

# LoRaWAN RANGE FRAME SPECIFICATIONS



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## 1. ABOUT THIS DOCUMENT

This document describes the payload of data frames in ELA Innovation’s line of LoRa products.

## 2. APPLICABLE PRODUCT(S)



### LR ID

IDF320002 : version EUROPE 868MHz

IDF320006 : version US 915MHz



### LR TEMP

IDF320003 : version EUROPE 868MHz

IDF320007 : version US 915MHz



### LR HOME

IDF320004 : version EUROPE 868MHz

IDF320008 : version US 915MHz



### LR N'TRACK

IDF320005 : version EUROPE 868MHz

IDF320009 : version US 915MHz IDF320005

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## 3. UPLINK FRAME FORMAT

**Version v1.0.5**  
*Trames LR - Uplink*

Uplink frame format											
Fixed length							Variable length				
Header Ela 2 bytes	FW_rev 1 byte	Protocol_rev 1 byte	Name 8 bytes	Tens_Bat 2 bytes	Frame_cnt 3 bytes	Frame_type 1 byte	Sensor 1		Sensor 2 à n-1	Sensor n	
							SensorInfo 1 byte	Sensor Data 0 to 16 bytes	...	SensorInfo 1 byte	Sensor Data 0 to 16 bytes

### Fields description:

Field	Lenght	Description
Header Ela	2 octets	Reserved field, cannot be modified
FW_rev	1 octet	Firmware version of LR tag
Protocol_rev	1 octet	Protocol version of LR tag (frame format)
Name	8 octets	Tag's name
Tens_Bat	2 octets	Battery voltage in mV
Frame_cnt	3 octets	Counter of the number of frame transmission attempts made by the TAG since the last JOIN sequence (start or restart of the application)
Frame_type	1 octet	Frame information  Bits 7-4 : frame type <ul style="list-style-type: none"> <li>• 0 : Standard mode periodic frame</li> <li>• 1 : Motion mode periodic frame</li> <li>• 2 : Non periodic frame for change magnetic state detection</li> <li>• 3 : Non periodic frame for motion detection</li> <li>• 4-15 : RFU</li> </ul> Bits 3-0 : Number of sensors <ul style="list-style-type: none"> <li>• 0 : no sensor (advertising frame)</li> <li>• 1-15 : number of sensors in the frame</li> </ul>
SensorInfo	1 octet	Sensor information Bits 7-4 : Type of sensor <ul style="list-style-type: none"> <li>• 0 : Temperature (T)</li> <li>• 1 : Humidity/temperature (RTH)</li> <li>• 2 : magnetic hall effect (MAG)</li> <li>• 3 : Movement (MOV)</li> <li>• 5 : Lightness (LUX)</li> <li>• 6 : Geolocation (GPS)</li> <li>• 7-15 : RFU</li> </ul> Bits 3-0 : Number of information bytes for the sensor (length field and sensor data) <ul style="list-style-type: none"> <li>• 0-15 : Number of information bytes for the sensor</li> </ul>
SensorData	0-15 octets	Sensor values

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### Detailed field descriptions for all sensors:

Field		Length	Description
Header Ela		2 octets	Reserved field, cannot be modified
FW_rev		1 octet	Firmware version of LoRa tag
Protocol_rev		1 octet	Protocol version of LORA tag (frame format)
Name		8 octets	Tag's name, fixed field
Tens_Bat		2 octets	Battery voltage in mV
Frame_cnt		3 octets	Counter of the number of frame transmission attempts made by the TAG since the last JOIN sequence
Frame_type		1 octet	Frame information
Temperature sensor (T)	SensorInfo	1 octet	0x02 (bit7-4=0 and bit3-0=2)
	SensorData	2 octets	Temperature sur 16 bits signed by 0,01°C step
Humidity/ Temp sensor (RTH)	SensorInfo	1 octet	0x13 (bit7-4=1 and bit3-0=3)
	SensorData	3 octets	Temperature on 16 bits signed by 0,01°C step Humidity on 8 bits non-signed by 1 % step RH of 0 to 100 %
Magnetic sensor (MAG)	SensorInfo	1 octet	0x22 (bit7-4=2 and bit3-0=2)
	SensorData	2 octets	Change state counter on the 15MSB (non-signed) Current state on the LSB
Movement sensor (MOV)	SensorInfo	1 octet	0x32 (bit7-4=3 and bit3-0=2)
	SensorData	2 octets	Threshold overrun counter on the 15MSB (non-signed) Current state on the LSB
Lightness sensor (LUX)	SensorInfo	1 octet	0x54 (bit7-4=5 and bit3-0=4)
	SensorData	4 octets	Lightness on 32bits non-signed by 0,01 Lux step
Geolocation sensor (GPS)	SensorInfo	1 octet	0x6D (bit7-4=6 and bit3-0=13)
	SensorData	13 octets	Longitude (float32 / 4 octets) Latitude (float32 / 4 octets) : Altitude in meters (uint16 / 2 octets) Speed in Km/h (uint16 / 2 octets) : speed in km/h Info (uint8 / 1 octet) <ul style="list-style-type: none"> <li>• Bit 7-6 : info fix (0= not fixed, 1=fixed OK)</li> <li>• Bit 5-0 : number of satellite</li> </ul>

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- Example with « n'TRACK » format:

**Raw data :**

0x010501014E545241434B30310DEB0000013322000032000B6D4074A455422E78F50

**Details :**

LEN.	TYPE	VALUE	
4	0x01050101	Header Ela	
8	0x4E545241434B3031	Name : NTRACK01	
2	0x0DEB	Battery voltage = 0x0DEB = 3563mV	
3	0x000001	1 transmitted frame by the Tag	
1	0x33	Non-periodic frame on motion detection , number of sensors= 3	
1	0x22	MAG code sensor	
2	0x0000	Event counter (15MSB) : no magnetic field detection Current state (LSB)= 0 no magnetic field	
1	0x32	MOV code sensor	
2	0x000B	Event counter (15MSB) : 5 motion detections Current state (LSB)= 1 movement detected	
1	0x6D		
13	0x4074A455422E78F5003C000F46	Longitude	0x4074a455 = 3.82253
		Latitude	0x422e78f5=43.6181
		Altitude	003c= 60 meters
		Speed	000f=15*0.1km/h=1.5km/h
		Info	0b01= FIX valid 0x6= 6 satellites

Note : longitude and latitude are coded in hexadecimal. To convert data to GPS coordinates, hexadecimal conversion to a float (sign, exponents, mantissa) must be used. These coordinates are in decimal degrees (DD).

## 4. FORMATTING OF DOWNLINK FRAMES

Bidirectionality is a feature of the LoRaWAN protocol, it is then possible to transfer data to the devices.

In receive mode, the TAG will interpret the Downlink messages received by the LoRaWAN module and perform the associated actions. In class A, the "Receive" mode is activated just after a transmission. Class C allows reception at any time but is much more energy consuming than class A.

Downlink message format:

Downlink frame format				
<i>Longueur fixe</i>				<i>Variable length</i>
Header Ela 2 bytes	FW_rev 1 byte	Protocol_rev 1 byte	CmdInfo 1 byte	Cmddata 0-16 bytes

Fields description:

Field	Lenght	Description
Header Ela	2 octets	Reserved field for information to be defined
FW_rev	1 octet	Firmware version TAGLR
Protocol_rev	1 octet	Protocol version TAGLR (frame format)
CmdInfo	1 octet	Information on the type of order Bits 7-4 : type of order <ul style="list-style-type: none"> <li>• 0 : Led</li> <li>• 1 : Reserved</li> <li>• 2 : Reserved</li> <li>• 3 : LoRa class</li> <li>• 4-15 : Reserved</li> </ul> Bits 3-0 : Number of bytes of the CmdData field <ul style="list-style-type: none"> <li>• 0-15 : Mandatory number of bytes of the CmdData field</li> </ul>
CmdData	0-16 octets	Order parameters

List of usable commands:

Commands	Firmware	Actions	Values	Activation
NAME	v1.0.5	Name modification	0001050328XXXXXXXXXXXXXXXXXX	Upon receipt
LED_OFF	v1.0.3	Turning off the LED	00010503020000	Upon receipt
	v1.0.4			
	v1.0.5			
LED_ON XXXX	v1.0.3	Activates the LED (XXXX in seconds)	0001050302XXXX	Upon reception with LED flashing (1 Hz)
	v1.0.4			
	v1.0.5			
Classe A	v1.0.3	Equipment in class A	000105033100	Upon receipt, the tag modifies the class and switches to the "JOIN" procedure.
	v1.0.4			
	v1.0.5			
Classe C	v1.0.3	Equipment in classe C	000105033102	Upon receipt, the tag modifies the class and switches to the "JOIN" procedure.
	v1.0.4			
	v1.0.5			
LoRaPower	v1.0.5	Lora transmission power (dBm)	0001050341XX	Upon reception: XX=04 (4dBm) XX=06 (6dBm) XX=08 (8dBm) XX=0A (10dBm) XX=0C (12dBm) XX=0D (14dBm)
LoRaDRMode	v1.0.5	Datarate mode of the Lora interface	0001050351XX	Upon reception: 0x00=DR0 [...], 0x06=DR6, 0xFF=ADR (adaptative data rate)
LoraAck	v1.0.5	Acknowledgement and retransmission disabled	0001050361XX	Upon reception: 0x00= Acknowledgement and retransmission disabled 0x01 = Acknowledgement and retransmission activated
Période standard	v1.0.5	Emission period in seconds	0001050373XXXXXX	Upon reception, example: XXXXXX=0x004650 = 18000 secondes.
Période Motion	v1.0.5	Wake-up period if motion is detected	0001050383XXXXXX	Upon reception, example: XXXXXX=0x000258 = 600 secondes.
AccThresh	v1.0.5	Acceleration threshold	0001050392XXXX	Upon reception, example: XXXX=0x0064 = 100.
RAZ CNT	v1.0.5	Resetting the MOV counter	00010503A100	Upon reception
		MAG counter reset	00010503A101	Upon reception

\* XX= hexadecimal characters

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## Example 1 : LED activation

The parameters of the LED activation command are as follows:

CmdInfo	CmdData
0x02 Bits 7-4=0 and Bits 3-0=2	LED activation time in seconds on 16 bits non-signed

## Example for an activation command of the LED :

00010503020020 : Flashing (1Hz) of the LED for 32 seconds.

Upon receipt of this command, the TAG will activate the LED for the period specified in the CmdData field. de cette commande, le TAG activera la LED durant la période spécifiée dans le champ *CmdData*.

## Example 2 : Change of Class LoRaWAN

The parameters of the class activation command are as follows:

CmdInfo	CmdData
0x31 Bits 7-4=2 et Bits 3-0=2	LoRa class on 8 bits non-signed <ul style="list-style-type: none"> <li>• 0x00=Class A</li> <li>• 0x01=Class B (not currently supported)</li> <li>• 0x02=Class C</li> <li>• 0x03 à 0xFF= not currently supported</li> </ul>

## Example for a LoRaWAN Class Change Order:

- 000105033102 : Passage to Class C.

As soon as this command is received, the TAG will modify the TAG operating class with the value indicated in the CmdData field. This change will involve a new OTAA procedure with the server.

## 5. ANNEXES

**Version v1.0.3 & v1.0.4**  
*LoRaWAN frames - Uplink*

Based on the sensor information established during configuration, the Tag creates frames to be transmitted using the following format:

LR tag (TAGLR) uplink frame format									
<i>Fixed length</i>					<i>Variable length</i>				
ELA header 2 bytes	FW_rev 1 byte	Protocol_rev 1 byte	Frame_cnt 3 bytes	Frame_type 1 byte	Sensor 1		Sensor 2 to n-1	Sensor n	
					SensorInfo 1 byte	SensorData 0 to 16 bytes	...	Sensor Info 1 byte	Sensor Data 0 to 16 bytes

### Field description

Field	Length	Description
ELA header	2 bytes	Field reserved for information to be defined
FW_rev	1 byte	TAGLR firmware version
Protocol_rev	1 byte	TAGLR protocol version (frame format)
Frame_cnt	3 bytes	Counter of the number of frame transmission attempts by the tag since the last JOIN sequence (application start or stop)
Frame_type	1 byte	Frame information Bits 7-4: frame type <ul style="list-style-type: none"> <li>• 0: Standard mode periodic frame</li> <li>• 1: Motion mode periodic frame</li> <li>• 2: Non periodic detection frame for magnetic state change</li> <li>• 3: Non periodic motion detection frame</li> <li>• 4-15: RFU</li> </ul> Bits 3-0: Number of sensors <ul style="list-style-type: none"> <li>• 0: no sensors (advertising frame)</li> <li>• 1-15: number of sensors in the frame</li> </ul>
SensorInfo	1 byte	Information about the sensor Bits 7-4: Sensor type <ul style="list-style-type: none"> <li>• 0: Temperature (T)</li> <li>• 1: Humidity/temperature (RTH)</li> <li>• 2: magnetic Hall effect (MAG)</li> <li>• 3: Movement (MOV)</li> <li>• 4: 3D Accelerometer (ANG)</li> <li>• 5: Luminosity (LUX)</li> <li>• 6: Geolocation (GPS)</li> <li>• 7-15: RFU</li> </ul> Bits 3-0: Number of information bytes for the sensor (length of SensorData field) <ul style="list-style-type: none"> <li>• 0-15: Number of information bytes for the sensor</li> </ul>
SensorData	0-15 bytes	Sensor values

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Description of the detailed fields for all sensors:

Champ		Longueur	Description
Header Ela		2 octets	Field reserved, not editable
FW_rev		1 octet	TAGLR firmware version, not editable
Protocol_rev		1 octet	TAGLR protocol version, not editable
Frame_cnt		3 octets	Counter of the number of frame transmission attempts by the tag since the last JOIN sequence (application start or stop)
Frame_type		1 octet	Frame information
Sensor Temperature (TEMP)	SensorInfo	1 octet	0x02 (bit7-4=0 et bit3-0=2)
	SensorData	2 octets	Temperature stored in 16 bits signed by 0,01°C step
Sensor Temperature + Relative humidity RHT	SensorInfo	1 octet	0x13 (bit7-4=1 et bit3-0=3)
	SensorData	3 octets	Temperature stored in 16 bits signed by 0,01°C step Relative humidity stored in 8 bits unsigned by 1 % RH step from 0 to 100 %
Sensor Magnetic Hall effect (MAG)	SensorInfo	1 octet	0x22 (bit7-4=2 and bit3-0=2)
	SensorData	2 octets	Event counter stored in 15MSB (unsigned) Current status stored in LSB
Sensor Movement (MOV)	SensorInfo	1 octet	0x32 (bit7-4=3 and bit3-0=2)
	SensorData	2 octets	Overflow counter stored in 15MSB (unsigned) Current status stored in LSB
Capteur Luminosity (LUX)	SensorInfo	1 octet	0x54 (bit7-4=5 and bit3-0=4)
	SensorData	4 octets	Luminosity stored in 32bits unsigned by 0,01 Lux step
Capteur Geolocation (GPS)	SensorInfo	1 octet	0x6D (bit7-4=6 et bit3-0=13)
	SensorData	13 octets	Longitude stored in 4 octets (float32) Latitude stored in 4 octets (float32) Altitude in meters stored in 2 octets (unsigned) Velocity (Km/h) stored in 2 octets (unsigned) Information stored in 1 octet (uint8): <ul style="list-style-type: none"> <li>• Bit 7-6: information fix (0=not of fix, 1=fix OK)</li> <li>• Bit 5-0: Number of satellites</li> </ul>

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- Example with “LR TEMP” format:

**Raw data:**

0x0103010100009C01020AAB

Details:

LEN.	TYPE	VALUE
4	0x01030101	Field reserved
3	0x00009C	156 frames transmit of the TAG
1	0x01	Standard mode periodic frame, number of sensors= 1
1	0x02	Sensor Temperature
2	0x0AAB	Data sensor 0x0AAB=2731 * 0,01°C = <b>27,31°C</b>

Note: for a negative temperature, 2’s complement is made: -27.31°C will be 55F5

- Example with “LR HOME” format:

**Raw data:**

0x103010100000303130B382922000354000

Details:

LEN.	TYPE	VALUE
4	0x01030101	Field reserved
3	0x00009c	156 frames transmit of the TAG
1	0x03	Standard mode periodic frame, number of sensors= 3
1	0x13	Sensor RHT
3	0x0B3829	Temperature: 0x0B38=2872 * 0,01°C = <b>28,72°C</b>
		Humidity: 0x29= 41% RH
1	0x22	Sensor MAG
2	0x0003	Event counter stored in 15 bits (MSB): 1 magnetic field detection
		Current status (LSB)= 1 magnet detected
1	0x54	Sensor LUX
4	0x0000F760	Luminosity: 0xF760= 63328 * 0.01 lux = 633.28 lux

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- Example with “LR ID » format:

**Raw data:**

0x10301010000412222001832000B

Details:

LEN.	TYPE	VALUE
4	0x01030101	Field reserved
3	0x000041	65 frames transmit of the TAG
1	0x22	Non periodic detection frame for magnetic state change, number of sensors= 2
1	0x22	Sensor MAG
2	0x0018	Event counter stored in 15 bits (MSB): 24 magnetic field detection Event status (LSB)= 0 no magnet detected
1	0x32	Sensor MOV
2	0x000B	Overflow counter stored in 15 bits (MSB): 5 motion detections Event status (LSB)= 1 detected motion

- Example with “LR n’TRACK”:

**Raw data :**

0x1030101000001332200003200576D4074A455422E78F5003C000F46

Details:

LEN.	TYPE	VALUE	
4	0x01030101	Field reserved	
3	0x000020	32 frames transmit of the TAG	
1	0x33	Non periodic motion detection frame, number of sensors = 3	
1	0x22	Sensor MAG	
2	0x0000	Event counter stored in 15 bits (MSB): no magnetic field detection Event status (LSB)= 0 no magnet detected	
1	0x32	Sensor MOV	
2	0x000B	Overflow counter stored in 15 bits (MSB): 5 motion detections Event status (LSB)= 1 detected motion	
1	0x6D	Sensor GPS	
13	0x4074A455422E78F5003C000F46	Longitude	0x4074A455 = 3.82253
		Latitude	0x422E78F5=43.6181
		Altitude	003C= 60 mètres
		Velocity	000F=15*0.1km/h=1.5km/h
		Info	0b01= FIX valid 0x6= 6 satellites

**Note:**

Longitude and latitude are coded in hexadecimal. To convert the data into GPS coordinates, use the hexadecimal conversion to a float (sign, exponents, mantisse). These coordinates are in decimal degrees (DD). A brief flashing of the LED is provided to indicate the geolocation search.

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