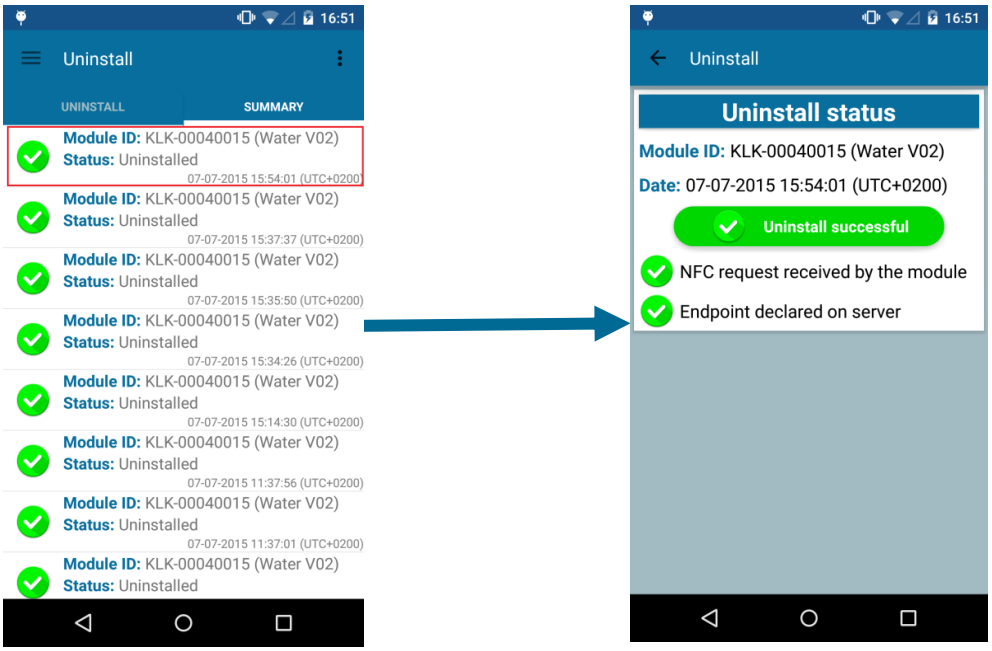


Figure 41: Summary get uninstall details

7.2 Other on-site maintenance checks

7.2.1 Mounting

During on-site maintenance, the operator must ensure that the Wirgrid RF Module 169MHz is still firmly tightened:

- Check M6 screws in case of wall mounting
- Check polyamide cable ties in case of tube mounting (vertical or horizontal)

7.2.2 Wiring to meter

During on-site maintenance, the operator must check the connection between the Wirgrid RF Module 169MHz and the meter:

- No degradation of the cable
- Ingress protection on:
  - Wirgrid RF Module 169MHz side
  - Meter side
  - Waterproof connector; make sure nuts are tightened properly

7.2.3 RF antenna

During on-site maintenance, the operator must check that the antenna of the Wirgrid Module 169MHz is still in optimized conditions to have an efficient RF transmission or reception:

- The antenna is at least at 20 cm far from any metallic part
- The cable between the meter and the Wirgrid RF Module 169MHz is not close to the antenna
- The RF antenna is in vertical position

- The Wirgrid RF Module 169MHz, when placed in a meter pit, is located as close as possible to the ground surface.

See also § 4.5.

7.2.4 Environment

During on-site maintenance, the operator must check that external environment do not degrade the performance of the Wirgrid RF Module 169MHz, such as clay, dust, water, etc...
In case of presence of theses interferences, remove them and clean the Wirgrid RF Module 169MHz, if necessary.

7.2.5 Fuse

As described in § 3.6, the Wirgrid RF Module 169MHz embeds a 0.75A fuse.
The F3 fuse is located on the bottom side, close to the battery. Its position is highlighted in red on the following picture:

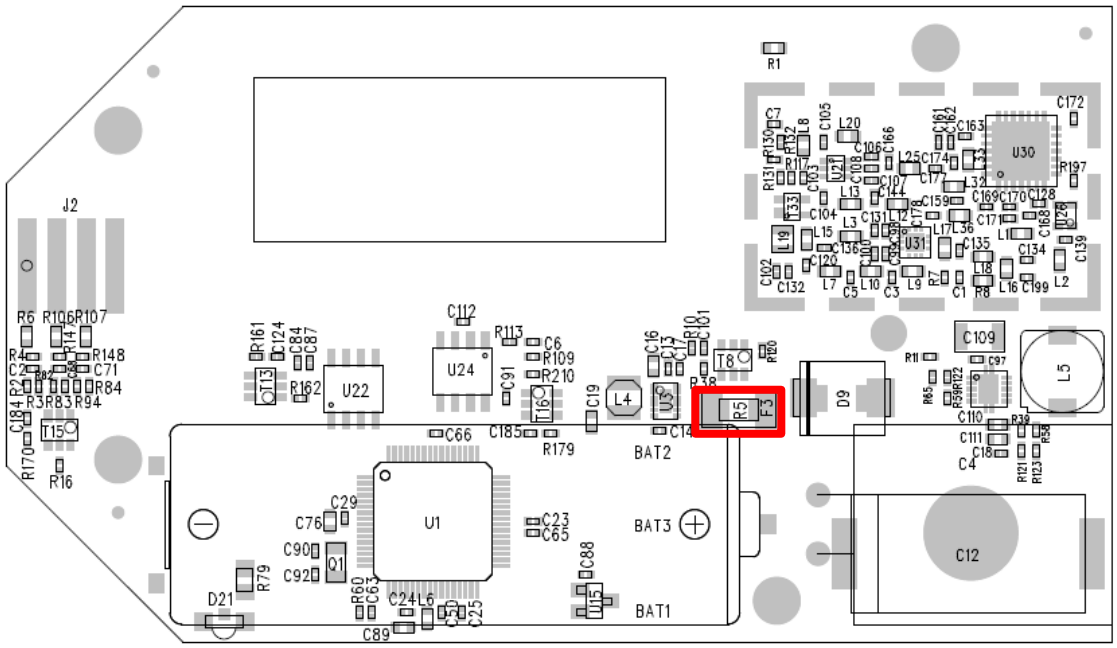


Figure 42: Position of the F3 fuse in the Wirgrid RF Module 169MHz

However, the F3 fuse is not accessible to any service person or operator due to the resin encapsulation. It cannot be extracted and changed during the product life cycle. If the fuse is broken due to a short circuit for instance, then the Wirgrid RF Module 169MHz is definitely considered as out of order. It cannot be repaired and must be replaced by another Wirgrid RF Module 169MHz.
The position of F3 is then provided here for information only.

7.3 OTA maintenance

7.3.1 Firmware upgrade

Firmware can be upgraded Over The Air with the following procedure:

- Firmware is broadcasted part by part by the Wirgrid Stations
- The Wirgrid RF Module 169MHz collect all parts, perform a firmware re-assembly and check
- Apply new firmware.
- In case of problem, the Wirgrid RF Module 169MHz automatically fallback on previous validated firmware.

7.3.2 OTA configuration

Parameters can be modified remotely using device management command frame. Mapping of parameters is defined in OpenAMR document.

8. Troubleshooting

8.1 Wirgrid NFC application

If installation cannot be fully completed, make sure the Wirgrid NFC application is working properly. Check:

- The installation of the Wirgrid NFC Application was properly done (see [2]).
- The permissions and folders structured were properly generated (see [2]).
- The user permissions are properly configured (see [2]).
- The application set-up is properly configured, especially login/passwords (see [2]).
- The NFC feature is enabled
- The GPS feature is enabled and GPS reception is OK
- A WAN connection (3G or WiFi) is established

8.2 RF Diagnosis

RF diagnosis can be used to check if the RF signals transmitted by the Wirgrid RF Module 169MHz are received by the Wirgrid Station. On the other side, it checks also that RF signals transmitted by the the Wirgrid Station are received by Wirgrid RF Module 169MHz. In each case, the associated RSSI are provided allowing checking if they are in line with the expected values or not.
This functionality can exhibits multipath fading issues or very harsh environment for the RF propagation.
See § 7.1.2 for further details.

8.3 Static data

Data are stored periodically in the NFC EEPROM of the Wirgrid RF Module 169MHz. They are then always available, including after the end of life of the product (battery out of order for instance).
See § 7.1.4 for further details.

8.4 Logs extraction

The NFC application allows retrieving LOG files of the Wirgrid RF Module 169MHz. The Wirgrid RF Module 169MHz has to be functional to run this application.
When a dysfunction is observed during the installation, check the LOG file to analyse the issue.
See § 7.1.5 for further details.

9. Recycling

As detailed in § 1.3, the Wirgrid RF Module 169MHz embeds:

- A Lithium Thionyl Chloride (Li-SOCI2) cell which contains 0.96g of lithium metal.
- A Hybrid Layer Capacitor which contains 0.01g of lithium metal.

These batteries must be recycled at the end of the product life.
The Li-SOCI2 battery and the HLC are located in a dedicated “outgrowth” at the bottom of the Wirgrid RF Module 169MHz as detailed on Figure 43.
The Wirgrid RF module 169MHz can be cut following the dotted lines to facilitate the access to the battery and the HLC.
The resin hardness (semi-rigid) inside the Wirgrid RF Module 169MHz allows an easy battery extraction.

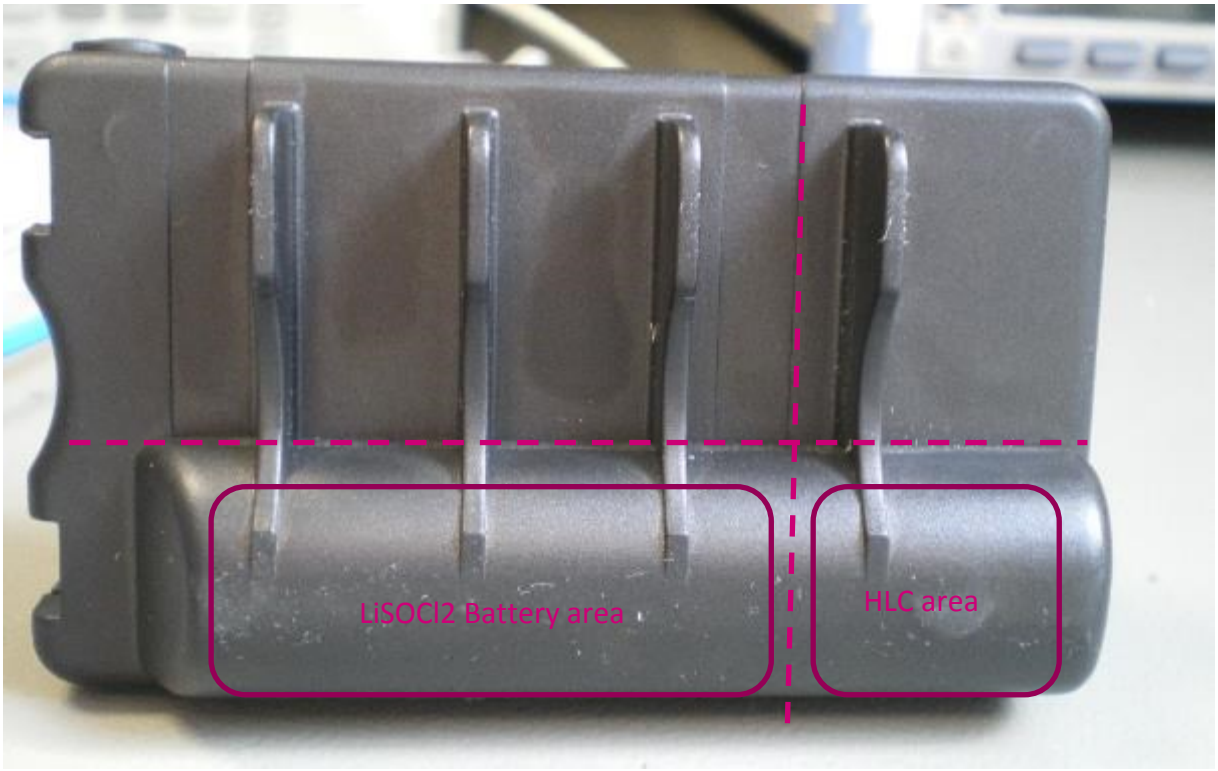


Figure 43: Location of the Li-SOCI2 battery and the HLC

10. Technical support

If technical support from Kerlink is required, please contact us at: support@kerlink.fr.

END OF DOCUMENT