

# Payload for LoRaWAN Sensors

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# Payload for LoRaWAN Lidar People Counter WSLRW-LPC

# Payload WSLRW-LPC | Firmware 1.0

## 1. Payload document is applied for the following products

Item code	HW Version	Firmware Version	Remarks
WSLRW-LPC-11	1.0	1.0	

## 2. Changes information in this version v.s previous version

Item	Changes	Changed by	Changed Date	Approved by	Approved Date
1	Initial version	P.N.Diep	09-05-2022	N.V.Loc	28-05-2022

**i** The approved date is also the release date of this document.

## 3. Payload for Uplink messages

When?	Purpose	Wait for Downlink?	LED color
This message will be sent in the pre-defined cycle OR when the resettable counter passes the threshold	To get the measured value from the device in the pre-defined cycle or when the counter passes the threshold	NO	Not applicable

Uplink Payload structure:

Payload	Sensor type	Battery level	Hw_error	reserved	NRC_Peo	NRC_Peo	RC_Peop	RC_Peop	Dist_fron	Dist_bac
bits	8	2	2	4	16	16	8	8	16	16
Value	yes	yes	yes	zeros	yes	yes	yes	yes	yes	yes

## 4. Payload Fields of Uplink

The length of the uplink payload is 12 bytes. Please refer below for an explanation.

Data	Size (byte)	Bit	Format	Meaning
Sensor type	1	all	Uint8	Sensor type = 0x13 means LoRaWAN People Counter
Status: battery level	1	Bit 7 and 6	Uint8	Battery capacity in 04 levels
				11: battery level 4 (99%)
				10: battery level 3 (60%)
				01: battery level 2 (30%)

				00: battery level 1 (10%)
Status: sensor module error		Bit 5 and 4		Status
				01: sensor module error
				00: no error with sensor module
NRC_People_in	2	all	Uint16	Non-resettable counter
NRC_People_out	2	all	Uint16	Non-resettable counter
RC_People_in	1	all	Uint8	Reset to 0 after sending to Gateway
RC_People_out	1	all	Uint8	Reset to 0 after sending to Gateway
Dist_front_zone	2	all	Uint16	Distance of front zone
Dist_back_zone	2	all	Uint16	Distance of back zone

## 5. Payload for Downlink messages

Users can use a downlink message to change the configuration of the device. There are 02 types of downlink messages:

- **Downlink type = 0:** to write the configuration for the specific type of Sigfox-ready sensor. The format is fixed for each type of sensor. **However**, this FW version does not support type 0 configuration. It only supports type 5 as below.
- **Downlink type = 5:** to write a value to any address of configuration parameter of any Sigfox-ready sensor. This method is generic and can be applied to any type of Sigfox-ready sensor, the user just needs to know the memory map of the sensor.

### 5.1 Downlink type = 0

Not available in this FW version.

### 5.2 Downlink type = 5

With this downlink, the user can write the configuration to any address on the memory map of the device. Please refer to the memory map of the device to understand what parameters can be written.



The length of the configuration parameter can be 1, 2 bytes, or 4 bytes, but the total length of the Downlink payload must equal 64 bits (8 bytes). Please see below the downlink format for both types.

#### **Downlink type 5 for the parameter of 2 bytes length:**

Payload	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	reserved	DOWNLINK_TYPE
bits	8	8	16	28	4
Value	yes	0x02 = 2	yes	zeros	0b0101 = 5

#### **Downlink type 5 for the parameter of 4 bytes length:**

Payload	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	reserved	DOWNLINK_TYPE
bits	8	8	32	12	4
Value	yes	0x04 = 4	yes	zeros	0b0101 = 5

Where:

- PRM\_ADDRESS: address of the configuration parameter in the memory map of the device;
- PRM\_LENGTH: is the length of that parameter, in bytes;
- PRM\_VALUE: is the value the user wants to write to that parameter;
- reserved: a series of bits of zero to fulfill the downlink so that it has the total length = 64 bits (8 bytes)

#### EXAMPLE FOR DOWNLINK TYPE = 5

- ✔ Here is the list of parameters of WSLRW-LPC that can be configured via Downlink type = 5, and the examples of the payload of downlink on the right-most side column. It is the example value, not the default value of the device. Please check the memory map of the device for more detail about the parameters.

**Note: the total length of down link must be equal 8 bytes**

Parameter	PRM_ADDR	PRM_LENGTH	PRM_VALUE	DOWNLINK_	Downlink Payload
(bytes)	1	1	4	2	8
cycle_send_data	0x4E	0x04 = 4	0x00000E10 = 3600	0x0005	4E0400000E100005
sensor_sampling_rate	0x54	0x04 = 4	0x00000078 = 120	0x0005	5404000000780005
count_threshold	0x80	0x02 = 2	0x0014 = 20	0x0005	8002000000140005
dist_threshold	0x81	0x02 = 2	0x0640 = 1600	0x0005	8102000000640005
dist_hys	0x82	0x02 = 2	0x0064 = 100	0x0005	8202000000640005
inter_meas_period	0x83	0x02 = 2	0x0030 = 48	0x0005	8302000000300005

## 5.3 Free online data conversion tools

- To convert from Float to Hex and vice versa, users may use this free online tool:  
<https://gregstoll.com/~gregstoll/floattohex/>
- To convert a decimal number to Hex, the user may use this free online tool:  
<https://www.binaryhexconverter.com/decimal-to-hex-converter>



## 6. Reed switches

The Sigfox-ready sensor normally comes with at least 1 reed switch for user manipulation during commissioning or maintenance.

Some other versions come with 02 reed switches.

The WSSFC-AC comes with 1 reed switch, please find below the functions of this switch.

EVENT	PRE-CONDITION	ACTION	LED STATUS	ACTIVITIES	POST-CONDITION
FORCE_DATA	Any state	Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, move Magnet Key away.	Blink SKY BLUE	the device will send the uplink message FORCE_DATA	Back to the previous state

<b>PARAMETERS</b>	Any state	Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, hold Magnet Key 5s. Led blink PURPLE, move Magnet Key away.	Blink PURPLE	the device will send the uplink message PARAMETER_UPD and wait for a new downlink to get the new configuration	Back to the previous state
					

Payload for LoRaWAN Flammable  
Gas Sensor WSLRWEX-GHC or  
WSLRW-GHC

# Payload for LoRaWAN Gas Sensor WSLRW-G4 or WSLRWEX-G




# Payload WSLRW-G4 or WSLRWEX-G | Firmware 1

## 1. Payload document is applied for the following products

Item code	HW Version	Firmware Version	Remarks
WSLRW-G4-...	1	1	
WSLRWEX-G-...	1	1	

## 2. Changes information in this version v.s previous version

Item	Changes	Changed by	Changed Date	Approved by	Approved Date
1	Initial version	P.N.Diep	22-06-2022	N.V.Loc	24-08-2022

 The approved date is also the release date of this document.

## 3. Payload for Uplink messages

### START\_UP message

When?	Purpose	Wait for Downlink?	LED color
This message will be sent once after 60 seconds from power-up the device	To understand when the device was powered up	YES	Blink WHITE

Payload	EVENT_ID	HW_VERSION	FW_VERSION	CURRENT_CONFIGURATION
bits	4	4	8	64
value	0b0000 = 0	yes	yes	yes

### PARAMETER\_UPDATE message

When?	Purpose	Wait for Downlink?	LED color
When the reed switch is activated by the magnet key. <b>How?</b> Move Magnet Key to the contact point of REED SWITCH. Buzzer beeps 1 time; hold Magnet Key 5s. Then the buzzer beeps 2 times; remove the Magnet key.	To send the new configuration to the device via downlink	YES	Blink <b>PURPLE</b>

Payload	EVENT_ID	HW_VERSION	FW_VERSION	CURRENT_CONFIGURATION
bits	4	4	8	64
value	0b0001 = 1	yes	yes	yes

### FORCE\_DATA message

When?	Purpose	Wait for Downlink?	LED color
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When the reed switch is activated by the magnet key. <b>How?</b> Move Magnet Key to the contact point of REED SWITCH. Buzzer beeps 1 time; move Magnet Key away.	To get the instant measured value from the device for calibration and validation.	YES	Blink SKY BLUE
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Payload	EVENT_ID	SENSOR_ERRO	reserved	SCALED_VAL	BATTERY_L	reserved	RAW_VAL
bits	4	1	3	16	2	6	32
value	0b0010 = 2	yes	zeros	yes	yes	zeros	yes

## CYCLIC\_DATA message

When?	Purpose	Wait for Downlink?	LED color
This message will be sent in the pre-defined cycle.	To get the measured value from the device in the pre-defined cycle.	YES	Blink SKY BLUE

Payload	EVENT_ID	SENSOR_I	reserved	SCALED_V	MIN_SCAL	AVG_SCA	MAX_SC	BATTERY	reserved
bits	4	1	3	16	16	16	16	2	6
value	0b0011 = 3	yes	zeros	yes	yes	yes	yes	yes	zeros

## ALARM message

When?	Purpose	Wait for Downlink?	LED color
This message will be sent upon the alarm's occurrence. Sensor_sampling_rate will determine the processing delay of the alarm.	To get the instant measured value upon the measured value was passing a threshold.	YES	Blink YELLOW

Payload	EVENT_ID	SENSOR_ER	reserved	ALARM_I	SCALED_V	ALARM_L	TENTAT	BATTERY	reserved
bits	4	1	1	2	16	8	8	2	6
value	0b0100 = 4	yes	zeros	yes	yes	yes	yes	yes	zeros

## 4. Payload Fields of Uplink

Below is an explanation of the payload fields in the uplink messages.

Data name	Description	Encoding or Possible values	Length (in bits)
EVENT_ID	Unique ID identifying the device event	4-bit unsigned integer 0 = START_UP 1 = PARAMETERS_UPDATE 2 = FORCE_DATA 3 = CYCLIC_DATA 4 = ALARM	4


<b>HW_VERSION</b>	HW_VERSION = HW_VERSION value in EEPROM set in production if the Value is unknown, the default value will be 0	4-bit unsigned integer 1..15	<b>4</b>
<b>FW_VERSION</b>	Indicate the FW version. Refer to the FW release note	8-bit unsigned integer 1..255	<b>8</b>
<b>CURRENT_CONFIGURATION</b>	The current configuration code of the device	64-bit encoded field Refer to the Downlink section	<b>64</b>
<b>SENSOR_ERROR</b>	Indicate the sensor error or not	0b0 = no sensor's error 0b1 = sensor's error	<b>1</b>
<b>ALARM_TYPE</b>	Alarm type	0b00 = no alarm 0b01 = Hi Alarm 1 (Hi alarm) 0b10 = Hi Alarm 2 (HiHi alarm) 0b11 = not used	<b>2</b>
<b>BATTERY_LEVEL</b>	Battery level	2-bit unsigned integer 0 to 3 0: 10% 1: 30% 2: 60% 3: 99%	<b>2</b>
<b>RAW_VALUE</b>	Raw value from the sensor	Float The raw value from the sensor; is not scaled or calibrated	32
<b>SCALED_VALUE</b>	The measured value is calculated (scaled/calibrated) from the raw value	16-bit signed integer Formula: (16- bit_SCALED_VALUE/100)= real_SCALED_VALUE in its unit** Example: 0x16B7 = 5815 => (5815 / 100) = 58.15ppm	16
<b>MIN_SCALED_VALUE</b>	The minimum value of the measured values in the duration of sending cycle*	16-bit signed integer Formula: (16- bit_MIN_SCALED_VALUE/100)= real_MIN_SCALE_VALUE in its unit** Example: 0x16B7 = 5815 => (5815 / 100) = 58.15ppm	16
<b>AVG_SCALED_VALUE</b>	The average value of the measured values in the duration of sending cycle*	16-bit signed integer Formula: (16- bit_AVG_SCALED_VALUE/100)= real_AVG_SCALE_VALUE in its unit** Example: 0x16B7 = 5815 => (5815 / 100) = 58.15ppm	16
<b>MAX_SCALED_VALUE</b>	The max value of the measured values in the duration of sending cycle*	16-bit signed integer Formula: (16- bit_MAX_SCALED_VALUE/100)= real_MAX_SCALE_VALUE in its unit** Example: 0x16B7 = 5815 => (5815 / 100) = 58.15ppm	16

<b>ALARM_DURATION</b>	Alarm duration in hours	8-bit unsigned integer Formula: 8-bit_Alarm_duration = real_Alarm_duration_in_hours Range: 0 to <b>255 hours</b> Resolution: <b>1 hour</b> Example: 0b00100000 = 0x20 = 32 => 32 hours	8
<b>TENTATIVE</b>	Tentative number <i>* This number counts how many uplink messages were sent since the alarm happened.</i>	8-bit unsigned integer Formula: (8-bit_Tentative + 1) = real_tentative # Range: 1 to 256 Accuracy: 1 Example: 0b00000111 = 0x7=7=> 7+1 => tentative # 8	8

#### Notes:

\* If the sending cycle = sensor sampling rate, all those values are at the same value: SCALED\_VALUE = MIN\_SCALE\_VALUE = AVG\_SCALED\_VALUE = MAX\_SCALED\_VALUE

\*\* Please refer to the unit of each gas sensor as below:

-  NH3: ppm
- CO: ppm
- Cl2: ppm
- SO2: ppm
- NO: ppm
- NO2: ppm
- O3: ppb

## 5. Payload for Downlink messages

Users can use a downlink message to change the configuration of the device. There are 02 types of downlink messages:

- **Downlink type = 0:** Write the configuration for the specific type of LoRaWAN sensor. The format is fixed for each type of sensor.
- **Downlink type = 5:** Write a value to any address of the configuration parameter of the LoRaWAN sensor. This method is generic and can be applied to any type of LoRaWAN sensor, the user just needs to know the memory map of the sensor.

### 5.1 Downlink type = 0

Configurable parameters	LED_BUZZER_ENABLE	Reserved	SENSOR_ENABLE	SEND_ENABLE	ALARM_ENABLE	Reserved	MEASURE_PERIOD	Reserved	CYCLIC_DATA_PERIOD	HI_ALARM1_THRESHOLD	HI_ALARM2_THRESHOLD	Reserved	DEVICE_RESET	DOWNLINK_TYPE
	1	3	1	1	1	1	4	1	3	8	8	24	4	4
	bits													

Below is the table to explain in detail the meaning of each configuration parameter and its default value.

Parameters	Description	Possible values	Default values	Length (in bits)
LED_BUZZER_ENABLE	Flag to enable/disable LED and Buzzer interactions for action not triggered by the button.	0b0 = false, LEDs are OFF 0b1 = true, LEDs are ON	0b1 = true	1
SENSOR_ENABLE	Enable Gas Sensing Module to measure	0b0 = false, gas sensing module is disabled 0b1 = true, gas sensing module is enabled	0b1 = true	1
SEND_ENABLE	Enable sending data in a cyclic period	0b0 = false, disabled 0b1 = true, enabled	0b1 = true	1
ALARM_ENABLE	Enable alarm processing and sending data	0b0 = false, disabled Alarm 0b1 = true, enabled Alarm	0b0 = false, disabled Alarm	1

<b>MEASURE_PERIOD</b>	Period for sensing module to wake up and take measurement	<i>0b0000 = every 1s</i> <i>0b0001 = every 2s</i> <i>0b0010 = every 5s</i> <i>0b0011 = every 10s</i> <i>0b0100 = every 20s</i> <i>0b0101 = every 30s</i> <i>0b0110 = every 1min</i> <i>0b0111 = every 2min</i> <i>0b1000 = every 5min</i> <i>0b1001 = every 10min</i> <i>0b1010 = every 20min</i> <i>0b1011 = every 30min</i> <i>0b1100 = every 1h</i> <i>0b1101 = every 2h</i> <i>0b1110 = every 3h</i> <i>0b1111 = every 6h</i>	0b1001 = every 10min	4
<b>CYCLIC_DATA_PERIO</b>	Period to send CYCLIC_DATA	<i>0b000 = every 10min</i> <i>0b001 = every 30min</i> <i>0b010 = every 1h</i> <i>0b011 = every 2h</i> <i>0b100 = every 3h</i> <i>0b101 = every 6h</i> <i>0b110 = every 12h</i> <i>0b111 = every 24h</i>	0b000 = every 10min	3
<b>HI_ALARM1_THRESH</b>	Hi alarm threshold #1 (it must be < HI_ALARM2_THRESHOLD)	<i>8-bit unsigned integer</i> <i>Formula: (8-bit VALUE/2)= real_VALUE_in_its unit**</i> <i>Example: <b>0b01110100</b> = 0x74 = 116 =&gt; (116 / 2) = 58ppm</i>	0b00001010 = 5ppm	8
<b>HI_ALARM2_THRESH</b>	Hi alarm threshold #2	<i>8-bit unsigned integer</i> <i>Formula: (8-bit VALUE/2)= real_VALUE_in_its unit**</i> <i>Example: <b>0b01110100</b> = 0x74 = 116 =&gt; (116 / 2) = 58ppm</i>	0b00010100 = 10ppm	8
<b>DEVICE_RESET</b>	Once this parameter is set, the device shall restart after receiving the Downlink. After restarting, the value turns to 0b0000 automatically.	<i>0b1010 = 0xA = Force device reset</i> <i>others = do nothing</i>	others = do nothing	4
<b>DOWNLINK_TYPE</b>	Downlink type	4-bit unsigned integer	0b0000	4

#### EXAMPLE FOR DOWNLINK TYPE = 0



If you plan to change the **MEASURE\_PERIOD = 30 minutes** and **CYCLIC\_DATA\_PERIOD = 30 minutes** then please enter your desired values, guided by the table below:

Parameter	Desired setting value	Setting Value (in binary)	Length (in bits)
<b>LED_BUZZER_ENABLE</b>	0b1 = enable LED and Buzzer	1	1
<b>Reserved</b>	0	000	3
<b>SENSOR_ENABLE</b>	0b1 = enable sensor module running	1	1
<b>SEND_ENABLE</b>	0b1 = enable to send cyclic data	1	1
<b>ALARM_ENABLE</b>	0b0 = false, disabled Alarm	0	1
<b>Reserved</b>	0	0	1
<b>MEASURE_PERIOD</b>	0b1011 = every 30min	1011	4
<b>Reserved</b>	0	0	1
<b>CYCLIC_DATA_PERIOD</b>	0b001 = every 30min	001	3
<b>HI_ALARM1_THRESHOLD</b>	0b00001010 = 5ppm	00001010	8
<b>HI_ALARM2_THRESHOLD</b>	0b00010100 = 10ppm	00010100	8
<b>Reserved</b>	0	000000000000000000000000	24
<b>DEVICE_RESET</b>	0b0000 = do nothing	0000	4
<b>DOWNLINK_TYPE</b>	0b0000	0000	4

Then you will get the final configuration code as below:



1000 1100 1011 0001 0000 1010 0001 0100 0000 0000 0000 0000 0000 0000 0000 0000 =  
**8CB10A1400000000**

## 5.2 Downlink type = 5

With this downlink, the user can write the configuration to any address on the memory map of the device. Please refer to the memory map of the device to understand what parameters can be written.



The length of the configuration parameter can be 1, 2 bytes, or 4 bytes, but the total length of the Downlink payload must equal 64 bits (8 bytes). Please see below the downlink format for both types.

**Downlink type 5 for the parameter of 2 bytes length:**

Payload	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	reserved	DOWNLINK_TYPE
<b>bits</b>	<b>8</b>	<b>8</b>	<b>16</b>	<b>28</b>	<b>4</b>
<i>Value</i>	<i>yes</i>	<i>0x02 = 2</i>	<i>yes</i>	<i>zeros</i>	<i>0b0101 = 5</i>

### Downlink type 5 for the parameter of 4 bytes length:

Payload	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	reserved	DOWNLINK_TYPE
bits	8	8	32	12	4
Value	yes	0x04 = 4	yes	zeros	0b0101 = 5

Where:

- PRM\_ADDRESS: address of the configuration parameter in the memory map of the device;
- PRM\_LENGTH: is the length of that parameter, in bytes;
- PRM\_VALUE: is the value the user wants to write to that parameter;
- reserved: a series of bits of zero to fulfill the downlink so that it has the total length = 64 bits (8 bytes)

#### EXAMPLE FOR DOWNLINK TYPE = 5

- ✓ Here is the list of parameters of WSLRW-G4 or WSLRWEX-G that can be configured via Downlink type = 5 and the examples of the downlink payload on the right-most side column. It is the example value, not the default value of the device. Please check the memory map of the device for more detail about the parameters.

**Note: the total length of the downlink must be equal to 8 bytes**

PARAMETER	DATA TYPE OF PARAMETER	PRM_ADDR	PRM_LENGTH	PRM_VALUE	DOWNLINK_RESERVED	PAYLOAD OF DOWNLINK (IN HEXA)
(bytes)		1	1	4	2	8
CONSTANT_A	Float	0x4E	0x04 = 4	0x3F8CCCCD = 1.1	0x0005	4E043F8CCCCD0005
CONSTANT_B	Float	0x50	0x04 = 4	0x3E4CCCCD = 0.2	0x0005	50043E4CCCCD0005
HIGH_CUT	Float	0x52	0x04 = 4	0x447A0000 = 1000	0x0005	5204447A00000005
LOW_CUT	Float	0x54	0x04 = 4	0x00000000 = 0	0x0005	5404000000000005
SENSOR+AMPLIFIER	Uint32	0x58	0x04 = 4	0x41300000 = 11	0x0005	5804413000000005

## 5.3 Free online data conversion tools

- To convert from Float to Hex and vice versa, users may use this free online tool:  
<https://gregstoll.com/~gregstoll/floattohex/>
- To convert a decimal number to Hex, the user may use this free online tool:  
<https://www.binaryhexconverter.com/decimal-to-hex-converter>

## 6. Reed switches



The LoRaWAN sensor typically comes with at least one reed switch for user manipulation during commissioning or maintenance.

Some other versions come with 02 reed switches.

The WSLRW-G4 or WSLRWEX-G comes with one reed switch; please find below the functions of this switch.

EVENT	PRE-CONDITION	ACTION	LED STATUS	ACTIVITIES	POST-CONDITION
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<b>FORCE_DATA</b>	Any state	Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, move Magnet Key away.	Blink SKY BLUE	the device will send the uplink message FORCE_DATA	Back to the previous state
<b>PARAMETERS</b>	Any state	Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, hold Magnet Key 5s. Led blink PURPLE, move Magnet Key away.	Blink PURPLE	the device will send the uplink message PARAMETER_UPD	Back to the previous state
					

# Payload for LoRaWAN Tilt Sensor WSLRW-AG


# Payload WSLRW-AG | Firmware 2

## 1. Payload document is applied for the following products

Item code	HW Version	Firmware Version	Remarks
WSLRW-AG	1	2	

## 2. Changes information in this version v.s previous version

Item	Changes	Changed by	Changed Date	Approved by	Approved Date
2	Improve accuracy and resolution on FW 2	P.N.Diep	07-09-2022	N.V.Loc	07-09-2022
1	Initial version FW 1	P.N.Diep	01-06-2022	N.V.Loc	02-06-2022

 The approved date is also the release date of this document.

## 3. Payload for Uplink messages

### START\_UP message

When?	Purpose	Wait for Downlink?	LED color
This message will be sent once after 60 seconds from power-up the device	To understand when the device was powered up	YES	Blink WHITE

Payload	EVENT_ID	HW_VERSION	FW_VERSION	CURRENT_CONFIGURATION
bits	4	4	8	64
value	0b0000 = 0	yes	yes	yes








### PARAMETER\_UPDATE message

When?	Purpose	Wait for Downlink?	LED color
When the reed switch is activated by the magnet key. <b>How?</b> Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, hold Magnet Key 5s. Led blink PURPLE, move Magnet Key away.	To send the new configuration to the device via downlink	YES	Blink <b>PURPLE</b>

Payload	EVENT_ID	HW_VERSION	FW_VERSION	CURRENT_CONFIGURATION
bits	4	4	8	64
value	0b0001 = 1	yes	yes	yes








### FORCE\_DATA message

When?	Purpose	Wait for Downlink?	LED color
When the reed switch is activated by the magnet key. <b>How?</b> Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, move Magnet Key away.	To get the instant measured value from the device for calibration and validation.	YES	Blink <b>SKY BLUE</b>

Payload	EVENT_ID	SENSOR_ERROR	reserved	BATTERY_LEVEL	reserved	X_TILT_VAL	Y_TILT_VAL	Z_TILT_VAL
								
bits	4	1	5	2	4	16	16	16
value	0b0010 = 2	yes	zeros	yes	zeros	yes	yes	yes

## CYCLIC\_DATA message

When?	Purpose	Wait for Downlink?	LED color
This message will be sent in the pre-defined cycle.	To get the measured value from the device in the pre-defined cycle.	YES	Blink SKY BLUE

Payload	EVENT_ID	SENSOR_ERROR	reserved	BATTERY_LEVEL	reserved	X_TILT_VAL	Y_TILT_VAL	Z_TILT_VAL
								
bits	4	1	5	2	4	16	16	16
value	0b0011 = 3	yes	zeros	yes	zeros	yes	yes	yes

## 4. Payload Fields of Uplink

Below is an explanation of the payload fields in the uplink messages.

Data name	Description	Encoding or Possible values	Length (in bits)
EVENT_ID	Unique ID identifying the device event	4-bit unsigned integer 0 = START_UP 1 = PARAMETERS_UPDATE 2 = FORCE_DATA 3 = CYCLIC_DATA	4
HW_VERSION	HW_VERSION = HW_VERSION value in EEPROM set in production if the Value is unknown, the default value will be 0	4-bit unsigned integer 1..15	4
FW_VERSION	Indicate the FW version. Refer to the FW release note	8-bit unsigned integer 1..255	8
CURRENT_CONFIGURATION	The current configuration code of the device	64-bit encoded field Refer to the Downlink section	64
SENSOR_ERROR	Indicate the sensor error or not	0b0 = no sensor's error 0b1 = sensor's error	1
BATTERY_LEVEL	Battery level	2-bit unsigned integer 0 to 3 0: 10% 1: 30% 2: 60% 3: 99%	2

<b>X_TILT_VALUE_X10</b>	X Tilt value	16-bit signed integer $X\_TILT\_VALUE = X\_TILT\_VALUE\_X10 / 10$ Range: -90.0 to 90.0	<b>16</b>
<b>Y_TILT_VALUE_X10</b>	Y Tilt value	16-bit signed integer $Y\_TILT\_VALUE = Y\_TILT\_VALUE\_X10 / 10$ Range: -90.0 to 90.0	<b>16</b>
<b>Z_TILT_VALUE_X10</b>	Z Tilt value	16-bit signed integer $Z\_TILT\_VALUE = Z\_TILT\_VALUE\_X10 / 10$ Range: -90.0 to 90.0	<b>16</b>

## 5. Payload for Downlink messages

Users can use a downlink message to change the configuration of the device. There are 02 types of downlink messages:

- **Downlink type = 0:** Write the configuration for the specific type of LoRaWAN sensor. The format is fixed for each type of sensor.
- **Downlink type = 5:** Write a value to any address of the configuration parameter of the LoRaWAN sensor. This method is generic and can be applied to any type of LoRaWAN sensor, the user just needs to know the memory map of the sensor.

### 5.1 Downlink type = 0

<b>DOWNLINK_TYPE = 0</b>	<i>(led blink GREEN)</i>							
Payload	reserved	LED_BUZZER_ENABLE	reserved	MEASURE_PERIOD	reserved	CYCLIC_DATA_PERIOD	DEVICE_RESET	DOWNLINK_TYPE
bits	44	1	3	4	1	3	4	4
Value	zeros	yes	zeros	yes	zeros	yes	yes	0b0000 = 0

*Below is the table to explain in detail the meaning of each configuration parameter and its default value.*

Parameters	Description	Possible values	Default values	Length (in bits)
<b>LED_BUZZER_ENABL</b>	Flag to enable/disable LED and Buzzer interactions for action not triggered by the button.	0b0 = false, LEDs are OFF 0b1 = true, LEDs are ON	0b1 = true	1




<b>DEVICE_RESET</b>	0b0000 = do nothing	0000	4
<b>DOWNLINK_TYPE</b>	0b0000	0000	4

Then you will get the final configuration code as below:

0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 1000 1011 0001 0000 0000 =  
**0000000000008B100**

## 5.2 Downlink type = 5

With this downlink, the user can write the configuration to any address on the device's memory map. Please refer to the device's memory map to understand what parameters can be written.

 The length of the configuration parameter can be 1, 2 bytes, or 4 bytes, but the total length of the Downlink payload must equal 64 bits (8 bytes). Please see below the downlink format for both types.

**Downlink type 5 for the parameter of 2 bytes length:**

Payload	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	reserved	DOWNLINK_TYPE
<b>bits</b>	<b>8</b>	<b>8</b>	<b>16</b>	<b>28</b>	<b>4</b>
<i>Value</i>	<i>yes</i>	<i>0x02 = 2</i>	<i>yes</i>	<i>zeros</i>	<i>0b0101 = 5</i>


**Downlink type 5 for the parameter of 4 bytes length:**

Payload	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	reserved	DOWNLINK_TYPE
<b>bits</b>	<b>8</b>	<b>8</b>	<b>32</b>	<b>12</b>	<b>4</b>
<i>Value</i>	<i>yes</i>	<i>0x04 = 4</i>	<i>yes</i>	<i>zeros</i>	<i>0b0101 = 5</i>




Where:

- PRM\_ADDRESS: address of the configuration parameter in the memory map of the device;
- PRM\_LENGTH: is the length of that parameter, in bytes;
- PRM\_VALUE: is the value the user wants to write to that parameter;
- reserved: a series of bits of zero to fulfill the downlink so that it has the total length = 64 bits (8 bytes)

### EXAMPLE FOR DOWNLINK TYPE = 5

 Here is the list of parameters of WSLRW-AG that can be configured via Downlink type = 5 and the examples of the downlink payload on the right-most side column. It is the example value, not the default value of the device. Please check the device's memory map for more detail about the parameters.

 **Note: the total length of the downlink must be equal to 8 bytes**

PARAMETER	DATA TYPE OF PARAMETER	PRM_ADDR	PRM_LENGTH	PRM_VALUE	DOWNLINK_TYPE	PAYLOAD OF DOWNLINK (IN HEXA)
						
<i>(bytes)</i>		<i>1</i>	<i>1</i>	<i>4</i>	<i>2</i>	<i>8</i>

<b>ADAPTIVE DATA RATE</b>	Uint16	0x40	0x02 = 2	0x00000001 = 1	0x0005	4002000000010005
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### 5.3 Free online data conversion tools

- To convert from Float to Hex and vice versa, users may use this free online tool:  
<https://gregstoll.com/~gregstoll/floattohex/>
- To convert a decimal number to Hex, the user may use this free online tool:  
<https://www.binaryhexconverter.com/decimal-to-hex-converter>

## 6. Reed switches

The LoRaWAN sensor typically comes with at least one reed switch for user manipulation during commissioning or maintenance.

Some other versions come with 02 reed switches.

The WSLRW-AG comes with one reed switch; please find below the functions of this switch.

EVENT	PRE- CONDITION	ACTION	LED STATUS	ACTIVITIES	POST- CONDITION
<b>FORCE_DATA</b>	Any state	Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, move Magnet Key away.	Blink SKY BLUE	the device will send the uplink message FORCE_DATA	Back to the previous state
<b>PARAMETERS</b>	Any state	Move Magnet Key to the contact point of REED SWITCH. Led blink SKY BLUE, hold Magnet Key 5s. Led blink PURPLE, move Magnet Key away.	Blink PURPLE	the device will send the uplink message PARAMETER_UPD	Back to the previous state