Payload for Sigfox-Ready Ultrasonic Level Sensor for Trash bin WSSFC-ULA

- Payload WSSFC-ULA | Firmware 2

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1. Payload document is applied for the following products

Item code	HW Version	Firmware Version	Remarks
WSSFC-ULA-01	2	2	

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

Item	Changes	Changed by	Changed Date	Approved by	Approved Date
1	Initial version	D.Q.Tuan	01-08-2022	N.V.Loc	24-08-2022

ℹ 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 was the device powered up	NO	Blink WHITE

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

HEART_BEAT message

When?	Purpose	Wait for Downlink?	LED color
This message will be sent in the pre-defined cycle, default is 24 hours	To check the health status, get the current configuration, and send the new configuration to the device via downlink	YES	Blink GREEN

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

PARAMETER_UPDATE message

When?	Purpose	Wait for Downlink?	LED color
When the reed switch is activated by the magnet key. **How?** 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 PURPLE

Payload	EVENT_ID	HW_VERSION	FW_VERSION	LATEST_SIGFOX_DOWNLINK
bits	4	4	8	64
value	*0b0010 = 2*	*yes*	*yes*	*yes*

FORCE_DATA message

When?	Purpose	Wait for Downlink?	LED color
When the reed switch is activated by the magnet key. **How?** 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.	NO	Blink SKY BLUE

Payload	EVENT_ID	HW_ERROR	reserved	ALARM	BATTERY_	reserved	LEVEL_T	LEVEL_M
bits	4	1	3	2	2	4	16	16
value	*0b0011 = 3*	*yes*	*zeros*	*yes*	*yes*	*zeros*	*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.	NO	Blink SKY BLUE

Payload	EVENT_ID	HW_ERROR	reserved	ALARM	BATTERY_	reserved	LEVEL_T	LEVEL_M	Tentative
bits	4	1	3	2	2	4	16	16	8
value	*0b0100 = 4*	*yes*	*zeros*	*yes*	*yes*	*zeros*	*yes*	*yes*	*yes*

ALARM message

When?	Purpose	Wait for Downlink?	LED color
This message will be sent upon the alarm occurs. 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.	NO	Blink RED

Payload	EVENT_ID	HW_ERROR	reserved	ALARM	BATTERY_	reserved	LEVEL_T	LEVEL_M	Tentative
bits	4	1	3	2	2	4	16	16	8
value	*0b0101 = 5*	*yes*	*zeros*	*yes*	*yes*	*zeros*	*yes*	*yes*	*yes*

4. Payload Fields of Uplink

Below is explanation about 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 = HEARTBEAT 2 = PARAMETERS_UPDATE 3 = FORCE_DATA 4 = CYCLIC_DATA 5 = ALARM	**4**
HW_VERSION	Indicate HW version	4-bit unsigned integer 1..15	**4**
FW_VERSION	Indicate FW version	8-bit unsigned integer 1..255	**8**
LATEST_SIGFOX_DOWNLIN	Latest received and valid sigfox downlink frame = Current configuration	64-bit encoded field See Sigfox Downlink tab	**64**
HW_ERROR	HW error	0b0 = no error 0b1 = error	**1**
ALARM	Alarm	0b00 = no alarm 0b01 = low alarm 0b10 = high alarm 0b11 = not used	**2**
BATTERY_LEVEL	Battery level	2-bit unsigned integer 0 to 3 0: 10% 1: 30% 2: 60% 3: 99%	**2**
LEVEL_PPT		16-bit unsigned integer Level value in part per thousand (scaled, used for alarm)	16
DISTANCE_MM		16-bit unsigned integer Distance value in mm	16
TENTATIVE	Tentative number ** This number counts how many uplink messages were sent since the alarm happened.*	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**

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.
- **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

Payload	HIGH_AI	LOW_AL	ALARM_	ALARM_	LED_BU	HEARTB	MEASUR	TX_REPI	CYCLIC_	DEVICE_	DOWNL
bits	**32**	**8**	**1**	**3**	**1**	**3**	**4**	**1**	**3**	**4**	**4**
Value	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*0b0000 = 0*

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

Parameter	Description	Possible values	Default value	Length (in bits)

HIGH_ALARM_SETPO	High alarm setpoint for calculated value	32-bit float value	1000000000	**32**
LOW_ALARM_SETPO	Low alarm setpoint for calculated value	8-bit unsigned integer LOW_ALARM_SETPOINT = HIGH_ALARM_SETPOINT * LOW_ALARM_SETPOINT_FACT / 200	0	**8**
ALARM_ENABLE	Enable/Disable ALARM event	0b0 = ALARM event is OFF 0b1 = ALARM event is ON	0b0 = ALARM event is OFF	**1**
ALARM_PERIOD	Period of time to send ALARM event ** when alarm occurs, the device will send uplink alarm message in every ALARM_PERIOD cycle, until the Alarm is end.*	0b000 = every 10min 0b001 = every 30min 0b010 = every 1h 0b011 = every 2h 0b100 = every 3h 0b101 = every 6h 0b110 = every 12h 0b111 = every 24h	0b000 = every 10min	**3**
LED_BUZZER_ENABL	Enable/Disable LEDs and Buzzers interactions for action not triggered by the reed switch	0b0 = LEDs and Buzzers are OFF 0b1 = LEDs and Buzzers are ON	0b1 = LEDs and Buzzers are ON	**1**
HEARTBEAT_PERIOD	Period of time to send HEARTBEAT event	0b000 = every 1h 0b001 = every 6h 0b010 = every 12h 0b011 = every 24h (1 day) 0b100 = every 48h (2 days) 0b101 = every 72h (3 days) 0b110 = every 120h (5 days) 0b111 = every 240h (10 days)	0b011 = every 24h (1 day)	**3**
MEASURE_PERIOD	Period of time to measure sensor	0b0000 = every 1s 0b0001 = every 2s 0b0010 = every 5s 0b0011 = every 10s 0b0100 = every 20s 0b0101 = every 30s 0b0110 = every 1min 0b0111 = every 2min 0b1000 = every 5min 0b1001 = every 10min 0b1010 = every 20min 0b1011 = every 30min 0b1100 = every 1h 0b1101 = every 2h 0b1110 = every 3h 0b1111 = every 6h	0b1011 = every 30min	**4**
TX_REPEAT	Sigfox TX repeat	0b0 = Send RF 1 time 0b1 = Send RF 3 time	0b1 = Send RF 3 time	**1**
CYCLIC_DATA_PERIO	Period of time to send CYCLIC_DATA event	0b000 = every 10min 0b001 = every 30min 0b010 = every 1h 0b011 = every 2h 0b100 = every 3h 0b101 = every 6h 0b110 = every 12h 0b111 = every 24h	0b001 = every 30min	**3**
DEVICE_RESET	Once this parameter is set, the device shall restart once after having received the Downlink.	0b1010 = 0xA = force device reset others = do nothing	0b0000 = do nothing	**4**
DOWNLINK_TYPE	Downlink type	4-bit unsigned integer See Sigfox Downlink tab	0b0000	**4**

EXAMPLE FOR DOWNLINK TYPE = 0

If you plan to change the ***MEASURE_PERIOD = 30 minutes*** and ***CYCLIC_DATA_PERIOD = 1 hr*** then please enter your desired values, guided by the table below:

Parameter	Setting value (in decimal)	Setting Value (in binary)	Length (in bits)
HIGH_ALARM_SETPOINT	1000000000	01001110011011100110101100101000	32
LOW_ALARM_SETPOINT_FACTOR	0	00000000	8
ALARM_ENABLE		0	1
ALARM_PERIOD		000	3
LED_BUZZER_ENABLE		1	1
HEARTBEAT_PERIOD		011	3
MEASURE_PERIOD		**1011**	***4***
TX_REPEAT		1	1
CYCLIC_DATA_PERIOD		**010**	***3***
DEVICE_RESET		0000	4
DOWNLINK_TYPE		0000	4

Then you will get the final configuration code as below:

0100 1110 0110 1110 0110 1011 0010 1000 0000 0000 0000 1011 1011 1010 0000 0000 = **4E6E6B28000BBA00**

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 WSSFC-ULA 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_AD	PRM_LENG	PRM_VALUE	DOWNLINK_	PAYLOAD OF DOWNLINK (IN HEXA)
(bytes)		*1*	*1*	*4*	*2*	*8*
CONSTANT_A	Float	0x16	0x04 = 4	0x3F8CCCCD = 1.1	0x0005	16043F8CCCCD0005
CONSTANT_B	Float	0x18	0x04 = 4	0x3E4CCCCD = 0.2	0x0005	18043E4CCCCD0005
HIGH_CUT	Float	0x1A	0x04 = 4	0x447A0000 = 1000	0x0005	1A04447A00000005
LOW_CUT	Float	0x1C	0x04 = 4	0x00000000 = 0	0x0005	1C04000000000005
SENSOR_BOOT_TIM	Uint32	0x1E	0x04 = 4	0x000000C8 = 200	0x0005	1E04000000C80005
NUMBER OF SAMPLES	Uint16	0x32	0x04 = 2	0x000A0000 = 10	0x0005	3202000A00000005

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 one reed switch for user manipulation during commissioning or maintenance.

Some other versions come with 02 reed switches.

The WSSFC-ULA comes with one 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

PARAMETERS	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