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ENGINKO DATA FRAME FORMAT

Rev. 1.34

The document describes encryptions related to LoRaWAN® payloads. Relevant chapters per product of interest are marked with a cross “X”.

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MCF-LW06485/B	X					X							X		X		
MCF-LW06VMC	X												X		X		
MCF-LW06VMC2	X												X		X		
MCF-LW06232	X		X									X	X		X		
MCF-LW06CNT/B	X				X						X		X		X		
MCF-LW06420/D	X							X					X		X		
MCF-LW06010/D	X							X					X		X		
MCF-LW06424/D	X							X					X		X		
MCF-LW06420B	X							X					X		X		
MCF-LW06010B	X							X					X		X		
MCF-LW06424B	X							X					X		X		
MCF-LW06420T	X							X			X		X		X		
MCF-LW06010T	X							X			X		X		X		
MCF-LW06424T	X							X			X		X		X		
MCF-LW06KIO	X		X		X					X	X	X	X		X		
MCF-LW06DO	X		X		X						X	X	X		X		
MCF-LW12PLG	X			X	X								X		X		
MCF-LW12MET	X			X	X						X		X		X		
MCF-LW13IO	X				X						X		X		X		
MCF-LW13MIO	X				X						X		X		X		
MCF-LW12TERWP	X	X											X		X		
MCF-LW12TERPM	X					X							X		X		
MCF-LW12TER	X	X											X		X		
MCF-LW12VOC	X				X		X						X		X		
MCF-LW12CO2/E	X				X				X				X		X		
MCF-LWWS00	X					X							X		X		
MCF-LWWS01	X					X							X		X		
MCF-LWWS02	X					X							X		X		
MCF-LWWS03	X					X							X		X		
MCF-LW06DAVK/P	X					X							X		X		
EGK-LW20Lxx	X												X	X	X		
EGK-LW20Wxx	X												X	X	X		
EGK-LW20LTxx	X												X	X	X		
EGK-LW20WTxx	X												X	X	X		
EGK-LW22PLG	X			X	X								X		X		
EGK-LW22CCMxx	X												X		X	X	X
EGK-LW22TWPxx	X	X											X		X		

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MCF-LW06485/B	x			x				x	x		x					x		x	x		x								x		x
MCF-LW06VMC	x			x					x		x										x								x		
MCF-LW06VMC2	x			x					x		x										x								x		
MCF-LW06232	x	x		x				x	x		x						x		x		x								x		
MCF-LW06CNT/B	x			x					x		x			x							x								x		

PRODUCT PART NUMBER	2.1 TIME SYNC ANSWER	2.2 UART MESSAGE	2.3 IO MESSAGE	2.4 SET PERIOD	2.5 METERING REQUEST	2.6 SET PRESSURE COMPENSATION	2.7 THRESHOLDS	2.8 SERIAL DATA	2.9 OFF COMMAND	2.10 SET ELEVATION	2.11 GENERAL SETTINGS	2.12 CO2 SENSOR SETTINGS	2.13 ENERGY METER SETTINGS	2.14 CNT OPTION	2.15 BVOC/PM SETTINGS	2.16 MODBUS SETTINGS	2.17 ENABLE LOG	2.18 DELAY SETTINGS	2.19 SERIAL SETTINGS	2.20 OUTPUT SETTINGS	2.21 CONFIGURATION REQUEST	2.22 ENABLE INPUT COUNTERS	2.23 ENABLE OUTPUT COUNTERS	2.24 LEVEL SENSOR SETTINGS	2.25 IO REQUEST MESSAGE	2.26 OUTPUT PULSE TRAIN	2.27 CCM SETTINGS	2.28 CCM LOG REQUEST	2.29 UTC SETTINGS	2.30 GEOGRAPHICAL COORDINATES	2.31 FORCE MESSAGE
MCF-LW06420/D/T	X			X			X		X		X			X				X			X								X		X
MCF-LW06010/D/T	X			X			X		X		X			X				X			X								X		X
MCF-LW06424/D/T	X			X			X		X		X			X				X			X								X		X
MCF-LW06420B	X			X					X		X							X			X								X		X
MCF-LW06010B	X			X					X		X							X			X								X		X
MCF-LW06424B	X			X					X		X							X			X								X		X
MCF-LW06KIO	X	X	X	X				X	X		X						X	X	X	X	X	X	X		X	X			X		
MCF-LW06DO	X	X	X	X				X	X		X									X	X		X		X	X			X		
MCF-LW12PLG	X		X	X	X		X		X		X		X							X	X		X		X	X			X		
MCF-LW12MET	X		X	X	X		X		X		X		X							X	X	X	X		X	X			X		
MCF-LW13IO	X		X	X					X		X									X	X	X	X		X	X			X		
MCF-LW13MIO	X		X	X					X		X									X	X	X	X		X	X			X		
MCF-LW12TERWP	X			X		X			X		X										X								X		
MCF-LW12TERPM	X			X		X			X		X				X						X								X		
MCF-LW12TER	X			X		X			X		X										X								X		
MCF-LW12VOC	X			X		X	X		X		X				X						X								X		
MCF-LW12CO2/E	X			X		X	X		X		X	X			X						X								X		
MCF-LWWS00	X			X					X	X	X										X								X	X	X
MCF-LWWS01	X			X					X	X	X				X						X								X	X	X
MCF-LWWS02	X			X					X	X	X										X								X	X	X
MCF-LWWS03	X			X					X	X	X				X						X								X	X	X
MCF-LW06DAVK/P	X			X					X	X	X				X						X								X	X	X
EGK-LW20Lxx	X			X					X		X										X			X					X		
EGK-LW20Wxx	X			X					X		X										X			X					X		
EGK-LW20LTxx	X			X		X			X		X										X			X					X		
EGK-LW20WTxx	X			X		X			X		X										X			X					X		
EGK-LW22PLG	X		X	X	X		X		X		X		X							X	X		X		X	X			X		
EGK-LW22CCMxx	X			X			X		X		X						X				X						X	X	X		
EGK-LW22TWPxx	X			X		X			X		X										X								X		

1. UPLINK MESSAGES FROM END-DEVICES

1.1 TIME SYNC REQUEST

name	size [byte]	hex value	meaning
Uplink ID	1 byte	01	Time sync request
Sync ID	4 byte	XX XX XX XX	ID of sync request
Sync Version	3 byte (optional)	XX XX XX	Major and minor version and build

name	size [byte]	hex value	meaning
Application type	2 byte	02 00	for MCF-LW06VMC
		02 01	for MCF-LW06232
		02 03	for MCF-LW06485
		02 04	for MCF-LWWS00 and MCF-LW06DAVK
		02 05	for MCF-LW06KIO
		02 07	for MCF-LW06420/010 OBSOLETE
		02 08	for MCF-LWWS01 and MCF-LW06DAVKP
		02 09	for MCF-LW06420
		02 0A	for MCF-LW06010
		02 0B	for MCF-LW06424
		02 0C	for MCF-LW06420D
		02 0D	for MCF-LW06010D
		02 0E	for MCF-LW06424D
		02 0F	for MCF-LW06VMC2
		02 10	for MCF-LW06420B
		02 11	for MCF-LW06010B
		02 12	for MCF-LW06424B
		02 13	for MCF-LW06CNT
		02 14	for MCF-LW06CNTB
		02 15	for MCF-LW06010T
		02 16	for MCF-LW06420T
		02 17	for MCF-LW06424T
		02 18	for MCF-LW06DO
		04 00	for MCF-LW12TER (old)
		04 01	for MCF-LW12TERWP
		04 02	for MCF-LW12VOC
		04 03	for MCF-LW12CO2
		04 05	for MCF-LW12TERPM
		04 06	for MCF-LW12TER
		04 07	for MCF-LW12CO2
		07 00	for MCF-LW12MET
		07 01	for MCF-LW13IO
		07 02	for MCF-LW12PLG
		09 00	for MCF-LW13MIO
		0A 00	for EGK-LW20L00
		0A 01	for EGK-LW20W00
		0A 02	for EGK-LW20LT00
		0A 03	for EGK-LW20WT00
		0A 04	for EGK-LW22CCM
		0A 05	for EGK-LW22TWP
		0B 00	for EGK-LW22PLG
		0A 06	for EGK-LW20L10
Option	1 byte (optional)	XX	bit 0 set if first message after boot
			bit 1 set if external power is going down
RFU	X byte	XX..	Optional RFU byte

The device, after sending the message, waits for the time sync answer (2.1 TIME SYNC ANSWER).If nothing received, il will try sendind 3 more downlinks.

You have to reply before the 4th uplink.

Time sync reply must be sent after a time sync request (starting with 01), otherwise it will be ignored.

If error persists, it will try again after one week. If it receives the right answer, it aligns the internal clock and a new sync message will be sent after a week to overcome real time clock drift.

If not handled in the right way can cause a unnecessary battery consumption.

Example
message after a power-on:
01787d3c250002000203 0**1**

Uplink ID **01** = Time Sync request
Sync ID **787d3c25** = ID of this Sync Reuest
Sync Version **000200** = Major and minor version and build
Application typ **0203** = MCF-LW06485
Option **01** = bit 0 set: first message after boot

message during a power down (only for MCF-LW06xxx family class C):
014e7d3c25000200020302

HOME

1.2 T/P/RH

name	size [byte]	hex value	meaning
Uplink ID	1 byte	04	Temperature/Pressure/Humidity
Data	10 byte	XX XX ...	Measure 1, refer to Note 1
	10 byte	XX XX ...	Measure 2, refer to Note 1
	10 byte	XX XX ...	Measure 3, refer to Note 1
Batt %	1 byte (optional)	XX	Battery percentage
RFU	4 byte (optional)	XX XX XX XX	Optional RFU byte

Note 1

The 10 bytes for each measurement are divided as follows:

- 4 bytes LSB are for the date and time. The MSB (most significant byte) is on the right so they must be read from the right. The 4 byte in reverse order are as follows:
  - 7 bit for the offset of the year, starting from the year 2000
  - 4 bit per month
  - 5 bit for day of the month

    - 5 bits for hour
    - 6 bits for minutes
    - 5 bits for half the seconds. The seconds range is from 0 to 31, so the result should be multiplied by 2 to find the actual seconds of the measurement.

- 2 bytes LSB for temperature. The temperature is represented by a signed integer with the least significant byte first. The temperature is expressed in hundreds of a °C degree.
- 1 byte for humidity. Relative humidity is an unsigned integer corresponding to twice the percentage of humidity.
- 3 bytes LSB for pressure. Pressure is an unsigned integer with the least significant byte first; it is expressed in Pascal.

Example Sample payload: 04dc7e3721b40a47608801dd7e3721b10a43608801e07e3721b20a425d8801 Remove the first byte and divide the other 30 into 3 parts by 10 byte that correspond to 3 measurements. <color green>The 3 measurements will be:

- dc7e3721b40a47608801
- dd7e3721b10a43608801
- e07e3721b20a425d8801

Decipher the first measurement dividing it by groups and applying the necessary transformations:

- Measurement date: dc 7e 37 21
    - Byte swapping, result: 21 37 7e dc
    - The result in bits will be: 00100001 00110111 01111110 11011100
        - The bits are divided as explained above
            - Year: 0010000
                - Result: 16
                    - 2000+16 = 2016
            - Month: 1001
                - Result: 9
            - Day: 10111
                - Result: 23
            - Hour: 01111
                - Result: 15
            - Minutes: 110110
                - Result: 54
            - Seconds: 11100
                - Result: 28
                    - 28*2 = 56
    - The date of the measurement will be: 23/09/2016 15:54:56.
- Temperature: b40a
    - Byte swapping, result: 0ab4
        - The result (with sign) will be +2740 with two decimal places, then + 27.40 °C.
- Humidity: 47
    - In decimal is 71, the humidity is 71/2 = 35.5% rH.
- Pressure: 608801
    - Byte swapping, result: 018860
        - In decimal, the result is 100448, with two decimal places the pressure is 1004.48 hPa

HOME

1.3 UART

name	size [byte]	hex value	meaning
Uplink ID	1 byte	05	UART
Data	Application related	XX XX..	Data to be forwarded (via serial or usb command)

HOME

1.4 POWER

The recurrent message of metering end-nodes is as follows:

name	size [byte]	hex value	meaning
Uplink ID	1 byte	09	Power
Date/Time	4 byte	XX XX XX XX	Date and time (as for Note1)
Active energy	4 byte (s32 LSB)	XX XX XX XX	Cumulative Active energy (Wh)
Reactive energy	4 byte (s32 LSB)	XX XX XX XX	Cumulative Reactive energy (VARh)
Apparent energy	4 byte (s32 LSB)	XX XX XX XX	Cumulative Apparent energy (VAh)
Running Time	4 byte (u32 LSB)	XX XX XX XX	Seconds of running (s)

After a message of metering request (2.5 METERING REQUEST), or enabled on the sensor, the uplink is as follows:

name	size [byte]	hex value	meaning
Uplink ID	1 byte	09	Power
Date/Time	4 byte	XX XX XX XX	Date and time (as for Note1)
Active energy	4 byte (s32 LSB)	XX XX XX XX	Cumulative Active energy (Wh)
Reactive energy	4 byte (s32 LSB)	XX XX XX XX	Cumulative Reactive energy (VARh)
Apparent energy	4 byte (s32 LSB)	XX XX XX XX	Cumulative Apparent energy (VAh)
Active power	2 byte (s16 LSB)	XX XX	Active power (W)
Reactive power	2 byte (s16 LSB)	XX XX	Reactive power (VAR)
Apparent power	2 byte (s16 LSB)	XX XX	Apparent power (VA)
Voltage	2 byte (u16 LSB)	XX XX	Voltage (dV RMS)
Current	2 byte (u16 LSB)	XX XX	Current (mA RMS)
Period	2 byte (u16 LSB)	XX XX	Period (us)
Running Time	4 byte (u32 LSB)	XX XX XX XX	Seconds of running (s)

HOME

1.5 IO

name	size [byte]	hex value	meaning
Uplink ID	1 byte	0A	Input/output
Date/Time	4 byte	XX XX XX XX	Date and time (as for Note1)
Inputs	4 byte (u32 LSB)	XX XX XX XX	Bit mask of the inputs
Outputs	4 byte (u32 LSB)	XX XX XX XX	Bit mask of the outputs
Events	4 byte (u32 LSB)	XX XX XX XX	Bit mask of input events

This uplink format is for 32 inputs and 32 outputs. Relevant bits depend on the device part number and its I/O capability.

In case of EGK-LW22PLG, the input status represents the status of the mains (1 for mains present, 0 for mains not present).

In case of MCF-LW12VOC or MCF-LW12CO2 with thresholds enabled, the input status represents the status of the measure (1 if over T+, 0 if under T-).

In case of MCF-LW12CO2E with thresholds enabled, the inputs 0 to 2 represents the led status (Input 0 = red, Input 1 = yellow, input 2 = green).

In case of EGK-LW20L00 and EGK-LW20W00, with accelerometer enabled, the inputs 0 represents the accelerometer status (Input = 1 start of accelerometer event start, input = 0 end of accelerometer event).

HOME

1.6 REPORT DATA

name	size [byte]	hex value	meaning
Uplink ID	1 byte	0B	Report data
Report ID	1 byte	0Y	for MCF-LW06KAM, “Y” is the sequential number of the transmission in progress, is incremented at the end of each transmission.
		1Y/4Y/7Y/8Y	for MCF-LW06485, successful reading, “Y” is the sequential number of the transmission in progress, is incremented at the end of each transmission, refer to Note 2
		5Y/6Y/9Y/AY	for MCF-LW06485, error reading, “Y” is the sequential number of the transmission in progress, is incremented at the end of each transmission, refer to Note 2
		2Y	for MCF-LWWS00, MCF-LWWS01, MCF-LW06DAVK and MCF-LW06DAVKP, “Y” is the sequential number of the transmission in progress, is incremented at the end of each transmission.
		3Y	for MCF-LW12TERPM, “Y” is the sequential number of the transmission in progress, is incremented at the end of each transmission.
Frame ID	1 byte	XX	Progressive frame index, increased at each transmission with the same identifier

name	size [byte]	hex value	meaning
Data	1..33 byte	XX XX ..	for MCF-LW06485 refer to Note 2
			for MCF-LWWS00 refer to Note 3
			for MCF-LW06DAVK refer to Note 3
			for MCF-LWWS01 refer to Note 4
			for MCF-LW06DAVKP refer to Note 4
			for MCF-LW12TERPM refer to Note 4A

Note 2

Report ID for MCF-LW06485:

- 1Y for recurrent data;
- 4Y for data received after a 0x8 serial data downlink;
- 5Y for recurrent data with error;
- 6Y for data received after a 0x8 serial data downlink with error.

The ModBus frame consists of at least 3 bytes.

In case of success (1Y/4Y), the first two bytes (us16 LSB) indicate the length (including the two bytes) and the remaining bytes is the data read from the peripheral Modbus device(s).

In case of error (5Y/6Y), the first two bytes (us16 LSB) indicate the length (including the two bytes) and the remaining bytes is the data successfully read from the peripheral Modbus device(s) before the error, and the last byte is the type of error:

- 0x05 configuration error
- 0x07 error reading internal configuration
- 0x7F ModBus command not implemented
- 0xCC communication error

For backwards compatibility in case of error, it will also return 0200XX where XX indicates the type of error:

- 0x05 configuration error
- 0x07 error reading internal configuration
- 0x7F ModBus command not implemented
- 0xCC communication error

Only for MCF-LW06485**B**

Report:

- 7Y for recurrent data;
- 8Y for data received after a 0x8 serial data downlink;
- 9Y for recurrent data with error;
- AY for data received after a 0x8 serial data downlink with error.

The ModBus frame consists of at least 4 bytes.

In case of success (7Y/8Y), the first two bytes (us16 LSB) indicate the length (including the two bytes) and the remaining bytes is the data read from the peripheral Modbus device(s). Last byte is the battery percentage.

In case of error (9Y/AY), the first two bytes (us16 LSB) indicate the length (including the two bytes) and the remaining bytes is the data successfully read from the peripheral Modbus device(s) before the error, then the type of error:

- 0x05 configuration error
- 0x07 error reading internal configuration
- 0x7F ModBus command not implemented
- 0xCC communication error

and as last byte the battery percentage.

Example

Sample payload:
0b10000a00be87424808010000 Uplink ID: 0b Report ID: 10 (recurrent data) Frame ID: 00

Data: 0a00be87424808010000

- Byte 1...2: 0a00 (LSB) → 0x000a data length
- Byte 3...10: be87424808010000 data content

Note 3

The Davis weather station frame is made up of at least 4 bytes. In the event of an error it returns XXYYZZZZ , where XX indicates the data version, YY the type of error, ZZZZ the size of the read data.

Error type (YY):

- A0 to A7 = no answer
- CB = data format error
- 22 = CRC error
- 19 = Davis type error

If case of successful reading of weather data, the data sequence will be as in the following table (data with more than 1 bytes is LSB):

name	**size [byte]**	**meaning**
Data version	1 byte	Current version is 2
Davis type	1 byte	16 (0x10) for Vantage Pro/Pro2
Barometer data	2 byte (u16 LSB)	Unit is milli inch Hg (inchHg/1000)
Outside temperature	2 byte (s16 LSB)	Unit is d°F (°F/10)

name	size [byte]	meaning
Wind speed	1 byte	Unit is mph (miles per hour)
Avg wind speed	1 byte	Unit is mph
Wind direction	2 byte (u16 LSB)	Value from 1 to 360 degrees. (0° is no wind data, 90° is East, 180° is South, 270° is West and 360° is north)
Outside humidity	1 byte	Relative humidity in %
Rain rate	2 byte (u16 LSB)	Number of rain clicks. Rain clicks/hour
UV	1 byte	Unit is in UV index / 10
Solar radiation	2 byte (u16 LSB)	The unit is in watt/meter2
Day rain	2 byte (u16 LSB)	Number of rain clicks (0.2mm).
Day et	2 byte (u16 LSB)	Unit is inch / 1000
Date/time	4 byte (u32 LSB)	Weather station date and time (as for Note 1)
Dew Point	2 byte (s16 LSB)	The value is a signed two byte value in whole degrees F. 255 = dashed data
Altitude	2 byte (s16 LSB)	Station elevation (ft.)
Forecast icons	1 byte	Single Bit meaning is: 0x01 = Rain, 0x02 = Cloud, 0x04 = Partly cloudy, 0x08 = Sun, 0x10 = Snow. Mixed forecasts are possible. See examples below.
Bar trend	1 byte	Signed byte that indicates the current 3-hour barometer trend. It is one of these values: -60 = Falling Rapidly = 196 (as an unsigned byte), -20 = Falling Slowly = 236 (as an unsigned byte), 0 = Steady, 20 = Rising Slowly, 60 = Rising Rapidly, 80 = ASCII “P” = no trend info is available. Any other value meanings that the Vantage does not have the 3 hours of bar data needed to determine the bar trend.
Battery	1 byte	Battery % (RFU on version 0)
RFU	2 byte	Optional RFU bytes. Only present in MCF-LWWS01 and MCF-LW06DAVKP

Examples of Forecast icons:

decimal	hex	Segments shown	Forecast
8	0x08	Sun	Mostly Clear
6	0x06	Partial Sun + Cloud	Partially Cloudy
2	0x02	Cloud	Mostly Cloudy
3	0x03	Cloud + Rain	Mostly Cloudy, Rain within 12 hours
18	0x12	Cloud + Snow	Mostly Cloudy, Snow within 12 hours
19	0x13	Cloud + Rain + Snow	Mostly Cloudy, Rain or Snow within 12 hours
7	0x07	Partial Sun + Cloud + Rain	Partly Cloudy, Rain within 12 hours
22	0x16	Partial Sun + Cloud + Snow	Partly Cloudy, Snow within 12 hours
23	0x17	Partial Sun + Cloud + Rain + Snow	Partly Cloudy, Rain or Snow within 12 hours

Note 4

Refer first to Note 3. In addition are PM readings are on a separate uplink. The field “Data”, in case of success, is as follow:
* 4 bytes LSB are for the date and time (as per Note 1)

- 6 bytes LSB are for PM measures: 2 bytes for each measurement, formatted as LSB, reporting in order PM1.0, PM2.5 and PM10 in µg/m3
- 6 bytes LSB (if present) are for PM measures: 2 bytes for each measurement, formatted as LSB, reporting in order PM1.0, PM2.5 and PM10 in #/cm3.

Note 4A

The 17 (23) bytes of Data are divided as follows:

- 4 bytes LSB are for the date and time. The MSB (most significant byte) is on the right so they must be read from the right. The 4 byte in reverse order are as follows:
  - 7 bit for the offset of the year, starting from the year 2000
  - 4 bit per month
  - 5 bit for day of the month
  - 5 bits for hour
  - 6 bits for minutes
  - 5 bits for half the seconds. The seconds range is from 0 to 31, so the result should be multiplied by 2 to find the actual seconds of the measurement.
- 2 bytes LSB for temperature. The temperature is represented by a signed integer with the least significant byte first. The temperature is expressed in hundreds of a °C degree.
- 1 byte for humidity. Relative humidity is an unsigned integer corresponding to twice the percentage of humidity.
- 3 bytes LSB for pressure. Pressure is an unsigned integer with the least significant byte first; it is expressed in Pascal.
- 6 bytes LSB are for PM measures: 2 bytes for each measurement, formatted as LSB, reporting in order PM1.0, PM2.5 and PM10 in µg/m3.
- 1 byte (if present) for battery percentage.
- 6 bytes LSB (if present) are for PM measures: 2 bytes for each measurement, formatted as LSB, reporting in order PM1.0, PM2.5 and PM10 in #/cm3.

Example
Sample payload:
0b3a006caf51266409338b8701170022002a0063

Uplink ID: 0b
Report ID: 3a
Frame ID: 00
Data: 6caf5126 6409 33 8b8701 1700 2200 2a00 63
* date and time are: 6c af 51 26

- Byte swapping, result: 26 51 af 6c
- The result in bits will be: 00100110 01010001 10101111 01101100
  - The bits are divided as explained above
    - Year: 0010011
      - Result: 19
        - 2000+19 = 2019

        - Month: 0010
            - Result: 2
        - Day: 10001
            - Result: 17
        - Hour: 10101
            - Result: 21
        - Minutes: 111011
            - Result: 59
        - Seconds: 01100
            - Result: 12
                - 12*2 = 24
    - The date of the measurement will be: 17/02/2019 21:59:24.
- Temperature: 6409
    - Byte swapping, result: 0964
        - The result (with sign) will be +2404 with two decimal places, then +24.04 °C.
- Humidity: 33
    - In decimal is 51, the humidity is 51/2 = 25.5% rH.
- Pressure: 8b8701
    - Byte swapping, result: 01878b
        - In decimal, the result is 100235, with two decimal places the pressure is 1002.35 hPa.
- PM1: 1700
    - Byte swapping, result: 0017
        - In decimal, the result is 23, the PM1 value is 23 µg/m3.
- PM2.5: 2200
    - Byte swapping, result: 0022
        - In decimal, the result is 34, the PM1 value is 34 µg/m3.
- PM10: 2a00
    - Byte swapping, result: 002a
        - In decimal, the result is 42, the PM1 value is 42 µg/m3.
- Battery: 63
    - In decimal, the result is 99, the battery value is 99%.

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1.7 T/P/RH/LUX/VOC

name	size [byte]	hex value	meaning
Uplink ID	11 byte	0C	Temperature/Pressure/Humidity/Lux/Voc
Data	14 byte	XX XX …	Measure 1, refer to Note 5
	14 byte	XX XX …	Measure 2, refer to Note Note 5
Batt %	1 byte (optional)	XX	Battery percentage
RFU	6 byte (optional)	XX XX XX XX	Optional RFU byte

Note 5

The first 10 bytes for each measurement are the same as defined in Note 1, the following 4 bytes are

as follows:

- 2 bytes LSB for illuminance. Luminance is represented by an unsigned integer with the least significant byte first. The Luminance is reported in lux (lx).
- 2 bytes LSB for VOC (Volatile organic compounds). The VOC level is reported according to setup of the device made with LoRaTool APP, as unsigned with the least significant byte first:
  - index (IAQ - indoor air quality) between 0 (clean air) and 500 (heavily polluted air)
  - bVOC value between 499ppb (clean air) and 50000ppb (heavily polluted air)

1.7.1. BVOC PPB EXTENDED

name	size [byte]	hex value	meaning
Uplink ID	1 byte	12	Temperature/Pressure/Humidity/Lux/Voc
Data	15 byte	XX XX ...	Measure 1, refer to Note 5A
	15 byte	XX XX ...	Measure 2, refer to Note 5A
Batt %	1 byte (optional)	XX	Battery percentage
RFU	4 byte (optional)	XX XX XX XX	Optional RFU byte

Note 5A

The first 10 bytes for each measurement are the same as defined in Note 1, the following 5 bytes are as follows:

- 2 bytes LSB for illuminance. Luminance is represented by an unsigned integer with the least significant byte first. The Luminance is reported in lux (lx).
- 3 bytes LSB for VOC (Volatile organic compounds). The VOC level is reported according to setup of the device made with LoRaTool APP, as unsigned with the least significant byte first:
  - index (IAQ - indoor air quality) between 0 (clean air) and 500 (heavily polluted air)
  - bVOC value between 499ppb (clean air) and 16700000ppb (heavily polluted air)

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1.8 ANALOG DATA

name	size [byte]	hex value	meaning
Uplink ID	1 byte	0D	Analog data
Type	1 byte	01	for MCF-LW06420/D/B/T
		01	for MCF-LW06010/D/B/T
		01	for MCF-LW06424/D/B/T
Data	1..34 byte	XX XX XX...	Refer to Note 6

Note 6

Data are as follow: 4 bytes are for the date and time (as per Note 1)

- 8 byte for measurements, 2 byte for each measurement, formatted as LSB with the following meaninging:
- Bit 0..11: measured value, to be rescaled according to the type
- Bit 12: equal to 1 if error: if the measured value is 0 meanings sensor disconnected (4-20mA only); greater or equal to 0xF00 it is a generic measurement error
- Bit 13..14: measure type:
  - 0: 4-20 mA
  - 1: 0-10 V
  - 2: 0-5 V
- Bit 15: RFU
- 1 byte (optional) for battery percentage, only for MCF-LW06420B, MCF-LW06010B, MCF-LW06424B.

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1.9 T/P/RH/LUX/VOC/CO2

name	size [byte]	hex value	meaning
Uplink ID	1 byte	0E	T/P/rH/Voc/Lux/Co2
Data	16 byte	XX XX ...	Measure 1, refer to Note 7
	16 byte	XX XX ...	Measure 2, refer to Note 7
Batt %	1 byte (optional)	XX	Battery percentage
RFU	2 byte (optional)	XX XX	Optional RFU byte

Note 7

Data are as follow:

- The first 14 bytes for each measurement are the same as defined in Note 5
- Following 2 bytes LSB are for CO2. CO2 concentration is represented by an signed integer with the least significant byte first. The CO2 is expressed in ppm.

1.9.1. BVOC PPB EXTENDED

name	size [byte]	hex value	meaning
Uplink ID	1 byte	13	T/P/rH/Voc/Lux/Co2
Data	17 byte	XX XX ...	Measure 1, refer to Note 7A
	17 byte	XX XX ...	Measure 2, refer to Note 7A
Batt %	1 byte (optional)	XX	Battery percentage

Note 7A

Data are as follow:

- The first 15 bytes for each measurement are the same as defined in Note 5A
- Following 2 bytes LSB are for CO2. CO2 concentration is represented by a signed integer with the least significant byte first. The CO2 is expressed in ppm.

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1.10 SPECIAL DATA

name	size [byte]	hex value	meaning
Uplink ID	1 byte	0F	Special data
Type	1 byte	00	Card Data message
Data	1..32 byte	XX XX...	for Card Data message refer to Note 8

Note 8

Data are as follow:

- 4 bytes for the date and time (as per Note 1)
- 1 byte for communication status:
  - Bit 0 (mask 0x01): equal to 1 is communication with the reader is OK
  - Bit 4 (mask 0x04): equal to 1 if card present

If card present, data frame also contains:

- 1 byte card identifier: equal to 0x01 for ISO14443 type
- 1 byte for UID legth
- 1 byte for SAK number
- n byte for UID

Example
Sample payload:
0f006caf512611010408447b8043
Uplink ID: 0f
Type: 00

Date and time: 6caf5126
* The date of the measurement will be: 17/02/2019 21:59:24. Communication status: 11

- bit 0 = 1 (communication OK), bit 4 = 1 (card present)

Card identifier: 01 UID Length: 04 SAK byte: 08 UID: 447b8043

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1.11 DIGITAL DATA

name	size [byte]	hex value	meaning
Uplink ID	1 byte	10	Digital data
Type	1 byte	00	Input counters type 1
	1 byte	01	Frequency meter type 1
	1 byte	02	Input counters type 2
	1 byte	03	Output counters
	1 byte	04	Frequency meter type 2
	1 byte	05	Output remaining activation time
	1 byte	06	Output full status
Data	1..33 byte	XX XX...	For input counters message refer to Note 9 For frequency meter message refer to Note 10 For output counters message refer to Note 11 For output remaining activation time refer to Note 11a For output full status refer to Note 11b

Note 9

Type 1: 2 bytes LSB per input counter (inputs 1 to 16).

Type 2: 30 byte for 5 measures (6 byte for every measure, 4 bytes date and time as defined in Note 1, 2 bytes LSB for counter value) and 1 byte (optional) for battery percentage.

Note 10

Type 1: 4 bytes for the date and time, 2 bytes LSB for frequency value (base 0.1Hz), 1 byte (optional) for battery percentage.

Type 2: 4 bytes for the date and time, 2 bytes LSB for frequency value (base 0.1Hz), 2 bytes LSB for input counter, 1 byte (optional) for battery percentage.

Note 11

Output counters: 1 bytes per output counter (inputs 1 to 8). Counter increases every ON to OFF or OFF to ON cycle.

Note 11a

Output remaining time: XX YY YY YY YY
XX 1 bytes for output number (n output - 1)
YY YY YY YY 4 bytes uLSB remaining time

Note 11b

Output full status data (15 byte):

name	size [byte]	hex value	meaning
Output number	1 byte	XX	Output number (n-1)
Options	1 byte (bit mask)	Bit 0	Output status 1 = set)
		Bit 1, 2	00: Standard
			02: Pulse train mode stopped
			06: Pulse train mode running
Remaining pulses	1 byte	XX	Number of remaining pulses
Remaining time	4 byte (u32 LSB)	XX XX XX XX	Remaining time [ms]
ON time	4 byte (u32 LSB)	XX XX XX XX	Pulse ON time [ms]
OFF time	4 byte (u32 LSB)	XX XX XX XX	Pulse OFF time [ms]

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1.12 SERIAL DATA

name	size [byte]	hex value	meaning
Uplink ID	1 byte	11	Serial data
Data Option	2 byte (u32 LSB)	XX XX	Refer to Note 12
Data	0..33 byte	XX XX...	Data received, refer to Note 12

Note 12

Data Option is LSB and formatted as follow:

- Bit 0..11: index of the first byte of the current frame
- bits 12...15:
  - 0x0 standard payload
  - 0x8 last frame of the buffer
  - 0x4 one BUFFER DOWNLINK frame missing, offset reports the expected one
  - 0x2 BUFFER DOWLINK frame too big, exceeds internal buffer
  - 0xE full buffer successfully saved (only after 0xC downlink type)

Data received from the device are buffered and sent via LoRa starting with index 0. Maximum data length is 1024 bytes. Empty data means receiving errors on RS232.

Example

Sample payload:
1100000103F400040001032401040001033401040001036601020001037601020001038011210001020001038801020001039001020001 03A8010200FF660400000002030100070011428000000000000

Uplink ID: 11
Data option: 0000

- Bit 0...11:0x000 first byte index = 0
- Bit 12...15: 0x0 standard payload

Data: \\0103F400040001032401040001033401040001036601020001037601020001038O Uplink ID: 11
Data option: 2100

- Bit 0...11:0x021 first byte index = 33
- Bit 12...15: 0x0 standard payload

Data: \\0102000103880102000103900102000103A8010200FF660400000020301000700
Uplink ID: 11
Data option: 4280

- Bit 0...11:0x042 first byte index = 66
- Bit 12...15: 0x8 last frame of the buffer

Data: 0000000000000

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1.13 LENGTH ERROR

name	size [byte]	hex value	meaning
Uplink ID	1 byte	EE	LENGTH ERROR
Type	1 byte	XX	Optional RFU byte
Data	1..9 byte	XX XX...	Optional RFU byte

In case the sensor's frame length is too long for the selected datarate (eg. for AS923, US915 devices). This means a problem with LoRa coverage or with the position of the sensor. If the NS receive the 0xEE, it should try with a lower SF.

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1.14 LEVEL MEASUREMENT

name	size [byte]	hex value	meaning
Uplink ID	1 byte	14	Level measurement
Type	1 byte	00	identifying a device EGK-LW20Lxx
		01	identifying a device EGK-LW20Wxx
		02	identifying a device EGK-LW20LTxx (except EGK-LW20LTx2)
		03	identifying a device EGK-LW20WTxx
		FE	identifying a device EGK-LW20LTx2

name	size [byte]	hex value	meaning
Timestamp	4 byte	XX XX XX XX	See Note 1
Battery voltage	2 byte (u16 LSB)	XX XX	Battery voltage is an unsigned integer, least significant byte first. Unit is [mV]
Height	2 byte	XX XX	Height (calculated as “End –Distance”)
Distance	2 byte (u16 LSB)	XX XX	unsigned integer, least significant byte first. This is the distance of the closest target within the defined range (refer to “Start” and “End” settings on LoraTool APP). Distance is > 60000 in case of errors. Unit is [mm].
Fill level [%]	1 byte	XX	Fill level percentage, based on to “Start” and “Length”. Fill level is > 100 in case of errors. **Only present for Type 01 and 03**.
Amplitude	2 byte (u16 LSB)	XX XX	Amplitude value (internal use). **Only present for Type FE**.
Gain	2 byte (u16 LSB)	XX XX	Gain value (internal use). **Only present for Type FE**.
Temperature	2 byte (s16 LSB)	XX XX	The temperature is represented by a signed integer with the least significant byte first. The temperature is expressed in hundreds of a °C degree. **Only present for Type 01, 02, 03 and FE**.
Relative Humidity	1 byte	XX	Relative humidity is an unsigned integer corresponding to twice the percentage of humidity. **Only present for Type 02, 03 and FE**.
Pressure	3 byte (u24 LSB)	XX XX XX	Pressure is an unsigned integer with the least significant byte first; it is expressed in Pascal. **Only present for Type 02, 03 and FE**.
Battery %	1 byte	XX	Remaining Battery percentage (if 0x65 not available)

Frame lenght for each type:

Uplink ID	Type	Timestamp	Battery Voltage	Height	Distance	Battery %
0x14	0x00	4 byte	2 byte	2 byte	2 byte	1 byte

Uplink ID	Type	Timestamp	Battery Voltage	Height	Distance	Fill level %	Temperature	Battery %
0x14	0x01	4 byte	2 byte	2 byte	2 byte	1 byte	2 byte	1 byte

Uplink ID	Type	Timestamp	Battery Voltage	Height	Distance	Temp	Rh	Pressure	Battery %
14	0x02	4 byte	2 byte	2 byte	2 byte	2 byte	1 byte	3 byte	1 byte

Uplink ID	Type	Timestamp	Battery Voltage	Height	Distance	Fill level %	Temp	Rh	Pressure	Battery %
14	0x03	4 byte	2 byte	2 byte	2 byte	1 byte	2 byte	1 byte	3 byte	1 byte

Uplink ID	Type	Timestamp	Battery Voltage	Height	Distance	Amplitude	Gain	Temp	Rh	Pressure	Battery %
14	0xFE	4 byte	2 byte	2 byte	2 byte	2 byte	2 byte	2 byte	1 byte	3 byte	1 byte

Example Sample payload:

1403dc7e3721b20b8518d3025ff9082d278a0163

14 03 dc7e3721 b20b 8518 d302 5f f908 2d 278a01 63

The meaning is:

- Uplink ID 0x14
- Type 0x03. The device is a EGK-LW20WTxx
- Timestamp 0xdc7e3721
    - Byte swapping result: 21 37 7e dc
    - The result in bits will be: 00100001 00110111 01111110 11011100
        - The bits are divided as explained above
            - Year: 0010000
                - Result: 16
                    - 2000+16 = 2016
        - Month: 1001
            - Result: 9
                - Day: 10111
                    - Result: 23
        - Hour: 01111
            - Result: 15
                - Minutes: 110110
                    - Result: 54
        - Seconds: 11100
            - Result: 28
                - 28*2 = 56

The date of the measurement will be: 23/09/2016 15:54:56.

- Battery voltage 0xb20b. Byte swapping result: 0x0bb2. The result (with sign) will be 2994 mV
- Height 0x8518, Byte swapping result: 0x1885. In decimal, the result is 6277mm
- Distance 0xd302, Byte swapping result: 0x02d3. In decimal, the result is 723mm
- Fill level % 0x5f, in decimal, the result is 95%
- Temperature 0xf908, Byte swapping result: 0x08f9. In decimal, the result is 2297 with two decimal places, meaning 22.97°C
- Humidity 0x2d, in decimal the result is 45, the humidity is 45/2 = 22.5% rH.
- Pressure 0x278a01. Byte swapping, result: 018a27. In decimal, the result is 100903, with two decimal places the pressure is 1009.03 hPa.
- Battery % 0x63. In decimal, the result is 99%.

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1.15 CURRENT CONFIGURATION

name	size [byte]	hex value	meaning
Uplink ID	1 byte	C0	Current configuration (from FW version 00.02.56)
Type	1 byte	01	General settings
		02	Thresholds settings
		03	Level sensor

name	size [byte]	hex value	meaning
DATA	1...33 byte	XX XX ..	For type 1 refer to Note 13
			For type 2 refer to Note 14
			For type 3 refer to Note 15

Note 13

Data are as follow:

size	meaning
1 byte	parity (0 = None 2 STOP, 1 = Odd, 2 = Even, 3 = None 1 STOP)
1 byte	baud rate [bps] (values 1 to 7: 2400,4800,9600,19200,38400,57600,115200)
1 byte	delay value ([s] for analog, [ms]for ModBus)
1 byte	rfu (only present from version 0.02.86)
2 byte (u16 LSB)	main period in minutes
2 byte (s16 LSB)	pressure compensation(pressure offset offset in Pa for MCF-LW12xxx, elevation in ft.for MCF-LW06DAV/P)
1 byte	output init (0x00 = OFF / 0x01 = ON)
1 byte	rfu
1 byte	rfu
1 byte	rfu
1 byte	I/O PERIOD in minutes
1 byte	COUNTERS PERIOD in minutes
1 byte	Input as pulses counters
	Bit 0...5: number of input as pulses counters
	Bit 6/7: edge type - 0x00 rising - 0x80 falling - 0x40 both
1 byte	Number of measures before transmission (for EGK-LW22CCMxx)
1 byte	**VOC/PM format:**
	0x00 = bVOC as IAQ (2 byte), PM as ug/m3
	0x01 = bVOC as ppb (2 byte), PM as #/cm3
	0x03 = bVOC as ppb (3 byte), PM as ug/m3 AND PM as #/cm3
1 byte	**first option bit mask (0 = disable / 1 = enable):**
	0x01 Wake-up on accelerometer
	0x02 CO2 ABC calibration
	0x04 No Time Sync request
	0x08 Unconfirmed uplink message
	0x10 LED low intensity
	0x20 Leds off
	0x40 Uplink time syncronized
	0x80 Single Join/day

size	meaning
1 byte	**second option bit mask (0 = disable / 1 = enable):**
	0x01 Send full metering data
	0x02 120V input voltage range
	0x04 Mifare USB card reader
	0x08 termination resistors – only for MCF-LW06485B
	0x10 input 1 as frequency meter
	0x20 outputs counters
	0x40 no output led
	0x80 thresholds high disable output
1 byte	**third option bit mask (0 = disable / 1 = enable):**
	0x01 button locked
	0x02 Davis PM enabled
	0x04 measure on UTC
2 byte	Latitude in decimal degrees LSB (for MCF-LW06DAV from FW version 02.100)
2 byte	Longitude in decimal degrees LSB (for MCF-LW06DAV from FW version 02.100)
…	RFU

Note 14

Data are as follow:

- 1 byte is for thresholds enable:
  - Bit 0: enable threshold high channel 1
  - Bit 1: enable threshold low channel 1
  - Bit 2: enable threshold high channel 2
  - Bit 3: enable threshold low channel 2
  - Bit 4: enable threshold high channel 3
  - Bit 5: enable threshold low channel 3
  - Bit 6: enable threshold high channel 4
  - Bit 7: enable threshold low channel 4
- 2 bytes LSB for threshold:
  - Channel 1 threshold high +
  - Channel 1 threshold high -
  - Channel 1 threshold low +
  - Channel 1 threshold low –
  - .
  - .
  - Channel 4 Threshold low –

MCF-LW06420, MCF-LW06010 and MCF-LW06424: Thigh and Tlow in bit for every channel (up to 4)
MCF-LW12VOC: Thigh only for channel 1 for bVOC [IAQ/ppm]
MCF-LW12CO2: Thigh only for channel 1 for bVOC [IAQ/ppm], Thigh only for channel 2 for CO2 [ppm]
MCF-LW12CO2E: channel 1 for bVOC [IAQ/ppm], channel 2 for CO2 [ppm]

Note 15

Data are as follow:

size	meaning
8 byte	RFU
2 byte	End [mm] - from FW version 2.89
4 byte	RFU
1 byte	Kref
1 byte	Algorithm
2 byte (u16 LSB)	Start [mm]
2 byte (u16 LSB)	Lenght [mm] - up to FW version 2.88, otherwise RFU
2 byte (u16 LSB)	Signal threshold
1 byte	RFU
1 byte	bits 3, 4, 5: Power / (bits 0,1,2,6,7: RFU)
1 byte	bits 6,7: Sort / (bits 0 to 5: RFU)
7 byte	RFU
2 byte	CRC

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1.16 T/RH

name	size [byte]	hex value	meaning
Uplink ID	1 byte	15	Temperature/Humidity
Type	1 byte	00	CCM
Data	n x 7 byte	XX XX ...	Measure n (1 to 3), refer to Note 16
Batt %	1 byte	XX	Battery percentage

Note 16

The 7 bytes for each measurement are divided as follows:

- 4 bytes LSB are for the date and time. The MSB (most significant byte) is on the right so they must be read from the right. The 4 byte in reverse order are as follows:
  - 7 bit for the offset of the year, starting from the year 2000
  - 4 bit per month
  - 5 bit for day of the month
  - 5 bits for hour
  - 6 bits for minutes
  - 5 bits for half the seconds. The seconds range is from 0 to 31, so the result should be multiplied by 2 to find the actual seconds of the measurement.
- 2 bytes LSB for temperature. The temperature is represented by a signed integer with the least significant byte first. The temperature is expressed in hundreds of a °C degree.
- 1 byte for humidity. Relative humidity is an unsigned integer corresponding to twice the percentage of humidity.

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1.17 T/RH LOG

name	size [byte]	hex value	meaning
Uplink ID	1 byte	16	Temperature/Humidity LOG
Type	1 byte	00	CCM
Data	n x 9 byte	XX XX ...	Measure n (1 to 3), refer to Note 16A

Note 16A

The 7 bytes for each measurement are divided as follows:

- 4 bytes LSB are for the date and time. The MSB (most significant byte) is on the right so they must be read from the right. The 4 byte in reverse order are as follows:
  - 7 bit for the offset of the year, starting from the year 2000
  - 4 bit per month
  - 5 bit for day of the month
  - 5 bits for hour
  - 6 bits for minutes
  - 5 bits for half the seconds. The seconds range is from 0 to 31, so the result should be multiplied by 2 to find the actual seconds of the measurement.
- 2 bytes LSB for temperature. The temperature is represented by a signed integer with the least significant byte first. The temperature is expressed in hundreds of a °C degree.
- 1 byte for humidity. Relative humidity is an unsigned integer corresponding to twice the percentage of humidity.
- 1 byte battery percentage. Battery percentage is an unsigned integer
- 1 byte for diagnostic. Diagnostic is 1 byte, bit masked:
  - bit 2: set if time sync expired - new time syncronization needed
  - bit 1: set if measure successfully sent
  - bit 0: set if measure sent, otherwise only logged

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2. DOWNLINK MESSAGES TO END-DEVICES

2.1 TIME SYNC ANSWER

name	size [byte]	hex value	meaning
Downlink ID	1 byte	00	Time sync answer
Sync ID	4 byte	XX XX XX XX	Copy of received Sync ID

name	size [byte]	hex value	meaning
Date/time	4 byte	XX XX XX XX	Date/time GMT, refer to Note 17

Note 17

Date/time GMT in DOS format with epoch 2000. Sent as LSB. In bits, will be:

- 7 bits for year, starting from the year 2000
- 4 bits for month
- 5 bits for day in the month
- 5 bits for hour
- 6 bits for minutes
- 5 bits for half of seconds

Example

For date 23/09/2016 15:54:56:

- Year 2016 = bit 0010000
- Month 9 = bit 1001
- Day 23 = bit 10111
- Hour 15 = bit 01111
- Minutes 54 = bit 110110
- Seconds 56 (/ 2 = 28) = bit 11100

The sequence in bits is “00100001001101110111111011011100”, corresponding to the hexadecimal “21377edc”, which will be sent as LSB: dc 7e 37 21

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2.2 UART MESSAGE

name	size [byte]	hex value	meaning
Downlink ID	1 byte	03	Uart
Data	Application related	XX XX....	Data to be forwarded, proprietary enginko protocol.

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2.3 IO MESSAGE

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	00	Identify an IO message
Enable	4 byte (u32 LSB)	XX XX XX XX	Bit mask of the outputs to be enabled
Disable	4 byte (u32 LSB)	XX XX XX XX	Bit mask of the outputs to be disabled

name	size [byte]	hex value	meaning
Ton	16 byte (Optional)	XX XX	2 bytes (LSB) per output (outputs 1 to 8): if ≠ 0, set the activation time (base 100ms) of output[n]

If both the enable and the disable bit are equal to zero, the current status will be sent (I/O, input counters, output counters, frequency).

Example

Payload to set out#1

04000100000000000000

Downlink ID: 04 Option: 00 (IO message) Enable: 01000000 → 0x01 0x00 0x00 0x00 → u32 LSB → 0x00 0x00 0x00 0x01 → 0x01 → 00000001b (out #1)
Disable: 00000000 –> No output disable **Payload to reset out#1**

04000000000001000000

Downlink ID: 04
Option: 00 (IO message)
Enable: 00000000 –> No output enable
Disable: 01000000 → 0x01 0x00 0x00 0x00 → u32 LSB → 0x00 0x00 0x00 0x01 → 0x01 → 00000001b (out #1)

Payload to set out#1 for 5 seconds:

040001000000000000003200

0x04 = Downlink ID
0x00 = Io type
Enable: 01000000 → 0x01 0x00 0x00 0x00 → u32 LSB → 0x00 0x00 0x00 0x01 → 0x01 → 00000001b (out #1)
Disable: 01000000 –> No output disable

0x3200 = Ton output[1] 0x32 0x00 → LSB → 0x00 0x32 → 50 * 100ms → Ton[1] = 5s

Ton is mandatory only if you want to use the pulse feature **Payload to set out#1 as normal and out#3 only for 1 second:**

040005000000000000000000000A00

0x04 = Downlink ID
0x00 = IO type
0x05000000 = Bit mask enable output 0x05 0x00 0x00 0x00 → u32 LSB → 0x00 0x00 0x00 0x05 → 0x05 → 00000101b → enable output[1]and output[3]
0x00000000 = Bit mask disable output–> No output disable
0x0000 = Ton output[1] 0x00 0x00 → LSB → 0x00 0x00 → 0 → 0 means infinite (as a normal output)
0x0000 = Ton output[2] 0x00 0x00 → LSB → 0x00 0x00 → 0 → 0 means infinite (as a normal output), in this case unused but mandatory to fill the space
0x0A00 = Ton output[3] 0x32 0x00 → LSB → 0x00 0x0A → 10 * 100ms → Ton[3] = 1s

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2.4 SET PERIOD

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	01	Identify a SET MAIN PERIOD message. fw release 1.40 and above supports Data size up to 2 byte LSB.
		04	Identify a SET I/O PERIOD message
		05	Identify a SET COUNTERS PERIOD message
Data	1 byte	XX	Set device operation period in minutes (note that some devices have a minimum period, eg MCF-LW12TER 10 min, MCF-LW12VOC 15 min, MCF-LW12TERPM 15 min)

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2.5 METERING REQUEST

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	02	Identify a METERING REQUEST message.
Option 2	1 byte	00	Full data reading.

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2.6 SET PRESSURE COMPENSATION

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	03	Identify a SET PRESSURE COMPENSATION message
Offset	2 byte (s16 LSB)	XX XX	

Only for MCF-LW12xxx environmental sensors.

altitude [m]	offset [Pa]	altitude [m]	offset [Pa]
-305	-3700	**1646**	18300
-244	-3000	**1707**	18900
-183	-2200	**1768**	19500
-122	-1500	**1829**	20100
-61	-700	**1890**	20700
0	0	**1951**	21300
		2012	21900

altitude [m]	offset [Pa]	altitude [m]	offset [Pa]
61	700	**2073**	22500
122	1500	**2134**	23100
183	2200	**2195**	23700
244	2900	**2256**	24300
305	3600	**2316**	24900
366	4300	**2377**	25500
427	5000	**2438**	26100
488	5700	**2499**	26600
549	6400	**2560**	27200
610	7100	**2621**	27800
671	7800	**2682**	28300
732	8500	**2743**	28900
792	9200	**2804**	29500
853	9800	**2865**	30000
914	10500	**2926**	30600
975	11200	**2987**	31100
1036	11800	**3048**	31600
1097	12500	**2926**	30600
1158	13200	**2987**	31100
1219	13800	**3048**	31600
1280	14500		
1341	15100		
1402	15700		
1463	16400		
1524	17000		
1585	17600		

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2.7 THRESHOLDS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	06	Identify a THRESHOLDS message
Enable	1 byte	XX	refer to Note 13
Data	1..32 byte	XX…XX	

Note 18

Data are as follow:

- 1 byte is for thresholds enable:
  - Bit 0: enable threshold high channel 1
  - Bit 1: enable threshold low channel 1

    - Bit 2: enable threshold high channel 2
    - Bit 3: enable threshold low channel 2
    - Bit 4: enable threshold high channel 3
    - Bit 5: enable threshold low channel 3
    - Bit 6: enable threshold high channel 4
    - Bit 7: enable threshold low channel 4

- 2 bytes LSB for threshold:
    - Channel 1 threshold high +
    - Channel 1 threshold high -
    - Channel 1 threshold low +
    - Channel 1 threshold low –
    - .
    - .
    - Channel 4 Threshold low –

MCF-LW06420, MCF-LW06010 and MCF-LW06424: Thigh and Tlow in bit for every channel (up to 4)
MCF-LW12VOC: Thigh only for channel 1 for bVOC [IAQ/ppm]
MCF-LW12CO2: Thigh only for channel 1 for bVOC [IAQ/ppm], Thigh only for channel 2 for CO2 [ppm]
MCF-LW12CO2E: channel 1 for bVOC [IAQ/ppm], channel 2 for CO2 [ppm]

MCF-LW12PLG: Thigh only for channel 1 for Power [W]

EGK-LW22PLG: Thigh only for channel 1 for Power [W]

EGK-LW22CCMxx: channel 1 for temperature [°C/100], channel 2 for RH [%*2]

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2.8 SERIAL DATA

name	size [byte]	hex value	meaning
Downlink ID	1 byte	05	Serial data
Data Option	2 byte (u16 LSB)	XX XX	Refer to Note 18
Data	0..33 byte	XX XX...	Data to send, refer to Note 19

Note 19

Data sent to the device are buffered starting with index 0 and sent on the serial port after the last frame.

Data Option is LSB and formatted as follow:

- Bit 0..11: index of the first byte of the current frame
- bits 12..15:
    - 0x0 standard payload
    - 0x8 last frame of the buffer
    - 0xC last frame of the buffer, data has to be saved into the enginko sensor (i.e. Modbus

configuration table)
- 0xD last frame of the buffer, data has to be saved into the enginko sensor (i.e. time schedule table)
- 0x4 one BUFFER DOWNLINK frame missing, offset reports the expected one

Maximum data length is 1024 bytes.

Example

Sample payload:

0500000103F400040001032401040001033401040001036601020001037601020001038005210001020001038801020001039001020001 03A8010200FF660400000002030100070005428000000000000

* Downlink ID: 05
* Data option: 0000

- Bit 0...11:0x000 first byte index = 0
- Bit 12...15: 0x0 standard payload

Data: 0103F400040001032401040001033401040001036601020001037601020001038005

Downlink ID: 05
Data option: 2100

- Bit 0...11:0x021 first byte index = 33
- Bit 12...15: 0x0 standard payload

Data: 0102000103880102000103900102000103A8010200FF660400000002030100070005

Downlink ID: 05
Data option: 4280

- Bit 0...11:0x042 first byte index = 66
- Bit 12...15: 0x8 last frame of the buffer

Data: 0000000000000

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2.9 OFF COMMAND

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	FF	Identify an OFF message
Option 2	1 byte	00	If it is a battery-powered device, turn off the module, otherwise it will restart it.
		01	Force a reboot
		BB	Force a Time Sync request

HOME

2.10 SET ELEVATION

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	07	Identify a SET ELEVATION message
Elevation	2 byte (s16 LSB)	XX XX	Set an elevation in ft. (LSB) (int with sign) for altitude compensation of the barometric pressure.

Only for MCF-LW06DAV and MCF-LWWS0x

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2.11 GENERAL SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	08	Wake-up on accelerometer (default = disable)
		0A	No Time Sync request
		0B	Unconfirmed uplink message
		0D	Leds off (default = disable)
		13	Single Join/day (default = disable)
		15	Uplink time syncronized (default = disable)
Data	1 byte	XX	0x00 = disable / 0x01 = enable

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2.12 CO2 SENSOR SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	09	CO2 ABC calibration (default = enable)
		11	LED low intensity
Data	1 byte	XX	0x00 = disable / 0x01 = enable

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2.13 ENERGY METER SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	0E	Send full metering data (defaut = disable)
		0F	Set 120V input voltage range (default = disable)
Data	1 byte	XX	0x00 = disable / 0x01 = enable

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2.14 CNT OPTION

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	14	Set input 1 as frequency meter
Data	1 byte	XX	0x00 = disable / 0x01 = enable

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2.15 BVOC/PM SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	0C	VOC/PM format
Data	1 byte	XX	0x00 = bVOC as IAQ (2 byte), PM as ug/m3
			0x01 = bVOC as ppb (2 byte), PM as #/cm3
			0x03 = bVOC as ppb (3 byte), PM as ug/m3 AND PM as #/cm3

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2.16 MODBUS SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	10	Set termination resistors (default = disable) – only for MCF-LW06485B
Data	1 byte	XX	0x00 = disable / 0x01 = enable

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2.17 LOG FUNCTION

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)

name	size [byte]	hex value	meaning
Option	1 byte	12	Enable LOG (default = disable)
Data	1 byte	XX	0x00 = disable / 0x01 = enable

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2.18 DELAY SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	16	Set delay
Data	1 byte	XX	[s] for analog, [ms]for ModBus

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2.19 SERIAL SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.54)
Option	1 byte	17	Serial port parameters
Data	2 byte	XX XX	Byte 1: baud rate [bps] (values 1 to 7: 2400,4800,9600,19200,38400,57600,115200)
			Byte 2: parity (0 = None 2 STOP, 1 = Odd, 2 = Even, 3 = None 1 STOP)

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2.20 OUTPUT SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.55)
Option	1 byte	18	Output 1 status at power on
		22	Disable output on threshold
		23	Button locked (output only)
Data	1 byte	XX	0x00 = OFF / 0x01 = ON

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2.21 CONFIGURATION REQUEST

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.56)
Option	1 byte	F0	Asking for current configuration
Data	1 byte	XX	General configuration = 01
			Thresholds configuration = 02
			Level sensor configuration = 03

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2.22 ENABLE INPUT COUNTERS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.56)
Option	1 byte	19	Enable pulses counter function on inputs
Data	1 byte	XX	Inputs number to be configured as pulses counter

---

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2.23 ENABLE OUTPUT COUNTERS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.56)
Option	1 byte	1A	Enable activations counter function on outputs
Data	1 byte	XX	0x01 = enable / 0x00 = disable

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2.24 LEVEL SENSOR SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message (from FW version 00.02.56)
Option	1 byte	XX	Level sensor parameter, refer to Note 20
Data	n byte	XX XX	Parameter dependent, refer to Note 20

Note 20

- **Start [mm]**: starting point of the measurement (in mm from “REFERENCE” point).
  - Option = 1B
  - Value: 2 byte (u16 LSB)
- **End [mm]**: Range of measure (in mm, from “REFERENCE” point) - from FW version 2.89.
  - Option = 1C
  - Value: 2 byte (u16 LSB)

- **Lenght [mm]**: Range of measure (in mm, from “Start” point) - up to FW version 2.88.
  - Option = 1C
  - Value: 2 byte (u16 LSB)
- **Signal threshold**: Minimum target detection threshold.
  - Option = 1D
  - Value: 2 byte (s16 LSB)
- **Power**: power setting for target detection.
  - Option = 1E
  - Value: 1 byte (values can be set from 1 to 5)
- **Sort**: data sorting.
  - Option = 1F
  - Value: 1 byte (values can be set from 0 to 3)
- **Algorithm:** type of analysis.
  - Option = 20
  - Value: 1 byte (values can be set from 0 to 255)

2.25 IO REQUEST MESSAGE

(from FW version 00.02.69)

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	00	Identify an IO message
TYPE	1 byte (Bit mask)	01	request of the current IO status
		02	request of the current inputs counters
		04	request of the current outputs counters
		08	request of the current frequency
		4x	request of the current output status and configuration, where **x**, bit 3 to 0, is output number (n-1)
		8x	request of the current remaining activation time, where **x**, bit 3 to 0, is output number (n-1)

2.26 OUTPUT PULSE TRAIN

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	24	Identify a “Pulse train” message
Output number	1 byte	XX	Output index (1 to 8)
Output options	1 byte	XX	option bit mask:
		0x01	Timebase (0=10ms, 1= 100ms)
		0x10	Start state (0=ON, 1=off)
		0x20	output pulses counter uplink update (0 = just at the end, 1 = update whenever possible)
		0x40	uplink update with new output status (0 = just at the end, 1 = update whenever possible) - alternative to 0x20
Cycles number	1 byte	XX	Number of cycles (0 = endless)

name	size [byte]	hex value	meaning
Ton	2 byte (u16 LSB)	XX XX	ON duration (value multiplied for Timebase)
Toff	2 byte (u16 LSB)	XX XX	off duration (value multiplied for Timebase)

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2.27 CCM SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	2A	Identify a CCM REQUEST message.
Data	1 byte	XX	number of measures before transmission

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2.28 CCM LOG REQUEST

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	2C	Identify a LOG REQUEST message
Start	5 byte	XX...XX	Start date/time log retrieval, refer to Note 21
Stop	5 byte	XX...XX	

Note 21

Start and Stop data are as follow:

- 1 byte for the offset of the year, starting from the year 2000
- 1 byte per month
- 1 byte for the day of the month
- 1 byte for hour
- 1 byte for minutes

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2.29 UTC SETTINGS

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	2B	Identify a UTC message.
		XX	set (0x01) for measure with UTC time

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2.30 GEOGRAPHICALS COORDINATES

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	30	Identify a coordinates message (from FW version 02.100)
Latitude	2 byte (s16 LSB)	XX...XX	Latitude in decimal degrees
Longitude	2 byte (s16 LSB)	XX...XX	Longitude in decimal degrees

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2.31 FORCE MESSAGE

name	size [byte]	hex value	meaning
Downlink ID	1 byte	04	General message
Option	1 byte	26	force a new report message (from FW version 02.71)
		27	force a new analog measures message (from FW version 02.71)

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