IR868LR & IRUS915LR Infrared sensor Programming manual

Preliminary

1 Sommario

Preliminary

Preliminary

Preliminary

Document revision

Doc. Rev.	FW rev	Author	Note / remarks	Date
2.0	1.0.3	R&D laboratory GM	Document created. First issue	Jun, 2017

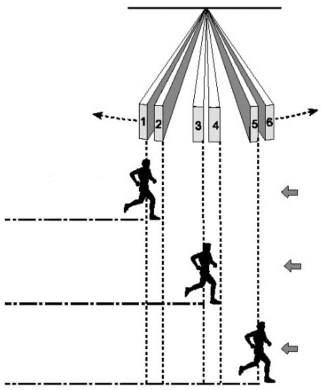
Preliminary

2 Introduction

The IR868LR family is an infrared passive sensor for indoor application.
All objects with a temperature above absolute zero emit heat in the form of radiation. Usually this radiation is not visible to the human eye it radiates at infrared wavelengths, but electronic devices designed for such a purpose can detect it.
The term *passive* in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects.
PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object.
The PIR sensor integrates a dual element pyroelectric detector for the detection of body heat in order to activate the alarm in case of intrusion. The sensor is suitable for apartments, offices, shops, buildings in general this thanks to the possibility to adjust its sensitivity, even for small areas such as motor homes. It has been designed to fit perfectly with any environment, aesthetically pleasing, compact and remarkably robust.
The use of digital technology obtained by the use of the microcontroller, coupled to the Fresnel optics it provides good accuracy in detecting (37 beams spread over 3 horizontal levels), immunity false alarms and high reliability without reducing the sensitivity of the IR868LR.
The device is protected against tampering of the container; in case of tampering it transmits the code that identifies this type of event.
It has a variable coverage from 8 to 20 meters adjustable with a trimmer with an aperture of 100° to adapt to installation requirements and it has a temperature compensation and a white light filter to minimize false alarms.
Of considerable importance is the low power consumption in stand-by mode that allows obtaining a remarkable battery life, minimizing its replacement during operation.
Furthermore, the joint allows to easily obtaining the right inclination in order to cover optimally the desired area.
IR868LR family is equipped with the radio module ACL868x that allows the device to connect to public or private networks that support the protocol LoRaWAN 1.0.1
PIR sensor is configured as a node of class A

This wireless motion sensor includes the following features:

- 16mt coverage area
- (37 beams on 3 horizontal planes, opening 100 °)
- Adjustable sensitivity detection level
- Adjustable inhibition time.
- Default four minutes transmitter lockout time after an alarm that helps to extend battery life
- Cover-activated tamper
- Supervisory signals transmitted every 50 minutes (default value, it can be modified) to the receiver system (ALIVE signal)
- Sensor reports Low battery level (trouble) to the receiver system
- Buzzer for low battery indication
- LoRaWAN 1.0.1 compliant radio module
- Three beams



Three beams feature

Preliminary

3 Installation

For obtain the maximum performance is mandatory follow few guidelines in installation procedures.
Because the sensor is based on passive infrared element detector, the key factor is carry on the PIR element the max level of infrared radiation. This is performed by the fresnel lens that focalize the IR on pyroelectric device.
The next figure show as the lens focalize the IR on PIR element; the measure is performed with the sensor fixed at 2,1 meter height and perpendicular to the floor, or tilted by 6 degree with an special mount bracket.

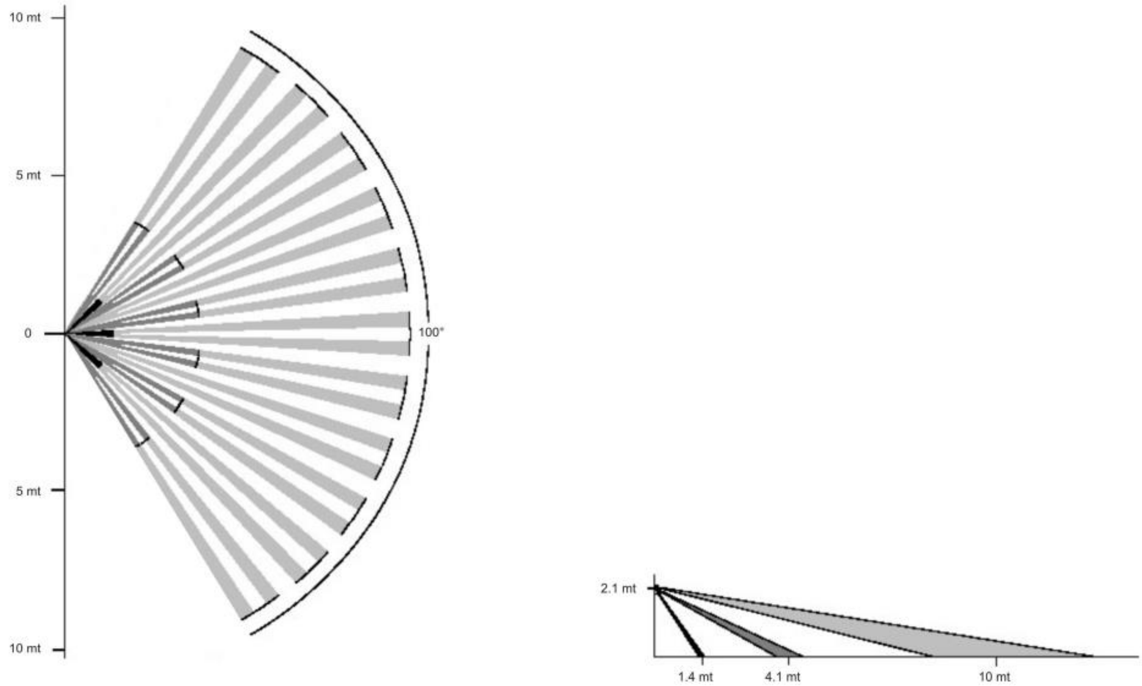


Fig. 2 (sensor tilted down to 6 degrees)

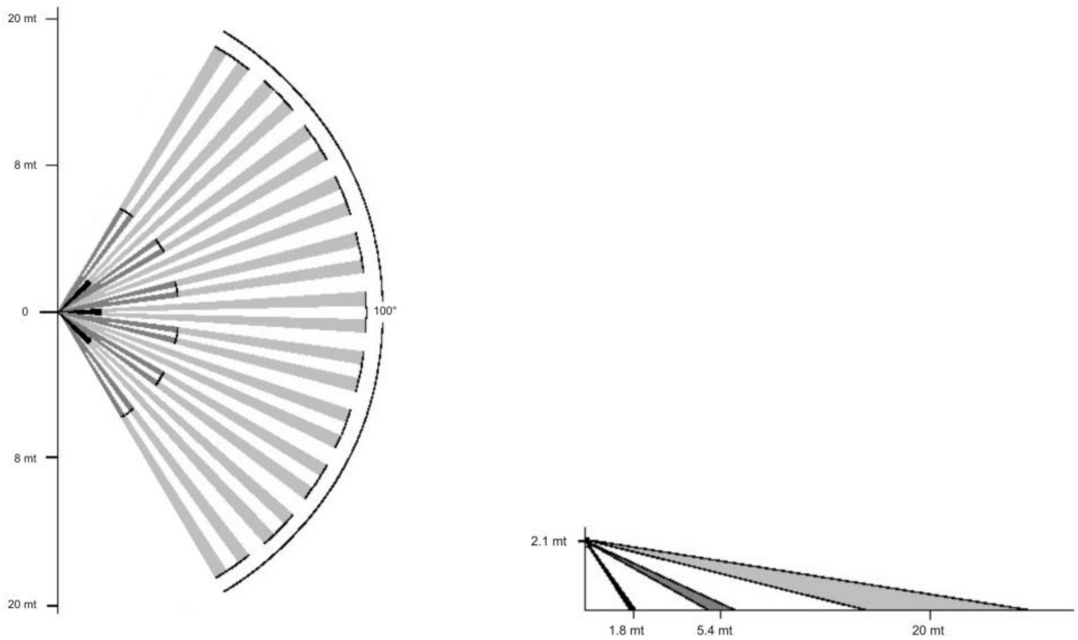


Fig. 3 (sensor mounted perpendicular to the floor)

3.1 Sensor fixing

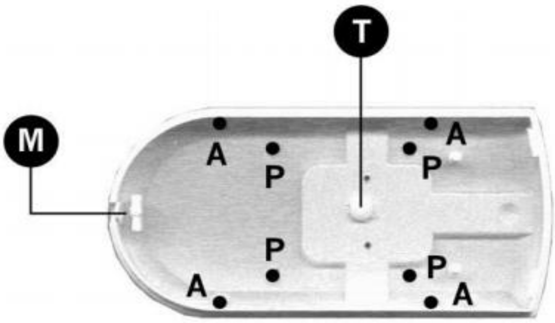


Fig. 1 Bottom of the container

3.1.1 Installation without the mount bracket:

- Remove the front cover and then the card by pulling back the plastic clip (M see Fig. 1 Bottom of the container).
- If necessary, hack the pre-printed holes in the box bottom, then drill holes
- 6 mm fixing in the wall, and fasten the plastic bottom oriented with the rounded part toward the floor to a height of 210 cm.
- Replace the card with the battery and then secure the cover previously removed.

3.1.2 Installation with the mount bracket:

- Fix the mount bracket at the bottom of the container using the two self-tapping screws.
- Fix the mount bracket to the wall at a height of 210 cm from the floor and then orient the sensor in appropriate direction to cover the affected area, while maintaining the sensor perpendicular to the floor or inclined towards the floor by about 6 ° degree
- Fit the batteries and reassemble the cover.

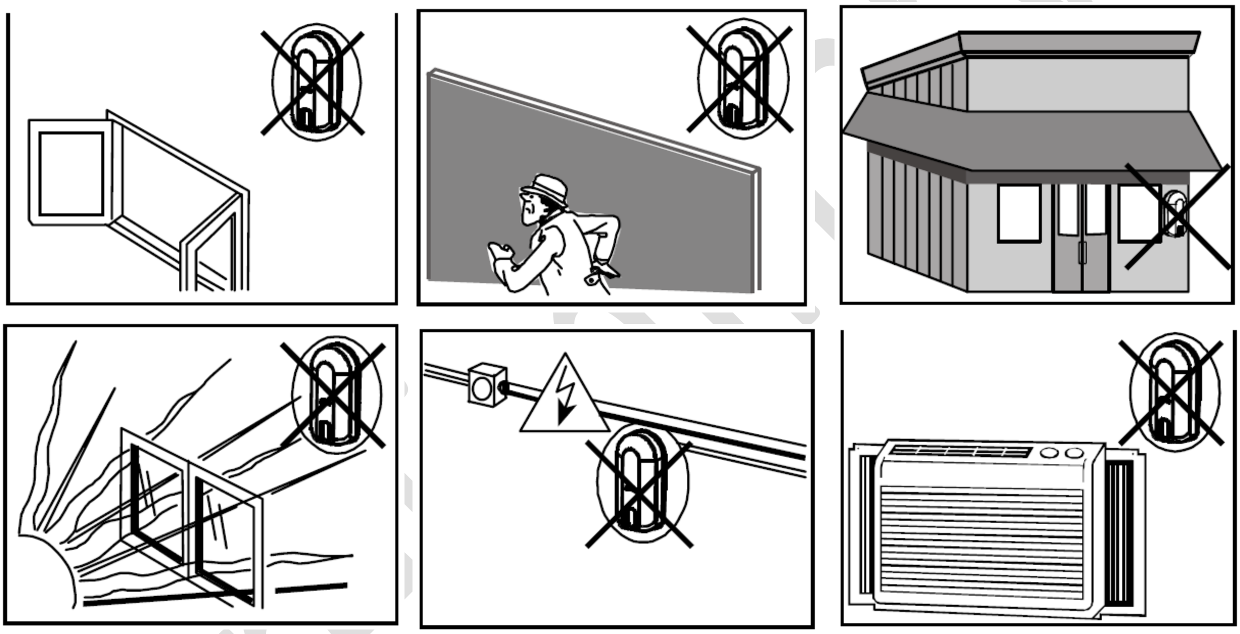
Please remember that mount bracket is optional accessories and must be ordered separately.

Preliminary

3.2 What to do and what don't to do

For proper installation and in order to avoid false alarms it is necessary to follow some rules for the sensor positioning:

- Position the sensor on stable and non-vibrated surfaces
- Do not install near sources of heat or sunlight
- Do not install near air currents
- Do not install near electrical wiring
- Do not run toward glass walls
- Windows should be closed in any area which has an armed motion sensor
- Position the sensor to protect an area where an intruder would be most likely to walk across the detection pattern
- Mount the sensor permanently on a flat wall or in a corner. Do not set it on a shelf.



3.3 Battery replacement

The sensor use a 3.6V 2700mAh size AA Primary Lithium thionyl chloride battery (LiSoCl2) Spiral type that supply the high energy pulse when the sensor transmit to the network.
To replacement it, please pay particular attention of the type of battery.

CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE.
DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS

Only authorized and qualified personnel may do any of the assembly, disassembly, installation and commissioning work.

When the system indicates the sensor battery is low, replace it immediately.
To replace the batteries, do the following:

- To remove the sensor cover, press a small flathead screw-driver into the slot on both sides of the sensor. This will disengage the clips holding the cover and base.
- Disconnect the battery cable from the board. Remove the old battery and replace it with another one as per battery specification reported in technical characteristic table.
- Insert the replacement battery and plug the cable in to connector (see below picture)

Preliminary

4 How the sensor works

The IR868LR family is developed for indoor use only and can be operating in several mode for meet several scenario request.
At the start-up time two message are transmits spontaneously for inform the server that sensor is power on:

- The first message is a string that representing the sensor model
  (see chapter 6.2.2 Message on port 5. *Presentation* pag.21)

- The second message is a string that report the version of the firmware, library and hardware
  (see chapter 6.2.4 Message on port 7. *FW release, library release, HW release* pag.21)

4.1 Confirmed an unconfirmed messages

The LoRaWAN protocol permits to send to the network server, messages of type confirmed or unconfirmed.
The difference is that unconfirmed messages are transmit one time only, and the sensor do not wait for any type of response from the server. The unconfirmed messages are preferred type for information that not have particular critical issues because is not guaranteed that messages are delivered to the destination.
Example of unconfirmed messages are ALIVE, LOW BATTERY and response from server Enquiry.

Differently, the confirmed messages are transmit several time (from 1 to 8 programmable) and the sensor wait to receive an acknowledge by the server.
The confirmed type messages are preferred for alarm event where the chance that message is not delivered is not permitted.

The programming of which messages are confirmed or not, is based on port.
Only by the shell in local mode is possible set which ports are confirmed type, with the appropriate command.
Is possible set up to 10 ports there are treated as confirmed type.

4.2 Alive

For get a periodic signal from the sensor, is available the ALIVE concept.
The ALIVE is a periodic message transmit to the server for inform it that sensor is operating correctly, this packet is transmitted on port 9 (see chapter 6.2.6 Message on port 9. *Alive* pag.22)

Preliminary

4.3 MODE of operation

The scenario where the sensor operate is called MODE and in this firmware revision four MODE are available.

4.3.1 MODE 1

This is the basic function mode where PIR sensor act as a typical Passive Infrared Sensor for burglar alarm.
When an intrusion is detected, the sensor send an immediate uplink message to the server reporting the alarm event.
Due to the nature of this type of function, the message of the return in the idle state is not transmit to the server (see the chapter MODE configuration flag4.4.1 Event flag pag.15)

When an intrusion transmission is performed, the sensor observe a period of transmit suspension called **"*PIR inhibit time*"**. This period is programmable from the server or via serial shell, between 20 and 600 seconds.
This behavior is necessary because if the sensor is installed in place with a high tax of walking people, at every detection will be generate a transmission to the network causing a consumption of battery energy and an abnormal occupancy of the radio network.
No other setup flag is needed if this mode is programmed.

4.3.2 MODE 2

With this mode, the PIR can work as a counter.
PIR sensor will send message only when a specific number of detection is reached, this counter is called ***Detection Counter Number***.
You can set from the server or via serial shell, a specific ***Detection Counter Number*** including between 1 and 65535.
PIR sensors will deliver an uplink message to server only when the ***Detection Counter Number*** you set is reach.
If desired, is possible reset the ***Detection Counter Number*** every time the transmission is performed.
If the ***Detection Counter Number*** is not reset, a total amount of detection counter is reported to the server.
For set this function refer to the chapter MODE configuration flag4.6 MODE configuration flag pag. 17

In MODE2 the **"PIR inhibit time"** delay is not applicable.

Example:
Detection Counter Number set to 15.

PIR will deliver an uplink message to server only when the detection of movement reach 15 counts.
It is totally independent by time: based on application and installation you can get this message in a frequent time or also at several days distance.
For example PIR installed in a corridor with huge number of people passage during the day hours but no passage in the night hours, PIR will deliver the message during the day time very frequency while during the night hours PIR will not send any message.
At every detection, a fast blinking of led can be observed.

4.3.3 MODE 3

With this mode, the sensor send messages at regular intervals called ***Periodic Interval Time*** as programmed from the server or via serial shell.
The ***Periodic Interval Time*** expressed in seconds, must be including between 15 and 864000 seconds (10 days).
The PIR will deliver to the server an uplink message with the ***Detection Counter Number*** collected from the sensor, when the specific interval time is elapsed.
If desired, is possible reset the ***Detection Counter Number*** every time the transmission is performed.
If the ***Detection Counter Number*** is not reset, a total amount of detection counter is reported to the server.
For set this function refer to the chapter MODE configuration flag4.6 MODE configuration flag pag. 17

Another feature that you have available, is the possibility of transmit a message when a programmed ***Detection Counter Number*** is reached, before the ***Periodic Interval Time*** is elapsed.
For do this, you set the appropriate flag in to the chapter MODE configuration flag4.6 MODE configuration flag pag. 17

In MODE3 the **"PIR inhibit time"** delay is not applicable.

Example:
Periodic Interval Time set to 10 minutes
Detection Counter Number set to 15

Sensor PIR will deliver a message to server every 10 minutes reporting the ***Detection Counter Number*** happened in this period of time.

Sensor will deliver to server a message reporting that the ***Detection Counter Number*** is 15 if this count is reach before the ***Periodic Interval Time*** of 10 minutes is elapsed, and if enable flag is set (see the chapter MODE configuration flag4.6 MODE configuration flag pag. 17)
At every detection, a fast blinking of led can be observed.

Preliminary

4.3.4 MODE 4

This mode was developed for working as a room or desk occupancy sensor.
You need to set a temporal interval called ***guard time***, that must be including between from 30 and 7200 seconds (2 hours)
The ***guard time*** is the period that the sensor must be not detect movement in own field of view, for indicate that room is empty.
*Note that if the **guard time** is abnormally high, when the room is leaved from the last occupant, the sensor will reporting the server the room empty message when **guard time** the is elapsed.*

At the time=0, sensor will consider the space as empty. As soon as a movement is detected, PIR will send a message to server for indicate that the room is occupied.
In that moment, PIR will activate the ***guard time*** and will start the countdown.
If during the ***guard time***, the sensor will detect a new movement, the ***guard time*** will re-start the countdown from the beginning. If during the ***guard time*** PIR will not detect any movement, PIR will deliver a new message to server for indicate that the room is now empty.
In this mode, the sensor send the information as state and not as event as per mode 1.
In MODE4 the **"PIR inhibit time"** delay is not applicable.
At every detection, a fast blinking of led can be observed.

Example:
guard time set to 900 (15 minutes)

At the first detection, the sensor will deliver a message to server for indicate that the room is occupied setting the bit 0 in the event flag (see the chapter MODE configuration flag4.4.1 Event flag pag.15)
At the same time, ***guard time*** will be activated and it will start the countdown.
If in these 15 minutes of ***guard time***, the sensor PIR will detect new movements, ***guard time*** will restart the countdown.
As soon as for 15 minutes (***guard time*** set) sensor PIR will not detect any movement, a new message will be sent to server for indicate the fact that now room is empty, clearing the bit 0 in the event flag (see the chapter MODE configuration flag 4.4.1 Event flag pag.15)

If you have a room occupied for 2 hours, PIR will send 2 messages: first one at time 0 when the first people got in the room, second one after 2 hours and 15 minutes after latest people left the room.

In this mode, you can also set a parameter called ***repetition time*** that ask to the PIR sensor to send message at a specific interval you set where it will tell you that room is still occupied.
This time can be set from minimum 20 seconds up to maximum value minor then ***guard time***.
You can choose if you want to have this repetition, function set or not. (see chapter MODE configuration flag 54.6 MODE configuration flag pag. 17)

Looking at above example, if you activate also ***repetition time*** at 10 minutes, in the 2 hours of room occupancy you will get:
First message as soon as the first people got in the room.
A message every 10 minutes that tell you that room is still occupied
A latest message after 2hrs and 15 minutes that tell you that the room is now free.

Be aware that repetition time send an uplink message to server and if it is set with short time it can reduce battery life time and don't respect the 1% duty cycle of LoRaWAN protocol.

4.4 Transmitted information

4.4.1 Event flag status

This byte is a mask bit flag that report the status of the sensor and is transmitted in several port and in various scenario.

Event Flag byte

	MSB 7	6	5	4	3	2	1	0 LSB
Bit value	**0**	**0**	**0**	**0**	**0**	**x**	**x**	**x**

[7:3] reserved

[2] **Battery status**
1 = low battery (below 25%)
0 = battery OK

[1] **Tamper**
1 = Tamper alarm
0 = No Tamper alarm

[0] **Intrusion Alarm detected**
1 = Intrusion alarm detected
0 = No Intrusion alarm detected

4.4.2 Detection counter number

This unsigned word (16 bits) report the number of the detection of the PIR sensor.

Detection counter number

	MSB 15	14	13	12	11	10	9	8 LSB
Bit value	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

	MSB 7	6	5	4	3	2	1	0 LSB
Bit value	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

[15:0] Number of detection

Preliminary

4.5 Device configuration flag

These flags, configure the device for operating in certain mode.

DEVICE CONFIGURATION FLAGS

	MSB 15	14	13	12	11	10	9	8 LSB
Bit value	0	0	0	0	0	0	0	x

	MSB 7	6	5	4	3	2	1	0 LSB
Bit value	0	0	0	0	0	0	x	x

[15:9] Unused - To be defined

[8] Setting LED always OFF
1: always OFF. The LED never will be ON
0: Led will be ON when PIR detect movement or when the radio transmit a message

[7:2] Unused - To be defined

[1] Setting Stop Blinking LED (unused in this firmware version)
1: stop blinking (unused in this firmware version)

[0] Reboot firmware
1 = reboot request

Preliminary

4.6 MODE configuration flag

All the MODE, have associated some flags that configure the behaviour of function.

MODE configuration Flag

	MSB 15	14	13	12	11	10	9	8 LSB
Bit value	0	0	0	0	0	0	0	0
	MSB 7	6	5	4	3	2	1	0 LSB
Bit value	0	0	0	0	x	x	x	x

[15:4] Unused
To be defined

[3] Transmit 'room busy' periodically at the ***repetition time*** interval (only for MODE 4)
1 = send a 'Room occupied' message periodically
0 = DO NOT sent (defaut value)

[2] TBD
1 = TBD
0 = TBD

[1] Transmit if ***Detection Counter Number*** if reached before ***Periodic Interval Time*** is elapsed (only for MODE 3)
1 = send ***Detection Counter Number*** is reached
0 = send only if ***Periodic Interval Time*** is elapsed (default value)

[0] ***Detection Counter Number*** reset (MODE 2 and MODE 3)
1 = reset request
0 = Not reset (default value)

Preliminary

5 Technical specification

Specifications				
Parameters	**Min**	**Typ**	**Max**	**unit**
Frequency band IR868LR	-	867.1 < f < 868.5	-	MHz.
IRUS915LR	-	902 < f < 928	-	MHz
RF power (EU868)	2	-	14	dBm EIRP
RF power (EN915)	2		18	dBm EIRP
Modulation		LoRa ™		
Protocol	LoRaWan 1.0.1 Class A			
RX sensivity			-138	dBm
Battery	1pz AA 3.6V lithium-thionyl 2700mA By EVE P/N ER14505V			
Temperature range	-20	+25	+55	°C
Antenna	-	PCB printed	-	
Power supply	2.8	3	3.6	Vdc
Consumption standby	13	15	17	uA
Consumption TX IR868LR	40	45	55	mA
Consumption TX IRUS915LR	60	70	80	mA
Alarm inhibit time	5	240 (default)	600	s
Dimension	120 x 60 x 45			mm
Reference standards	EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 - EN 62311:2008 EN 301 489-1 V1.9.2 EN 301 489-3 V1.6.1; Part 3 EN 300 220 V2.4.1			

Preliminary

6 Payload

6.1 Overview

All the messages exchanged between sensors and server are reduced to the strictly necessary for transport of the information requested. No other types of protocols are used for transport the information on top the LoRaWAN protocol; this one is all the needed for ensure the correct relay of information.
All message are transmitted in RAW format.
The maximum length of any messages in uplink direction is limited to 11 bytes. This precautions is necessary for don't trespassing the maximum length of 11 bytes in US915 band at DR0.
The message from sensor node to the server (uplink direction) don't expected any type of control how message length, checksum or any other type of error correction.
The messages from server to the sensor node (downlink direction) are completed with length and checksum control. This precaution is necessary for avoid that wrong messages transmitted from the server may put the sensors in unpredictable state.
The messages received from the sensors, are confirmed to the server by sending ACK to inform him of the correct receipt, or NACK in case of corrupted message. If nothing message is received from sensor, this one no respond anything.

The information that the sensor is able to transmit, are organized on several port number.
This mechanism is used both for uplink that downlink messages.

Preliminary

Uplink message list:

From sensor to server (uplink)	Port #	Example	Payload raw (example)
Last sequence downlink	2	15	0000000F
Presentation	5	IR868LR	49523836384C52
Serial Number	6	Serial number of device	AA112233445566FF
FW release, library release, HW release	7	Firmware release 1.11.2639 LoRaWan stack Release 4.3.15 Hardware release B	010B0A4F04030F42
Battery level	8	Level in percentage, 94%	5E
Alive	9	Level in percentage, 94% Event flag (tamper alarm)	5E02
ACK	10	Ack on port 9	41636b09
Event + counter	20	Event flag, number of detection counter (flag tamper+PIR) and 15 detection	03000F

Downlink message list:

From server to sensor (Downlink)	Port #	From server	Example Payload raw	Response from the sensor
Request last downlink counter sequence number	2	Enq	05456E715F	The last SEQDN received
Request sensor model	5	Enq	05456E715F	CM868LRCB
Request Serial Number	6	Enq	05456E715F	Serial number
Request FW, lib & HW release	7	Enq	05456E715F	Fw, lib & HW revision
Request Battery level	8	Enq	05456E715F	Battery level in percentage
Alive interval setting	9	Set the alive interval to 2 hours (7200 seconds)	041C2038	Ack or Nack
PIR Inhibit time	11	Set the inhibition time for the PIR sensor	0400F0F4	Ack or Nack
Mode settings	12	Set the scenario		Ack or Nack
Flag parameters settings	13	Set various flags	040F0803	Ack or Nack

6.2 Uplink message specification

In this chapter will be analyzed in detail the message transmit in specific port.

6.2.1 Message on port 2. *Last downlink sequence number received*

This message is basically a service message and report to the server the last downlink counter value received from the sensor.
The downlink counter is part of authentication mechanism of LoRaWAN protocol and avoid that the previously message can be reproduced and retransmit from the server to sensor in a typically *man-in-the middle* attach.
If a duplicated downlink counter is received, a transmission on port 2 is generated with the current downlink counter number. If the server is able to rebuild the message with the next counter number, the sensor will accept the message.
The Last Downlink number message is provided also if the server send an "Enq" on port 2.
(ref. chapter 6.4.1)

6.2.2 Message on port 5. *Presentation*

The payload contains the sensor model string in ASCII format.
For this specific sensor, the string IR868LR is transmitted in HEX format 49523836384C52
The presentation message is sent ONLY every times the sensor performs a reboot.
The reboot is caused by power-on reset or by a server command.
The presentation message is provided also if the server send an "Enq" on port 5. (ref. chapter 6.4.2)

6.2.3 Message on port 6. *Serial Number*

The payload contains the serial number string in Hexadecimal format. 8 bytes length (e.g. AA112233445566FF)
The Serial Number message is provided ONLY if the server send an "Enq" on port 6. (ref. chapter 6.4.3)

6.2.4 Message on port 7. *FW release, library release, HW release*

The payload contains the firmware release, the LoRaWAN Stack release and the Hardware revision.
This information is provided at the start-up of the sensor, and if the server send an "Enq" on port 7. (ref. chapter 6.4.4)
The fields are not divided by separator char.

An example of message is: 010B0A4F04030F42
Where:

Value HEX	Description	width	range	meaning
01	Major release	1 byte	Binary from 0 to 0xFF Hex	Firmware release 1.11.2639
0B	Minor release	1 byte	Binary from 0 to 0xFF Hex	
0A 4F	Build	2 byte	Binary from 0 to 0xFFFF Hex	
04	Major rel. of LoRaWAN stack	1 byte	Binary from 0 to 0xFF Hex	LoRaWAN stack release 4.3.15
03	Minor rel. of LoRaWAN stack	1 byte	Binary from 0 to 0xFF Hex	
0F	Build rel. of LoRaWAN stack	1 byte	Binary from 0 to 0xFF Hex	
42	Hardware revision	1 byte	ASCII Format from A to Z	HW rel. B

Preliminary

6.2.5 Message on port 8. *Battery level*

The payload contains the battery charge percentage level.
The battery Level message is sent spontaneously on port 8 if the battery charging level is below 25% or if the server send an "Enq" on port 8. (ref. chapter 6.4.56.4.2)

This message is automatically repeated every 6 hours when the battery is below the 25% of charge level.

An example of message is: 5E
Where:

Value HEX	Description	width	range	meaning
5E	Percentage of battery charge	1 byte	Binary from 0 to 0x64 hexadecimal	Level battery from 0% to 100%

6.2.6 Message on port 9. *Alive*

The payload contains the ALIVE message.
This type of message is intended ONLY to verify if the sensor is operating, by sending a message at regular interval.
The programmable interval is comprise from 15 to 172800 seconds (48 hours)
In this message, in the payload are reported other information useful for know the sensor state.
In this message is also present the battery percentage level charge and the flags of the status of the sensor.

An example of message is: 5E03
Where:

Value HEX	Description	width	range	meaning
5E	Percentage of battery charge	1 byte	From 0 to 0x64 Hex	Level battery from 0% to 100%
03	Event Flag (see chapter 4.4 **6.3 Transmitted information** pag.15)	1 byte	From 0 to 0x0F Hex	Report the status of the device

Preliminary

6.3.1 Message on port 10. *Ack / Nack*

For inform the server that messages are received, the sensor confirm to it sending a message of ACK or NACK, followed by the number of port where the message is incoming.
This mechanism is used ONLY for messages that not expected an explicit response with data from sensor. For example, ALIVE setting interval, do not response with data, but confirm the reception with ACK or NACK.
The messages that expected an explicit response from sensor, do not response with ACK/NACK but directly with data. An example of that is the request of firmware revision.
ACK is transmitted if the received messages are correct in the length, checksum and semantic.
If the received message is corrupt, the sensor response is NACK; in either the cases ACK and NACK is followed by the number of port where the message are incoming.

An example of message are: 41636b09 (Ack on port 9 for alive setting message ok)
4e61636b09 (Nack on port 9 for alive setting message corrupted)

Where:

Value HEX	Description	width	range	meaning
41636b 4e61636b	Ack Nack	3 or 4 bytes	Not applicable	Ack or Nack
09	Port	2 byte	0x01 to 0xDC Hex	Port of incoming message

Preliminary

6.3.2 Message on port 20. *Alarm event*

The sensor, basically is a device that send alarm events when the the PIR sensor detect a presence.

The payload is in raw format (3 Bytes)

Name	Type	Function
EVENT	Unsigned char (8 bits)	Event flag. See chapter 4.4.1 Event flag status pag.15
CONTER	Unsigned int (16 bits BIG ENDIAN)	***Detection Counter Number***

The sensor sends **spontaneously** a messages with the above structure to the server if :

- If the tamper switch change its status (from CLOSE to OPEN and vice versa)
- If the battery level reaches the 25% of the full charge.
- If **MODE 1** has been programmed, the sensor send ***Detection Counter Number*** value to the server every time an intrusion is detected. ***Detection Counter Number*** is never reset.
- If **MODE 2** has been programmed, the sensor send a message to the server if ***Detection Counter Number*** reach the programmed value.
- If **MODE 3** has been programmed, the sensor send a message when ***Periodic Interval Time*** is elapsed or if ***Detection Counter Number*** reach the programmed value
- If **MODE 4** has been programmed, the sensor send a message to the server when the room has been occupied, and when the last occupant leave the room and the ***guard time*** is elapsed.

Preliminary

6.4 Downlink message specification

The sensor is fully configurable from application server.
The nature of LoraWAN class A permits to exchange messages only when the end-device transmits data to the server (uplink).
After sending the data, the end-device enable two RX windows to receive packets from the server.
In these windows, the server has the opportunity to send the data at the end node using specifics LoRaWAN protocol ports.
Downlink communications from the server at any other time different from the above mentioned RX windows, will have to wait until the next scheduled uplink occurs.

In function on which port the message is received, the sensor perform different action; for example the ***'Enq'*** message is the same for several request, but assume different role based on port this, which is received.

Unlike upload messages, the downlink messages are completed with information as message length and checksum control. This is a precaution from sensor side for to avoid that wrong messages from server, cause unpredictable behaviour of the sensor.

Every message from server to sensor has 1 byte header that contains the total length of the message and 1 byte footer that contains the checksum.
The checksum is calculated doing a logical XOR of all the bytes on the message except the last one, which is the checksum itself.
Refer to ***Message Builder*** tool to easily built and verify the correctness message to send to the sensor.
Refer to Message Builder tool to easily built and verify the correctness of the message to send to the sensor.

Header (1 Byte) Total message length	Payload contain the data	Footer (1 Byte) Checksum byte

6.4.1 Message on port 2. *Enquiry last downlink sequence number*

This message from server, request the last sequence counter received by device.
When the sensor receive an ***'Enq'*** on port 2, the device reply with a message that contains a 32 bits word with the last sequence counter received. The value is represented in BIG ENDIAN.

An example of message is: 05456E715F
Where:

Value HEX	Description	width	range	meaning
05	Message length	1 byte	From 0 to 0xFF HEX	Total length 5 bytes
456E71	Payload '*Enq*'	3 bytes	Enq	Enquiry command
5F	Message checksum (XOR)	1 byte	From 0 to 0xFF HEX	Checksum

The device replies with the last sequence counter received. (ref. chapter 6.2.1 pag.216.2.2)

6.4.2 Message on port 5. *Enquiry model*

This message from server, request the model of the sensor.
When the sensor receive an ***'Enq'*** on port 5, the device reply with a message contains our model.
Example 49523836384C52 (IR868LR)

An example of message is: 05456E715F
Where:

Value HEX	Description	width	range	meaning
05	Message length	1 byte	From 0 to 0xFF hexadecima	Total length 5 bytes
456E71	Payload '*Enq*'	3 bytes	Enq	Enquiry command
5F	Message checksum (XOR)	1 byte	From 0 to 0xFF hexadecima	Checksum

The device replies with model string. (ref. chapter 6.2.2 pag. 21)

6.4.3 Message on port 6. *Enquiry Serial number of device*

This message from server, request the serial number of device.
When the sensor receive an ***'Enq'*** on port 6, the device reply with a message contains our S/N.
Example AA112233445566FF

An example of message is: 05456E715F
Where:

Value HEX	Description	width	range	meaning
05	Message length	1 byte	From 0 to 0xFF hexadecima	Total length 5 bytes
456E71	Payload '*Enq*'	3 bytes	Enq	Enquiry command
5F	Message checksum (XOR)	1 byte	From 0 to 0xFF hexadecima	Checksum

The device replies with own serial number. (ref. chapter 6.2.3 pag.21)

Preliminary

6.4.4 Message on port 7. Enquiry Firmware release, LoraWAN Lib release, HW revision

This message from server, request the revision of device.
When the sensor receive, an ***'Enq'*** on port 7, the device transmit a message that contains:

- Firmware release
- LoRaWAN Library release
- Hardware revision

The Firmware release and LoRaWAN Library, are identified by the scheme, MAJOR, MINOR and BUILD.
The MAJOR and MINOR value, they will have value from 0 to 255 (0x0 to 0XFF); the BUILD will be a value from 0 to 65535 (0x0 to 0xFFFF).
Hardware revision will be only literal value in the range A to Z.

For example:
Firmware release 1.11.2639, LoRaWan stack Release 4.3.15, Hardware release B
Will be reported to the server with the message 010B0A4F04030F42.

An example of message is: 05456E715F
Where:

Value HEX	Description	width	range	meaning
05	Message length	1 byte	From 0 to 0xFF Hex	Total length 5 bytes
456E71	Payload '*Enq*'	3 bytes	Enq	Enquiry command
5F	Message checksum (XOR)	1 byte	From 0 to 0xFF Hex	Checksum

The device replies with firmware, library and Hardware revision. (ref. to chapter 6.2.4 pag. 21)

Preliminary

6.4.5 Message on port 8. *Enquiry Battery level*

This message from server, request the battery level of device.
When the sensor receive an ***'Enq'*** on port 8, the device reply with the value in percentage of the battery level, the value is in the range 0 to 100%.
The percentage is transmitted in Hexadecimal format.

An example of message is: 05456E715F
Where:

Value HEX	Description	width	range	meaning
05	Message length	1 byte	From 0 to 0xFF HEX	Total length 5 bytes
456E71	Payload '*Enq*'	3 bytes	Enq	Enquiry command
5F	Message checksum (XOR)	1 byte	From 0 to 0xFF HEX	Checksum

The device replies with battery level in percentage.

6.4.6 Message on port 9. *ALIVE setting interval value*

This message from server set the value of the timeout for the ALIVE signal.
This value is expressed in seconds and is in the range 60 to 172800 seconds (48 hours).
When a valid interval value is received, the sensor transmit a ACK message to the server with the number of port where this message has received, if the interval is out of range or the message is corrupted, the sensor reply to the server with NACK. (ref. chapter 6.3.1).

The factory default value is: 3000 seconds (50 minutes)

An example of message is: 0400000BB8B7
Where:

Value HEX	Description	width	range	meaning
06	Message length	1 byte	From 0 to 0xFF Hex	Total length 10 bytes
00000BB8	Interval in seconds	4 bytes	From 60 to 172800 seconds	3000 seconds
B7	Message checksum (XOR)	1 byte	From 0 to 0xFF Hex	Checksum

The device replies with Ack or Nack. (ref. chapter 6.2.6 pag. 22)

Preliminary

6.4.7 Message on port 13. *Device configuration flags*

The Device configuration flags command, allow to perform action on behavior of the sensor, or for command several actuators inside the device.

For complete description of this flag, see chapter 4.5 Device configuration flag pag. 16

An example of message is: 040F0803
Where:

Value HEX	Description	width	range	meaning
04	Message length	1 byte	From 0 to 0xFF Hex	Total length 4 bytes
0F08	Bit Mask Flag	2 bytes	From 0 to 65535	Refer to chapter 4.5
03	Message checksum (XOR)	1 byte	From 0 to 0xFF Hex	Checksum

The device replies with Ack or Nack. (ref. chapter 6.3.1 pag. 23)

Preliminary

7 Uart Interface

All of the module’s settings and commands are transmitted over UART using the ASCII interface.
All commands need to be terminated with <CR><LF> and any replies they generate will be terminated by the same sequence.
The settings for the UART interface are 115200 bps, 8 bits, no parity, 1 Stop bit, no flow control. The baud rate cannot be changed.
Because the sensor operate in CLASS A in low power state, the UART is put in idle mode for reduce the consumption. For wake the processor is need send a break condition with length equal to 10mS.
The processor remain in wake condition until the UART continues to receive characters; if the UART don’t receive data for above 15 seconds, the processor return in sleep mode and for wake it, is necessary send again the break condition.

8 Command Syntax

To issue commands to the ACL868 module, the user sends keywords followed by optional parameters. Commands and parameters are case insensitive. Hex input data can be uppercase or lowercase.
String text data, such as **ON** or **OFF**, is case-insensitive.
Depending on the command, the parameter may expect values in either decimal or hexadecimal form; refer to the command description for the expected form. For example, when configuring the frequency, the command expects a decimal value in Hertz such as **869525000** (869.525 MHz).
Alternatively, when configuring the LoRaWAN device address, the hex value is entered into the parameter as **aabbccdd**. To enter a number in hex form, use the value directly. For example, the hex value **0xFF** would be entered as **FF**.

8.1 Command organization

There are four general command categories, as shown in Table 1 Command type

Command	Keyword	Description
General	*none*	Issues various type of command ‘*general purpose’*
LoRaWAN™ Protocol	<**mac**>	Issues LoRaWAN protocol network communication behaviours, actions and configurations commands.
Device	<**dev**>	Issues device specific configurations, directly accessing and updating the mode of function
Radio	<**rad**>	Issues radio specific configurations, directly accessing and updating the transceiver setup.
System	<**sys**>	Issues system level behaviour actions, gathers status information on the firmware and hardware version.

Table 1 Command type

All configuration must be save in the flash memory to avoid lost configuration on the next reboot or reset.
The MAC command, involve the communication behaviours in the LoRaWAN network.
For use the new configuration, the module must be reset with a reboot command or power-on cycle.

Preliminary

9 Shell access level

To gain the access to the shell, is mandatory supply the password.
The shell is protected by two password with different level of privileges, in this document the passwords are named USER and SUPER-USER and are abbreviated with **US**(user) and **SU**(super-user) acronym.
The various shell prompt are:

> when no password is entered. In this state the actions are in very limited.
US> when the user password in entered. In this state the actions are partially limited.
SU> when the super user password in entered. In this state the actions are totally enabled.

Note

When the SAVE command is entered for store the parameters in flash memory, the access level will be revoke and the prompt return to ***>*** *automatically*

The command for switch troughs the levels is **pw** followed by desired level.

To gain access with user privileges enter: **pw user** followed by the password
To gain access with super-user privileges enter: **pw suser** followed by the password

The default passwords are different for any sensors and are supplied by ASCOEL.
The passwords are modifiable by respective user or super-user.

10 General Command

General commands are used for execute action without supply parameters.

Command	Password	Description
info	no	Show various information about the sensor. The informations are depending of the device type.
reboot	no	Reboot the sensor immediately.
default	super-user	Load the default parameters. The parameters are depending of the device ty
save	no	Store ALL parameters in flash memory.
pw	yes	To change password or gain access to the shell

11 MAC Command

MAC commands are common for all type of the sensors and define the access behaviour to the LoRaWAN network.
Because the MAC commands are very important for the correct operating of the sensors, for varying the parameters is mandatory accessing to the shell with the super-user password
For showing some parameters, the user level is sufficient.

For access to the shell in super-user mode:
>pw suser *<user password>* The prompt will switch to **SU>**

SU>mac <action> <parameter> <value>

11.1 DevEui Command

Parameter	action	Password	Description
deveui	set	locked	This command sets the globally unique device identifier for the module. The module contains a pre-programmed unique EUI and can retrieved using the **`mac get deveui`** command. This command is not available for the user.
	get	User	This command returns the globally unique end-device identifier, as set in the module. Default: 0000000000000000 Example: **`mac get deveui`** *Response example*: **`deveui 0E7E346401AB02CC`** 8-bytes hexadecimal number representing the device EUI.

Preliminary

Preliminary

11.2 Devaddr Command

Parameter	action	Password	Description
devaddr	set	Super-user	4-byte hexadecimal number representing the device address, from 00000000 – FFFFFFFF. The address must be unique in the current network and is used only for ABP (activation by personalization) devices. For OTAA (over-the-air activation) this parameter is useless. Default: 0000000000000000 <u>Example:</u> **`mac set devaddr 01AB02CC`** *<u>Response</u>*: **`devaddr OK`** *if address is valid* **`devaddr error: invalid value`** *if address is out of range*
	get	User	This command will return the current end-device address of the module. Default: 00000000 *<u>Example</u>*: **`mac get devaddr`** *<u>Response example</u>*: **`devaddr 01AB02CC`** 4-bytes hexadecimal number representing the device address.

11.3 Appeui Command

Parameter	action	Password	Description
appeui	set	Super-user	8-byte hexadecimal number representing the application EUI. This command sets the application identifier for the module. The application identifier should be used to identify device types (sensor device, lighting device, etc.) within the network. Default: 0000000000000000 <u>Example:</u> **`mac set appeui A456FFC199A123F5`** *<u>Response</u>*: **`appeui OK`** *if value is valid* **`appeui error: invalid value`** *if value is out of range*
	get	User	This command will return the current application EUI of the module. Default: 0000000000000000 *<u>Example</u>*: **`mac get appeui`** *<u>Response example</u>*: **`appeui A456FFC199A123F5`** 8-bytes hexadecimal number representing the application EUI.

11.4 NwkSkey Command

Parameter	action	Password	Description
nwkskey	set	Super-user	16-byte hexadecimal number representing the network session key. The key should remain the same until the communication session between devices is terminated. Default: 2B7E151628AED2A6ABF7158809CF4F3C Example: **`mac set nwkskey A456FFC199A123F501FA1345CF34F516`** *Response*: **`nwkskey OK`** *if value is valid* **`nwkskey error: invalid value`** *if value is out of range*
	get	Super-user	This command will return the current network session key. Default: 2B7E151628AED2A6ABF7158809CF4F3C *Example*: **`mac get nwkskey`** *Response example*: **`nwkskey 2B7E151628AED2A6ABF7158809CF4F3C`** 16-bytes hexadecimal number representing the network session key.

11.5 AppSkey Command

Parameter	action	Password	Description
appskey	set	Super-user	16-byte hexadecimal number representing the application session key. This key is unique, created for each occurrence of communication, when the network requests an action taken by the application Default: 2B7E151628AED2A6ABF7158809CF4F3C Example: **`mac set appskey A456FFC199A123F5`** *Response*: **`appskey OK`** *if value is valid* **`appskey error: invalid value`** *if value is out of range*
	get	Super-user	This command will return the current application session key. Default: 2B7E151628AED2A6ABF7158809CF4F3C *Example*: **`mac get appskey`** *Response example*: **`appskey 2B7E151628AED2A6ABF7158809CF4F3C`** 16-bytes hexadecimal number representing the application session key.

Preliminary

11.6 Appkey Command

Parameter	action	Password	Description
appkey	set	Super-user	16-byte hexadecimal number representing the application key. The application key is used to identify a grouping over module units which perform the same or similar task Default: 2B7E151628AED2A6ABF7158809CF4F3C Example: **`mac set appkey A456FFC199A123F5`** *Response*: **`appkey OK`** *if value is valid* **`appkey error: invalid value`** *if value is out of range*
	get	Super-user	This command will return the current application key. Default: 2B7E151628AED2A6ABF7158809CF4F3C *Example*: **`mac get appkey`** *Response example*: **`appkey 2B7E151628AED2A6ABF7158809CF4F3C`** 16-bytes hexadecimal number representing the application session key.

11.7 Pwridx Command (in current FW revision this command is disabled)

Parameter	action	Password	Description
pwridx	set	Super-user	Decimal number representing the index value for the output power, from 0 to 5 for 433 MHz frequency band and from 1 to 5 for 868 MHz frequency band. Default: 5 Example: **`mac set pwridx 5`** *Response*: **`pwridx OK`** *if value is valid* **`pwridx error: invalid value`** *if value is out of range*
	get	User	This command will return the current application session key. Default: 5 *Example*: **`mac get pwridx`** *Response example*: **`pwridx 5`** 1-bytes decimal number representing the RF power.

11.8 Dr Command (in current FW revision this command is disabled)

Parameter	action	Password	Description
dr	set	Super-user	Decimal number representing the data rate, from 0 and 7, but within the limits of the data rate range for the defined channels. This command sets the data rate to be used for the next transmission. Please refer to the *LoRaWAN™ Specification* for the description of data rates and the corresponding spreading factors Default: 0 Example: **`mac set dr 3`** *Response*: **`dr OK`** *if value is valid* **`dr error: invalid value`** *if value is out of range*
	get	User	This command will return the current datarate. Default: 0 *Example*: **`mac get dr`** *Response example*: **`dr 3`** 1-bytes decimal number representing the data rate.

11.9 Adr Command

Parameter	action	Password	Description
adr	set	Super-user	This command turn ON or OFF the adaptive data rate (ADR) control. The server is informed about the status of the module's ADR in every uplink frame it receives from the ADR field in uplink data packet. If ADR is enabled, the server will optimize the data rate and the transmission power of the module based on the information collected from the network. Default: ON Example: **`mac set adr ON`** *Response*: **`adr OK`** *if value is valid* **`adr error: invalid value`** *if value is out of range*
	get	User	This command will return the state of ADR control. Default: ON *Example*: **`mac get adr`** *Response example*: **`adr OFF`** ON or OFF string.

11.10Confirmed/unconfirmed port Command

Parameter	action	Password	Description
confport	set	Super-user	A confirmed message will expect an acknowledgment from the server; otherwise, the message will be retransmitted by the number indicated by the command **`mac set retry <value>`**, whereas an unconfirmed message will not expect any acknowledgment back from the server. Please refer to the *LoRaWAN™ Specification* for further details. The **confport** command, permit to set until 10 ports where the message will be treated as confirmed type. For example, if desired that message send on the port 20 will be confirmed type, the command is **`mac confport 20`**. Is possible set up to 10 ports for use as confirmed, Every time that **`mac confport <port number>`** is entered, the *<port number>* is added to the list. If the list is full or if the port number is invalid or already present, the processor answer with error message. For delete all list, the command is: **`mac confport none`** Default: 0 (no confirmed port) Example: **`mac set confport 3`** *Response*: **`confport OK`** *if value is valid* **`confport error: invalid value`** *if value is out of range*
	get	User	This command will return the list of *confirmed ports*. Default: 000 000 000 000 000 000 000 000 000 000 *Example*: **`mac get confport`** *Response example*: **`Confport 008 020 031 000 000 000 000 000 000 000`** A list of decimal values of port number.

Preliminary

11.11 Retry Command

Parameter	action	Password	Description
retry	set	Super-user	Decimal number representing the number of retransmissions for an uplink confirmed packet, from 1 to 8. Default: 1 Example: **`mac set retry 3`** *Response*: **`retry OK`** *if value is valid* **`retry error: invalid value`** *if value is out of range*
	get	User	This command will return the current retry number. Default: 0 *Example*: **`mac get retry`** *Response example*: **`retry 3`** 1-bytes decimal number representing the number of retransmissions, from 1 to 8.

11.12 Link Check Command

Parameter	action	Password	Description
linkchk	set	Super-user	Decimal number that sets the time interval in seconds for the link check process, from 0 to 65535. This command sets the time interval for the link check process to be triggered periodically. A `<value>` of '0' will disable the link check process. When the time interval expires, the next application packet that will be sent to the server will include also a link check MAC command. Please refer to the *LoRaWAN™ Specification* for more information on the Link Check MAC command Default: 0 Example: **`mac set linkchk 600`** *Response*: **`linkchk OK`** *if value is valid* **`linkchk error: invalid value`** *if value is out of range*
	get	User	This command will return the current link check interval. Default: 0 *Example*: **`mac get linkchk`** *Response example*: **`linkchk 600`** Decimal number representing the interval in seconds for the next link check test.

Preliminary

11.13 Rx delay1 Command

Parameter	action	Password	Description
rxdelay1	set	Super-user	Decimal number representing the delay between the transmission and the first Reception window in milliseconds, from 0 to 65535. This command will set the delay between the transmission and the first Reception window to the `<rxDelay>` in milliseconds. The delay between the transmission and the second Reception window is calculated in software as the delay between the transmission and the first Reception window + 1000 (ms). Default: 1000 Example: **`mac set rxdelay1 1500`** *Response*: **`rxdelay1 OK`** *if value is valid* **`rxdelay1 error: invalid value`** *if value is out of range*
	get	User	This command will return the current RX1 delay. Default: 0 *Example*: **`mac get rxdelay1`** *Response example*: **`rxdelay1 1500`** Decimal number representing the RX1 delay in mS.

11.14 Rx2 frequency Command

Parameter	action	Password	Description
rx2freq	set	Super-user	Decimal number representing the frequency, from 863000000 to 870000000 Hz. This command sets the frequency for the second Receive window. The configuration of the Receive window parameters must be in concordance with the server configuration Default: 869525000 Example: **`mac set rx2freq 869525000`** *Response*: **`rx2freq OK`** *if value is valid* **`rx2freq error: invalid value`** *if value is out of range*
	get	User	This command will return the current second Receive window frequency. Default: 869525000 *Example*: **`mac get rx2freq`** *Response example*: **`rx2freq 869525000`** Decimal number representing the frequency in Hz.

Preliminary

11.15 Rx2 data rate Command

<table>
<tr><th>Parameter</th><th>action</th><th>Password</th><th>Description</th></tr>
<tr><td rowspan="2">rx2dr</td><td>set</td><td>Super-user</td><td>Decimal number representing the data rate for RX2, from 0 to 7.
This command sets the data rate for the second Receive window. The configuration of the Receive window parameters must be in concordance with the server configuration
<table><tr><th>Value</th><th>Spreading factor</th></tr><tr><td>0</td><td>SF12</td></tr><tr><td>1</td><td>SF11</td></tr><tr><td>2</td><td>SF10</td></tr><tr><td>3</td><td>SF9</td></tr><tr><td>4</td><td>SF8</td></tr><tr><td>5</td><td>SF7</td></tr><tr><td>6</td><td>FSK</td></tr><tr><td>7</td><td>TBD</td></tr></table>
Default: 0

<u>Example:</u>
mac set rx2dr 3

<u>Response</u>:
rx2dr OK if value is valid
rx2dr error: invalid value if value is out of range</td></tr>
<tr><td>get</td><td>User</td><td>This command will return the current datarate in RX2 window.

Default: 0

<u>Example</u>:
mac get rx2dr

<u>Response example</u>:
rx2dr 3
Decimal number representing spreading factor used in RX2 window.</td></tr>
</table>

Preliminary

11.16 Duty cycle Command

Parameter	action	Password	Description
dutycycle	set	Super-user	This command enable or disable the control of dutycycle. The duty cycle of radio devices is often regulated by government. If this is the case, the duty cycle is commonly set to 1%, but make sure to check the regulations of your local government to be sure. In Europe, duty cycles are regulated by section 7.2.3 of the ETSI EN300.220 standard. Please refer to the *LoRaWAN™ Specification* for further details. The control should be turned OFF **ONLY** for test purpose. Default: ON Example: `mac set dutycycle ON` *Response*: `dutycycle OK` *if value is valid* `dutycycle error: invalid value` *if value is out of range*

	get	User	This command will return the state of Duty Cycle control.
			Default: ON
			Example:
			`mac get dutycycle`
			Response example:
			`Dutycycle OFF`
			ON or OFF string.

Preliminary

11.17 OTAA Command

Parameter	action	Password	Description
otaa	set	Super-user	This command choice the method of provisioning the sensor on the network server. If OTAA is set to YES, automatically the ABP (Activation By Personalization) is switched OFF. Vice-versa if OTAA is set to NO, the ABP mode is enabled. Please refer to the *LoRaWAN™ Specification* for further details. Default: NO Example: **`mac set otaa ON`** *Response*: **`otaa OK`** *if value is valid* **`otaa error: invalid value`** *if value is out of range*
	get	User	This command will return the state of OTAA. Default: ON *Example*: **`mac get otaa`** *Response example*: **`Otaa YES`** YES or NO string.

11.18 Class Command

Parameter	action	Password	Description
class	set	Super-user	This command choice the class of operation of the device. The available class are A or C. Please refer to the *LoRaWAN™ Specification* for further details. Default: A Example: **`mac set class C`** *Response*: **`class OK`** *if value is valid* **`class error: invalid value`** *if value is out of range*
	get	User	This command will return the selected Class. Default: ON *Example*: **`mac get class`** *Response example*: **`class C`** A or C string.

 ©2017 ASCOEL S.r.l.
Preliminary

11.19 Password Command

Parameter	action	Password	Description
pw	none	Super-user or User	This command allow to change the current password or to gain the access to the shell. Every sensors are shipped with a specific set of passwords; these passwords are supplied by ASCOEL when the device is shipped. The passwords are freely modifiable by the *user* or *super-user* in according with the own level access; for do this is mandatory enter the own level password for set the new password. The max length password is 16 characters. <u>Example:</u> The current user password is '***user***' and the current super-user password is '***suser***' • For gain access to the shell in user level: *pw user <current password>* **pw user user** • For gain access to the shell in super-user level: *pw suser <current password>* **pw suser suser** • For change the user level password the command is: *pw set user <current user pw> <new user pw>* **pw set user user *newpassword*** • For gain access to the shell in super-user level: *pw set suser <current super pw> <new super pw>* **pw set suser suser *newpassword*** *<u>Response</u>*: **user OK** *if value is valid* **user error**

Preliminary

11.20 Default Command

Parameter	action	Password	Description
default	none	Super-user	This command allow loading the factory default values for all parameters. This command is executed only with super-user privileges. Example: **`default`** *Response*: **`default OK`** *if value is valid* **`default error`**

11.21 Save Command

Parameter	action	Password	Description
save	none	none	This command store all parameters in non-volatile flash memory. Example: **`save`** *Response*: **`save OK`** *if value is valid* **`save error`**

11.22 Reboot Command

Parameter	action	Password	Description
reboot	none	none	Performs a reboot of the sensors. Example: **`reboot`** *Response*: **`none`**

11.23 Info Command

Parameter	action	Password	Description
info	none	none	Show some data or parameters related to the sensor. The response format is not and vary between firmware releases and sensors type. Example: **`info`** *Response*: **`none`**

Preliminary

12 IR868LR specific shell command (DEV)

DEV commands are specific for every one type of the sensor and define the operating behaviour for which sensors was developed.
Because the DEV commands allow setting some vital parameters, the shell level access can be of type USER or SUPERUSER.
For showing only DEV parameters, the user level is sufficient.

For access to the shell in superuser mode:
>pw suser <*user password*> The prompt will switch to **SU>**

For access to the shell in user mode:
>pw user <*user password*> The prompt will switch to **US>**

12.1 Alive interval Command

Parameter	action	Password	Description
alive	set	Superuser	The alive interval allows you to set a time expressed in seconds that regularly transmits a data packet to the server. For the contents of the packet, refer to the specific device manual. Default: 3000 (min. 15 max 172800 seconds) Example: **`dev set alive 5000`** *Response*: **`alive OK`** *if value is valid* **`alive error: invalid value`** *if value is out of range*
	get	User	This command will return the value of alive interval. Default: 3000 *Example*: **`dev get alive`** *Response example*: **`alive 18000`** A decimal values of alive interval, in seconds.

Preliminary

12.2 Device Flag Command

Parameter	action	Password	Description
flag	set	User	The flag is a 16-bit wide register where the sensor store some information. Refer to specific sensor chapter for detailed explanation of each available flag. Default: 0 Example: **`dev set flag 15`** *Response*: **`flag`** **`OK`** *if value is valid* **`flag error: invalid value`** *if value is out of range*
	get	User	This command will return the bit mask of flag. Default: 0 *Example*: **`dev get flag`** *Response example*: **`flag 15`** A decimal values a bit mask flag.

12.3 PIR sensor inhibition

Parameter	action	Password	Description
pirinh	set	User	Specify the inhibition time applied to the PIR sensor. Default: 240 Example: **`dev set pirinh 300`** *Response*: **`pirinh OK`** *if value is valid* **`pirinh error: invalid value`** *if value is out of range*
	get	User	This command will return the inhibition time of the PIR sensor. Default: 240 *Example*: **`dev get pirinh`** *Response example*: **`pirinh 300`** A string that report the inhibit time in seconds.

Preliminary

12.4 MODE 1

Parameter	action	Password	Description
mode1	set	User	Setting of the **mode1** of the functionally of the PIR sensor. <u>Syntax:</u> **mode1 (*no parameter needed*)** <u>Default:</u> **nothing** <u>Example:</u> **dev set mode1** *<u>Response</u>*: **mode1 OK** *if value is valid* **mode1 error: invalid value** *if value is out of range*

12.5 MODE 2

Parameter	action	Password	Description
mode2	set	User	Setting of the **mode2** of the functionally of the PIR sensor. <u>Syntax:</u> **mode2 <counter number> <flag>** <u>Default:</u> **counter number 1** **flag 0** <u>Example:</u> **dev set mode2 20 1** *<u>Response</u>*: **mode2 OK** *if value is valid* **mode2 error: invalid value** *if value is out of range*

12.6 MODE 3

Parameter	action	Password	Description
mode3	set	User	Setting of the **mode3** of the functionally of the PIR sensor. <u>Syntax:</u> **mode3 <interval time> <counter number> <flag>** <u>Default:</u> **interval time 15 seconds** **counter number 1** **flag 0** <u>Example:</u> **dev set mode3 20 5 2** *<u>Response</u>*: **mode3 OK** *if value is valid* **mode3 error: invalid value** *if value is out of range*

Preliminary

12.7 MODE 4

Parameter	action	Password	Description

mode4	set	User	Setting of the **mode4** of the functionally of the PIR sensor.
			
			Syntax:
			`mode4 <guard time> <periodic interval> <flag>`
			
			Default:
			`guard time 600 seconds`
			`periodic interval number 15`
			`flag 0`
			
			Example:
			`dev set mode4 300 20 8`
			
			Response:
			`mode4 OK` *if value is valid*
			`mode4 error: invalid value` *if value is out of range*

Preliminary

12.8 Mode Command (get only)

Parameter	action	Password	Description
mode	get	User	This command will return the MODE currently programmed. _Example_: **`dev get mode`** _Response example for:_ **MODE1**: **`mode 1`** **MODE2**: Syntax: **`mode 2 <counter number> <flag>`** Example: **`mode 2 15 2`** **MODE3**: Syntax: **`mode 3 <interval time> <counter number> <flag>`** Example: **`mode 3 300 20 2`** **MODE4**: Syntax: **`mode 4 <guard time> <periodic interval> <flag>`** Example: **`mode 3 600 60 8`**

Preliminary

12.9 Model Command (get only)

Parameter	action	Password	Description
model	get	User	This command will return the model of sensor. Default: any *Example*: **`dev get model`** *Response example*: **`model CM868LRCB`** String that representing the model of the sensor.

12.10 Production date Command (get only)

Parameter	action	Password	Description
proddate	get	User	This command will return the production date of the sensor. Default: any *Example*: **`dev get proddate`** *Response example*: **`proddate 06/07/17`** String that representing the production date in the format dd/mm/yy.

12.11 Serial number Command (get only)

Parameter	action	Password	Description
serial	Get	User	This command will return the serial number of the sensor. Default: none *Example*: **`dev get serial`** *Response example*: **`Serial 363636365E368101`** String that representing the serial number of the sensor.

Preliminary

12.12 Battery level Command (get only)

Parameter	action	Password	Description
battery	get	User	This command will return the current level of charge of the internal battery. The values reported represent the charge in several mode: Percentage, voltage, numeric and a flag for low battery threshold alert. Default: any *Example*: **dev get battery** *Response example*: **battery 100 3600 254 0** The response format is: **battery <percentage> <voltage> <level> <flag>** where:

Value	Percentage
0 to 100	Percentage of the charge

Value	Voltage
2800 to 3600	Voltage in mV

Value	level
0	External battery
1 to 253	Level charge
254	Fully charged
255	Unknown

Value	flag
0	Battery OK
1	Battery charge is below the 25%

Preliminary

© Ascoel 2017
Reproduction in whole or in part is prohibited without the prior written consent of ASCOEL.
The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use.
Publication thereof does not convey nor imply any license under patent or other industrial or intellectual property rights. ASCOEL assumes no responsibility or liability whatsoever for any failure or unexpected operation resulting from misuse.

Contact Information

ASCOEL Srl
Via degli Artigiani 7 26025 Pandino -CR- ITALY
Phone: (+39)0373 970473
E-mail: info@ascoel.com
Internet: http://www.ascoel.it

Preliminary