ACS-SWITCH-BUZZ -Generic

Technical documentation

ineo·sense
BRINGING SENSE TO WIRELESS

Summary

Revisions

Date	Author	Version	Comment	Minimum firmware
22/06/2023	FRR	1.0	1st version	

1 Main features

ACS-Switch-buzz -buzz is intended to be used on different system. The most common example is the door opening checking using a magnetic reed switch.

ACS-Switch-buzz embeds a set of parameters to allow a full configuration of switches management, periodic frame and event frames sending.

ACS-Switch-buzz is able to generate events from 4 different types and also 2 at a time:

→Reed event

→ Motion event (acceleration)

→ Tilt event

→ Magnetic event

Thresholds or a reference value can be setup according to the measured value and event can be sent each time a threshold is reached.

1.1 Behaviour

The ACS-Switch-buzz can send an audible alarm, an event or a periodic frame with the state of the chosen source: Reed/motion/tilt/Magnetic.

1.2 Sensors

1.2.1 *Buzz sensor*

- the buzz sensor can generate 3 different sounds, Bip/Buzz/Siren.
- the audible alarm duration is configurable.
- The audible alarm can be triggered by 2 different event sources and 4 different states.
- Maximum power 100db with tone adjustment.

to make this setting you have several parameters:

configuration of sounds for each type	BUZZ_FREQ
configuration of buzzer for source 1 state 0	BUZZ_CONF_SRC1_STAT0
configuration of buzzer for source 1 state 1 to 4	BUZZ_CONF_SRC1_STATn
configuration of buzzer for source 2 state 0	BUZZ_CONF_SRC2_STAT0
configuration of buzzer for source 2 state 1 to 4	BUZZ_CONF_SRC2_STATn

1.2.2 *Reed sensor*

The couple, reed sensor and magnet, serves two purposes in our device:

-To detect a door opening or closing
-To do a LoRaWAN JOIN

1.2.2.1 Reed sensor to state opening

Several parameters concern the REED sensor: REED_source_parameters

- Internal or external Reed — REED_CONF
- Reed input filtering (delay) — REED_FILTER
- External Reed input filtering(delay) — EXTREED_FILTER

1.2.2.2 Reed sensor to LoRaWAN JOIN

When magnet is detected in front of the embedded reed relay, the following phases are processed.

Notice that ACS-Switch-buzz -Generic does not react to all phases, see details here below.

Phase 0 ..... **Duration:** 200ms
LED indication: nothing
Actuator change is ignored the first 200ms in order to avoid intempestive errors

Phase 1 ..... **Duration:** Runs 3 secs
LED indication: Red LED blinks 50ms each 500ms
If the actuator is released during this phase, the application can trig an action

Phase 2 ..... **Duration:** Runs 3 secs more
LED indication: Red LED blinks 50ms each 200ms
If the actuator is released during this phase, ACS-Switch-buzz -Range resets its internal counters and sends an event.

Phase 3 ..... **LED indication:** After these 5 sec, installation phase, like LoRaWAN JOIN is the following description
LED indication: Red LED shines
If the actuator is not released in the next 5sec, the application can manage an error notification and ignore the action.
If the actuator is released in the next 5sec, Installation process is launched.

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1.2.3 *Motion sensor*

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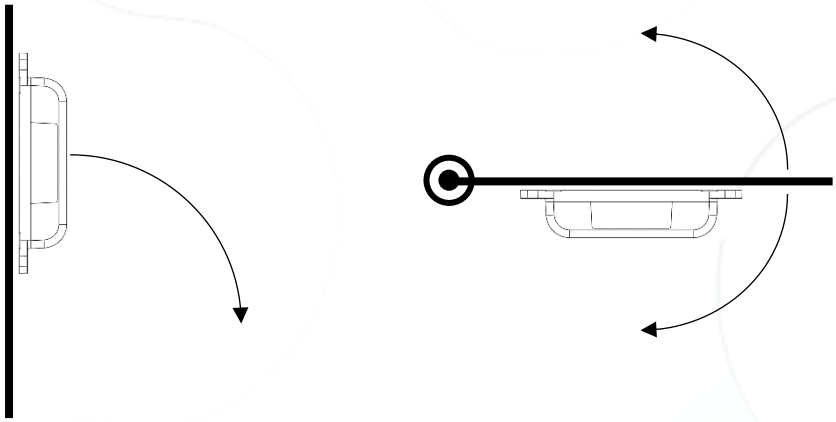
Our ACS-Switch-buzz device can detect motion when enabled. Parameters are available to define sensor sensitivity such as MOT_SHO_CONFIG

MOTION mode enables ACS-Switch-buzz to detect movement, acceleration and shocks.

1.2.4 *TILT sensor*

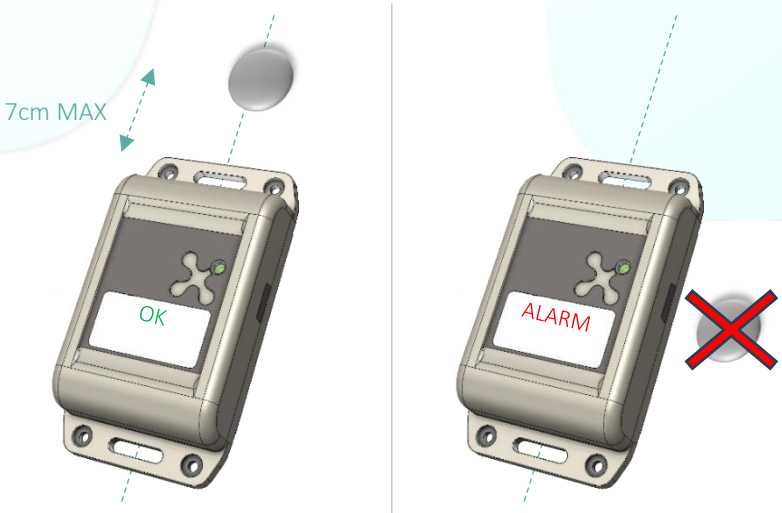
Parameters are available to define sensor sensitivity such as TILT_CONFIG

Tilt trig configuration	TILT_TRIG_CONF
4 Tilt source references	TITL_REF_1
4 tilt source thresholds	TILT_THS_1



1.2.5 *Magnetic sensor*

Magnetic mode enables ACS-Switch-buzz to detect a heading position or movement as the MOTION/TILT feature. Parameters are available to define sensor sensitivity such as MAG_CONFIG



Do not position the magnet here.
risk of REJOIN LoRaWAN

Parameters are available to define sensor sensitivity such as MAG_CONFIG

Mag trig configuration	MAG_TRIG_CONF
4 Mag source references	MAG_REF_1
4 Mag source thresholds	MAG_THS_1

1.2.6 *The choice of sensor mode*

The sensor mode can be chosen in parameters SRC1 (0x90) and SRC2 (0x91)

2 Configuration

2.1 Default settings

LoRaWAN settings	
LoRaWAN Class	**A**
LoRaWAN Mode	**Public**
Activation	**OTAA**
ADR	**Active**
DutyCycle	**Inactive**
Tx Power	**14dB**

Functional settings	
Event frame format	**Standard**
Periodic picture	**Standard every 4h**
Keep alive period	**Standard every 72h**
Sound on event source 1	**Buzz x6**
Sensors mode source 1	**Motion enabled**
Sensors mode source 2	**Disabled**

2.2 Set ACS-Switch-Buzz by Downlink Command

⚠ **LoRaWAN downlinks commands are always on port #1**

2.2.1 *Change type of sound or deactivate sound*

Request	0401C985 FF00000000XX00000000	(BIT to BIT WRITING)
LoRaWAN answer	8401C900	

See parammeter 0XC9 first byte (configuration of buzzer for source 1 state 0) and change XX by the type of sound you want.

..... 0x00	Deactivated
..... 0x01	Stop buzzer
..... 0x02	Siren
..... 0x03	Buzz
..... 0x04	Bip

2.2.2 *Change duration*

Request 0401C985 00FFFF000000XXVV0000 (BIT to BIT WRITING)
LoRaWAN answer 8401C900

See parammeter 0XC9 second byte (configuration of buzzer for source 1 state 0) and change XX by the Duration in second or number of iteration (for buzz or bip) you want.

This byte is in an according with the next byte so you have to also change this byte VV by :

00 if Buzz or Bip

01 if Siren

2.2.3 *Change duration of buzz/bip ON/OFF*

Request 0401C985 000000FFFF000000YYZZ (BIT to BIT WRITING)
LoRaWAN answer 8401C900

See parammeter 0XC9 4th byte (configuration of buzzer for source 1 state 0) and change YY by the Duration in second of time ON.
See parammeter 0XC9 5th byte (configuration of buzzer for source 1 state 0) and change YY by the Duration in second of time OFF.

2.2.4 *Delay audible alarm*

Request 0401A002WWWW (BIT to BIT WRITING)
LoRaWAN answer 8401C900

See parammeter 0XA0 4th byte (configuration of buzzer for source 1 state 0) and change WWWW by the Duration in second in hexadecimal value.
Example to 20 second 0014

2.2.5 *Set the sensor mode on source 1 and/or 2*

Request 0403028280008000900103910104
LoRaWAN answer 8403020090009100

Generic parameters signature = *8008000* (*see Parameters section parameter 0x02*)
(BIT to BIT WRITING)
Source 1 configuration = *03* (*see Parameters section parameter 0x90*)
Motion mode
source 2 configuration = *04* (*see Parameters section parameter 0x91*)
Tilt mode

2.2.6 *Set ACS-Switch-buzz -Reed mode on source 1*

Request 040302828000800090010191 0100

LoRaWAN answer 840302009000 9100

Generic parameters signature = *80008000* (*see Parameters section parameter 0x02*)
(BIT to BIT WRITING)

Source 1 configuration = *01* (*see Parameters section parameter 0x90*)
reed mode

source 2 configuration = 00 (*Parameters section parameter 0x91*)
disable

you can also set up the parameters in section: REED_source_parameters

2.3 *Set ACS-Switch-buzz -Motion mode on source* 1

MOTION mode enables ACS-Switch-buzz to detect a basic movement (shake).

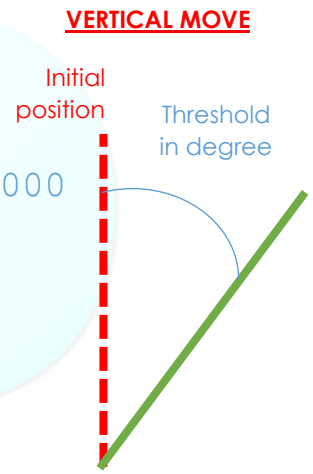
Request
040302828000800090010360 0F07020205010F05000000000258012C

LoRaWAN answer 840302009000 6000

Generic parameters signature = *80008000* (*see Parameters section parameter 0x02*)
(BIT to BIT WRITING)
Source 1 configuration=03 (*see Parameters section parameter 0x90*)
Motion/Shock configuration= 07020205010F05000000000258012C (*see Parameters section parameter 0x60*)

To a better understanding of motion algorithm see section: Motion management

2.3.1 *Set ACS-Switch-buzz -Tilt mode on source 1*



Request
040302828000800090010461 0C37000A00140002020000000 0

LoRaWAN answer 840302009000 6100

Generic parameters signature = *80008000* (*see Parameters section parameter 0x02*)
(BIT to BIT WRITING)
Source 1 configuration=04 (*see Parameters section parameter 0x90*)
Tilt config = 37000A00140002020000000 0 (*see Parameters section parameter 0x61*)

Do a reference position with the applicative command 0x34

Request

340000

LoRaWAN answer B40000

For a more complicated installation (several references and thresholds) you can also configure the following parameters:

Tilt trig configuration	TILT_TRIG_CONF
4 Tilt source references	TITL_REF_1
4 tilt source thresholds	TILT_THS_1

2.3.2 *Set ACS-Switch-buzz -Magnetic mode on source1*

Request 04030282800080009010562 0C37000A00C8001E0200000000

LoRaWAN answer 840302009100 6000

Generic parameters signature = *80008000* (*see Parameters section parameter* 0x02)
(BIT to BIT WRITING)
Source 1 configuration = 05 (see Parameter section 0x90)

Mag config = 37000A00C8001E0200000000 (see Parameter section 0x62)

Do a reference position with the applicative command 0x34

Request

340000

LoRaWAN answer B40000

For a more complicated installation (several references and thresholds)
you can also configure the following parameters:

Mag trig configuration	MAG_TRIG_CONF
4 Mag source references	MAG_REF_1
4 Mag source thresholds	MAG_THS_1

3 Payloads

3.1 Event frames

REMINDER ***Allocated frame headers are 0x68, 0x69, 0x6A and 0x6B.***
The first 3 will be used for respectively short, standard and long frame type.
The forth one is available for any other special event frame format.
A device can support only some of these frame types, according to its specifications.

3.1.1 *[0x68] – Short event frame*

Frame format

FH	STATUS		TEMP	EVT_TYPE	EVT_DATA	OTOTx_info	
0	1.....2		3	4	…	…	
0x68	MSB	LSB				MSB	LSB

STATUS.....Status of the device and basic frame counter:

b15-12 are a basic spontaneous frame counter that overlaps each 16 spontaneous frame generated. This is typically used to detect frame repetition on system level.
b11-0 are a copy of the same bits of parameter DEV_STAT

TEMP.....Last measured temperature. Two's complemented signed byte formatted. Expressed in [degree Celsius]

EVT_TYPE.....Enumeration of event types. See the description table below.

EVT_TYPE	Description	EVT_DATA
0x01	High operating temperature alert	TEMP_DATA
0x02	Low operating temperature alert	
0x03	Operating temperature returned to normal range	
0x81	High application temperature alert	
0x82	Low application temperature alert	
0x83	Application temperature returned to normal range	
0x84	Application temperature sensor issue	
0x85	High application hygrometry alert	HYGRO_DATA
0x86	Low application hygrometry alert	
0x87	Application hygrometry returned to normal range	
0x88	Application hygrometry sensor issue	
0x89	State changed on source 1	SRC_DATA
0x8A	State changed on source 2	
0x8B	References initialized	REF_DATA
0x8C	Counters reset	CTR_RST_DATA
0x8D	Data error on source x	ERR_DATA
0x90	Critical error detected	CRITIC_ERROR_DATA

EVT_DATA .....Data related to the event. See the description table below.

TEMP_DATA – Size 4 bytes

Byte 1 – Byte 4		
MSB	…	LSB
Temperature value expressed in 1/256th degree Celsius, Two's complemented		

HYGRO_DATA – Size 4 bytes		
Byte 1 – Byte 4		
MSB	…	LSB
Hygrometry value expressed in 1/256th %		

SRC_DATA – Size 4 bytes			
Byte 1	Byte 2 – Byte 4		
	MSB	…	LSB
b7-4: Previous state b3-0: New state	Counter of new state detections for given source on 3 bytes		

REF_DATA – Size 3 bytes		
Byte 1	Byte 2 – Byte 3	
	MSB	LSB
b7-4: Source 1 configuration b3-0: Source 2 configuration	References initialized as defined in (0x34) – Start references initialization	

CTR_RST_DATA – Size 1 byte	
b7-4	b3-0
Source 1 configuration	Source 2 configuration

ERR_DATA – Size 2 bytes	
Byte 1	Byte 2
b7-4: Source 1 configuration b3-0: Source 2 configuration	Source that triggered the error

CRITIC_ERROR_DATA – Size 5 bytes		
Byte 1	Byte 2	Byte 3 – Byte 5
Parameter CRITIC_ISSUE_CNT	0x01: Source 1 error 0x02: Source 2 error 0x03: BLE error	**Detail of error** If Source 1 or 2 error: depends on source type (see Appendix E: Description of errors depending on source) If BLE: parameter BLE_STAT

OTOTx_info .....Time between the moment the frame is generated and the moment of sending [expressed in seconds]
Occupies always the last 2 bytes in this type of frame
Thus, event calculated timestamp is: `reception time - OTOTx_delay`

3.1.2 *[0x69] – Standard event frame*

Frame format

FH	STATUS		TEMP	EVT_TYPE	EVT_DATA	OTOTx_info	
0	1.....2		3	4	…	…	
0x69	MSB	LSB				MSB	LSB

STATUS.....Status of the device and basic frame counter:

b15-12 are a basic spontaneous frame counter that overlaps each 16 spontaneous frame generated. This is typically used to detect frame repetition on system level.
b11-0 are a copy of the same bits of parameter DEV_STAT

TEMP.....Last measured temperature. Two's complemented signed byte formatted. Expressed in [degree Celsius]

EVT_TYPE.....Enumeration of event types. See the description table below.

EVT_TYPE	Description	EVT_DATA
0x01	High operating temperature alert	TEMP_DATA
0x02	Low operating temperature alert	
0x03	Operating temperature returned to normal range	
0x81	High application temperature alert	
0x82	Low application temperature alert	
0x83	Application temperature returned to normal range	
0x84	Application temperature sensor issue	
0x85	High application hygrometry alert	HYGRO_DATA
0x86	Low application hygrometry alert	
0x87	Application hygrometry returned to normal range	
0x88	Application hygrometry sensor issue	
0x89	State changed on source 1	SRC_DATA
0x8A	State changed on source 2	
0x8B	References initialized	REF_DATA
0x8C	Counters reset	CTR_RST_DATA
0x8D	Data error on source x	ERR_DATA
0x90	Critical error detected	CRITIC_ERROR_DATA

EVT_DATA.....Data related to the event. See the description table below.

TEMP_DATA – Size 4 bytes		
Byte 1 – Byte 4		
MSB	…	LSB
Temperature value expressed in 1/256th degree Celsius, Two's complemented		

HYGRO_DATA – Size 4 bytes		
Byte 1 – Byte 4		
MSB	…	LSB
Hygrometry value expressed in 1/256th %		

SRC_DATA – Size 44 bytes																	
Byte 1	Byte 2	Byte 3 – Byte 6			Byte 7 – Byte 10			Byte 11 – Byte 14			Byte 15 – Byte 18		
		MSB	…	LSB	MSB	…	LSB	MSB	…	LSB	MSB	…	LSB
b7-4: Previous state b3-0: New state	Source	Counter state 0			Counter state 1			Counter state 2			Counter state 3		

Byte 19 – Byte 22			Byte 23 – Byte 28			Byte 29	Byte 30 – Byte 44
MSB	…	LSB	MSB	…	LSB		
Counter state 4			Position (see description in Appendix D)			Hygrometry value expressed in %	• User data as defined in parameter USER_DATA

REF_DATA – Size 27 bytes																	
Byte 1	Byte 2 – Byte 3		Byte 4 – Byte 5		Byte 6 – Byte 20			Byte 21 – Byte 26			Byte 21 – Byte 26		
	MSB	LSB	MSB	LSB	MSB	…	LSB	MSB	…	LSB	MSB	…	LSB
b7-4: Source 1 configuration b3-0: Source 2 configuration	References initialized as defined in (0x34) – Start references initialization		Reception ordo ID as defined in parameter RCP_ORD_ID		User data as defined in parameter USER_DATA			Position source 1 (see description in Appendix D)			Position source 2 (see description in Appendix D)		

CTR_RST_DATA – Size 1 byte	
b7-4	b3-0
Source 1 configuration	Source 2 configuration

ERR_DATA – Size 2 bytes	
Byte 1	Byte 2
b7-4: Source 1 configuration b3-0: Source 2 configuration	Source that triggered the error

CRITIC_ERROR_DATA – Size 5 bytes		
Byte 1	Byte 2	Byte 3 – Byte 5
Parameter CRITIC_ISSUE_CNT	0x01: Source 1 error 0x02: Source 2 error 0x03: BLE error	**Detail of error** If Source 1 or 2 error: depends on source type (see Appendix E: Description of errors depending on source) If BLE: parameter BLE_STAT

OTOTx_info .....Time between the moment the frame is generated and the moment of sending [expressed in seconds]

Occupies always the last 2 bytes in this type of frame
Thus, event calculated timestamp is: `reception time - OTOTx_delay`

3.2 Periodic picture frames

REMINDER ***Allocated frame headers are 0x6C, 0x6D, 0x6E and 0x6F.***
The first 3 will be used for respectively short, standard and long frame type.
The forth one is available for any other special periodic picture frame format.
A device can support only some of these frame types, according to its specifications.

3.2.1 *[0x6C] – Short periodic picture frame*

Frame format

FH	STATUS		TEMP	S1_ST	S2_ST	S1_ST0	S2_ST0	S1_CTR	S2_CTR	ACT_PER
0	1.....2		3	4	5	6	7	8	9	10
0x6C	MSB	LSB								

STATUS.....Status of the device and basic frame counter:

b15-12 are a basic spontaneous frame counter that overlaps each 16 spontaneous frame generated. This is typically used to detect frame repetition on system level
b11-0 are a copy of the same bits of parameter DEV_STAT

TEMP.....Last measured temperature form Clover-Sense sensor
Two's complemented signed byte formatted

S1_ST .....Previous and current state of source 1:

b7-4.. previous state
b3-0.. current state

S2_ST .....Previous and current state of source 2:

b7-4.. previous state
b3-0.. current state

S1_ST0 .....Source 1 percentage of time passed in state 0 since last transmission. 0xFF means not allowed by current profile

S2_ST0 .....Source 2 percentage of time passed in state 0 since last transmission. 0xFF means not allowed by current profile

S1_CTR .....Source 1 counter of current state limited to 1 byte

S2_CTR .....Source 2 counter of current state limited to 1 byte

ACT_PER.....Activity percentage. Current device usage in % (0% = battery full)

3.2.2 *[0x6D] – Standard periodic picture frame*

Frame format

FH	STATUS		TEMP	S1_ST	ACT_PER	SRC1	S1_CTR0	S1_CTR1	S1_CTR2
0	1.....2		3	4	5	6	7.....10	11.....14	15.....18
0x6D	MSB	LSB							

S1_CTR3	S1_CTR4	S1_POS	HYGRO	USER_DATA	OTOTx_info	
19 22	23 26	27 32	33	34 48	49 50	
					MSB	LSB

STATUS.....Status of the device and basic frame counter:

b15-12 are a basic spontaneous frame counter that overlaps each 16 spontaneous frame generated. This is typically used to detect frame repetition on system level
b11-0 are a copy of the same bits of parameter DEV_STAT

TEMP.....Last measured temperature form Clover-Sense sensor
Two's complemented signed byte formatted

S1_ST .....Previous and current state of source 1:

b7-4.. previous state
b3-0.. current state

ACT_PER.....Activity percentage. Current device usage in % (0% = battery full)

SRC1.....Source 1 configuration

S1_CTRx .....Source 1 counters of different states

S1_POS.....Source 1 current position (see description in Appendix D)

HYGRO.....Hygrometry value expressed in %

USER_DATA .....User data as defined in parameter USER_DATA

OTOTx_info .....Time between the moment the frame is generated and the moment of sending [expressed in seconds]
Occupies always the last 2 bytes in this type of frame
Thus, event calculated timestamp is: `reception time - OTOTx_delay`

3.2.3 *[0x6F] – Special periodic picture frame*

Frame format

FH	S1_ST	S2_ST	S1_ST0	S2_ST0	ACT_PER	SRCS	S1_CTR0	S1_CTR1	S1_CTR2
0	1	2	3	4	5	6	7 10	11 14	15 18
0x6F									

S1_CTR3	S1_CTR4	S2_CTR0	S2_CTR1	S2_CTR2	S2_CTR3	S2_CTR4	HYGRO
19 22	23..... 26	27 30	31 34	35..... 38	39 42	43 46	47

S1_ST .....Previous and current state of source 1:

b7-4.. previous state
b3-0.. current state

S2_ST .....Previous and current state of source 1:

b7-4.. previous state
b3-0.. current state

S1_ST0 .....Source 1 percentage of time passed in state 0 since last transmission. 0xFF means not allowed by current profile

S2_ST0 .....Source 2 percentage of time passed in state 0 since last transmission. 0xFF means not allowed by current profile

ACT_PER.....Activity percentage. Current device usage in % (0% = battery full)

SRCS.....Configuration of sources:

b7-4.. source 1 configuration
b3-0.. source 2 configuration

S1_CTRx .....Source 1 counters of different states

S2_CTRx .....Source 2 counters of different states

HYGRO.....Hygrometry value expressed in %

3.3 Keep alive frames

REMINDER ***Allocated frame headers are 0x78, 0x79, 0x7A and 0x7B.***
The first 3 will be used for respectively short, standard and long frame type.
The forth one is available for any other special keep-alive frame format.
A device can support only some of these frame types, according to its specifications.

NOTE ***Since any keep-alive frame type brings FW version, triggering on of these frame to the requester allow to get the FW version.***

3.3.1 *[0x78] – Short keep-alive frame*

Frame format

FH	RTC			BATT	CIF	FW_VER		OTOTx_delay	
0	1 4			5	6	7 8		9 10	
0x78	MSB		LSB			MSB	LSB	MSB	LSB

RTC.....Device RTC when the frame is delivered to the OTOTx service
[in seconds since 01/01/2010
BATT.....Consumed battery level [%]
CIF.....Customer Information Field
FW_VER .....FW version [major.minor]
OTOTx_delay.... Time between the moment the frame is delivered to OTOTx service the moment of sending [expressed in seconds]
Thus, device RTC at the moment of the frame reception (more or less few seconds) is RTC + OTOTx_delay. occupies always the last 2 bytes in this type of frame

3.3.2 *[0x79] – Standard keep-alive frame*

Frame format

FH	RTC	BATT	CIF	FW_VER	FW_NB	SC_CFG	SC1_PER	SC1_MODE	SC1_CH
0	1 4	5	6	7 9	10.....11	12.....13	14..... 15	16	17
0x79	MSB FIRST			MSB FIRST	MSB FIRST	MSB FIRST	MSB FIRST		

SC1_SF	TX_PWR	LWAN TX_PWR	GBL_RST	PWR_RST	FRM_SENT	NRJ_DET	SCW_DET	FRM_RCV
18	19	20	21	22	23..... 24	25 26	27 28	29.....30
					MSB FIRST	MSB FIRST	MSB FIRST	MSB FIRST

DAY_PAST	CORE_FL	CORE_FLD	UR_TABLE0	UR_TABLE1	EXT_CH	RFU	OTOTx_delay
31 32	33 34	35.....36	37.....38	39 40	41	42 ..48	49.....50
MSB FIRST	MSB FIRST	MSB FIRST	MSB FIRST	MSB FIRST			MSB FIRST

RTC .....Device RTC when the frame is delivered to the OTOTx service [in seconds since 01/01/2010]

BATT .....Consumed battery level [%]

CIF .....Customer Information Field

FW_VER.....FW version [major.minor.test_id]

FW_NB .....FW number

SC_CFG.....Clover-Net scan configuration

SC1_PER ....Clover-Net scan 1 period

SC1_MODE Clover-Net scan 1 mode

SC1_CH .....Clover-Net scan 1 channel

SC1_SF.....Clover-Net scan 1 LoRa Spreading Factor

TX_PWR.....Clover-Net current Tx Power in dBm

LWAN_TX_PWR LoRaWAN current power in dBm

GBL_RST.....Global number of resets

PWR_RST ....Number of power-on resets

FRM_SENT ..Number of frames sent

NRJ_DET.....Number of power detected in FSK and valid CAD in LoRa, expressed in x8

SCW_DET ...Number of syncword detected in FSK and valid header in LoRa

FRM_RCV...Number of frames received intended for this device

DAY_PAST..Number of days past since device was started

CORE_FL....Internal Clover-Core flags

CORE_FLD..Internal Clover-Core dynamic flags

UR_TABLE0 .Number of unread logs in table 0

UR_TABLE1 .Number of unread logs in table 1

EXT_CH.....Number of known childs in Extender service (0x00 if not active)

RFU.....Reserved for Future Use

OTOTx_delay Time between the moment the frame is delivered to OTOTx service the moment of sending [expressed in seconds]
Thus, device RTC at the moment of the frame reception (more or less few seconds) is RTC + OTOTx_delay.
Occupies always the last 2 bytes in this type of frame

4 Downlinks : Commands

⚠ **LoRaWAN command downlinks on port #1**

4.1 Generic commands list

Frame header	Description
0x00	Trigger spontaneous frame
0x01	Read firmware version
0x02	Find device
0x03	Read parameters
0x04	Write parameters

4.2 Generic commands details

4.2.1 *(0x00) - Trigger spontaneous frame*

This command allows to force sending one of the spontaneous frame. The desired frame is given by `FRAME` parameter which correspond to its frame header (one of those specified in section **Payloads**).

NOTE ***This command has no limitation: if we ask for sending a frame which is longer than the size supported by the requested `TX_MODE`, nothing will happen since it is impossible to send it, but the reply will be OK if the device knows the requested `FRAME`.***

Request format

FH	FRAME	TX_MODE	DELAY MIN	DELAY MAX	CUSTOM_DATA
0	1	2	3	4	5 ..... n
0x00					

FRAME.....Frame header of the spontaneous frame we want to trig a sending

TX_MODE.....Mode used to send the requested frame
If 0xFF → the current configuration is used else, specify another mode (same definition as EVT_MODE, PP_MODE, PDL_MODE, PEL_MODE, KA_MODE, VS_MODE).

DELAY MIN & MAX Min and Max values in seconds used to set a random delay for sending the frame
If both 0xFF, uses the configurated values associated ot the frame type (`FRAME`)

CUSTOM_DATA..Specify application data to send. If left empty, application will fill buffer.

Reply format

FH	STATUS
0	1
0x81	

STATUS..... Request status:
0x00 = Sending will be processed
0xFF = Such a frame is not supported
0xFE = Such a tx mode is not supported
0xFD = Min delay must be lower or equal to max delay
0xFC = Frame triggering failed

4.2.2 *(0x01) – Read firmware version*

Firmware version reading request format

CMD	-
1 byte	-
0x01	

Firmware version reading answer format

ANS	APP_FW_NB	APP_FW_VER	RES_FW_NB	RES_FW_VER	BOOT_VER	REJ_OTA
1 byte	2 bytes	4 bytes	2 bytes	4 bytes	4 bytes	1 byte
0x81	Applicative fw number	Applicative fw version	Rescue fw number	Rescue fw version	Bootloader version	Rejected actions on firmware upgrade*

* Rejected Actions:

This filled was provided during the initialization of the RF service "firmware upgrade" (done automatically at the initialization of the product). It is used to inform the RF service "firmware upgrade" to reject some firmware upgrade session. Most of time when encryption is required on application, none crypt messages are all rejected to prevent attacks.

b5.....A Bootloader firmware upgrade will be rejected
b4.....A Rescue firmware upgrade will be rejected
b3.....A continue of the previous session (session in timeout) will be rejected
b2.....A firmware downgrade will be rejected
b1.....on Firmware reboot the EEPROM erasing will be rejected
b0.....A none crypt firmware upgrade session will be rejected

4.2.3 *(0x03) - Read parameters*

Request format

FH	NB_PARAM	P1_ID	P1-SIZE	…*	Pn_ID *	Pn_SIZE*
0	1	2	3	…	[1B]	[1B]
0x03						

NB_PARAM .....Number of parameters to be read
P1_ID .....ID of parameter 1 to read (same for Pn_ID)
P1_SIZE .....Size of the parameter 1 to read (same for Pn_SIZE)

Reply format

FH	NB_PARAM	P1_ID	P1_SIZE	P1_VALUE	…	Pn_ID*	Pn_SIZE*	Pn_VALUE*
0	1	2	3	[mB]		[1B]	[1B]	[oB]
0x83			m				o	

NB_PARAM .....Number of parameters read
P1_ID .....ID of parameter 1 read (same for Pn_ID)
P1_SIZE .....Size of the parameter 1 read (same for Pn_SIZE)
P1_VALUE.....Value of the parameter 1 read

NOTE ***In case of request format error, reply will be `8300FF`.***

4.2.4 *(0x04) - Write parameters*

Request format

FH	NB_PARAM	P1_ID	P1-SIZE	P1_VALUE	...*	Pn_ID *	Pn_SIZE*	Pn_VALUE
0	1	2	3	[mB]	...	[1B]	[1B]	[oB]
0x04			m				o	

NB_PARAM .....Number of parameters to be write
P1_ID .....ID of parameter 1 to write (same for Pn_ID)
P1_SIZE .....Size of the parameter 1 to write (same for Pn_SIZE)
P1_VALUE.....Value of the parameter 1 write

Reply format

FH	NB_PARAM	P1_ID	P1_STATUS	...	Pn_ID*	Pn_STATUS*
0	1	2	3		[1B]	[1B]
0x84						

NB_PARAM .....Number of parameters written
P1_ID .....ID of parameter 1 written (same for Pn_ID)
P1_STATUS.....Writing status same for Pn_SIZE):
00 = Writing success
FF = Writing error (see note below)

NOTE ***In case of param information error, its reply will be ...`<Pn_ID>FF` and <Pn_VALUE> will be missing.***

4.2.5 *Write parameters by bit field*

For an easier management of parameters defined as "bit fields", the command to write parameter can address only one or more of these bits. This allows to avoid the need to read a parameter, modify some bits and write its new value. To do that, for each parameter we want to address by bit field, it is necessary to set the most significant bit of the size of the parameter and add a mask value. The info field of this parameter becomes:

x^{th} param info			
Param ID	***Param Size + 0x80***	***Param mask***	***Param value***
1 byte	***1 byte***	***N bytes***	***N bytes***

Example: Applicative command to write bit b7 to '1' and bit b2 to '0' of parameter 0x01, 2 bytes size:

0301018200840080

4.3 Applicative commands list

Frame header	Description
0x34	Start references initialization
0x37	Immediate reading

4.3.1 *(0x34) – Start reference initialization*

This command allows to initialize references used by the device for TILT, MAGNETIC or TOF sources. This is a part of "applicative installation" process and it takes approximatively 10 seconds. During execution of this initialization, LED will blink in **orange** and it is mandatory to keep the device in required position.

Request format

FH	REF_INIT	
0	1 2	
0x34	MSB	LSB

REF_INIT.....References to initialize
0x0000 means that all references required will be initialized. This depends on active device configuration. Else:

b15-12 unused
b11 ... Initialize TOF reference 4
b10 ... Initialize TOF reference 3
b9 ..... Initialize TOF reference 2
b8 ..... Initialize TOF reference 1
b7 ..... Initialize MAGNETIC reference 4
b6 ..... Initialize MAGNETIC reference 3
b5 ..... Initialize MAGNETIC reference 2
b4 ..... Initialize MAGNETIC reference 1
b3 ..... Initialize TILT reference 4
b2 ..... Initialize TILT reference 3
b1 ..... Initialize TILT reference 2
b0 ..... Initialize TILT reference 1

Reply format

FH	STATUS
0	1
0xB4	

STATUS.....Request status:
0x00 = Start reference initialization success
0xFF = Error

4.3.2 *(0x37) – Immediate reading*

This command is used to execute an immediate reading of a source sensor. The difference with reading of parameter related to this sensor is that a real reading is executed so value is refreshed.

Request format

FH	SENSOR_TO_READ
0	1
0x37	

SENSOR_TO_READ This field allows to choose sensor to read.

0x01 .. REED
0x02 .. EXTERNAL REED
0x04 .. TILT
0x05 .. MAGNETIC
0x07 .. TOF
0x09 .. WEIGHT

Reply format

FH	SENSOR_READ	STATUS	VALUE
0	1	2	3.....8
0xB7			

SENSOR_READ ...Sensor effectively read in answer

STATUS.....Status of reading

0x00 .. Reading success
0xFC . Reading error – sensor internal error
0xFD.. Reading error – cannot access sensor, retry required
0xFE .. Reading error – sensor required to be active to be read
0xFF... Reading error – sensor not handled

VALUE.....Value of sensor read. This field is always 6 bytes but meaning depends on sensor read. Meaning is described below:

Sensor	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
REED	0: closed 1: opened	0xFF	0xFF	0xFF	0xFF	0xFF
TILT	X position in degree		Y position in degree		Z position in degree	
MAGNETIC	X magnetic data x1.5mG		Y magnetic data x1.5mG		Z magnetic data x1.5mG	
TOF	Target distance in mm		Signal rate in kcps		Ambiant rate in kcps	
WEIGHT	Current weight in g		0xFF	0xFF	0xFF	0xFF

5 Downlinks : some samples

⚠ **LoRaWAN command downlinks on port #1**

5.1 Read TitI or Magnetic current position

TITL current position

Request 03016406

LoRaWAN answer uplink 840164060014003200 50

(see *Parameter section parameter 0x64*) 001400320050 *(HEX format) = 20° X AXE (Decimal format)*
50° Y AXE (Decimal format)
80° Z AXE (Decimal format)

Magnetic current position

Request 03016606

LoRaWAN answer uplink 840166060 3E80BB81F40

(see *Parameter section parameter 0x64*) 001400320050 *(HEX format) = 1000 X AXE (Decimal format)*
3000 Y AXE (Decimal format)
8000 Z AXE (Decimal format)

5.2 Setup periodic picture period

Request 04012D02*05A0*

LoRaWAN answer uplink 84012D00

05A0: Period expressed in multiple of 30 seconds
(see *Parameter section parameter 0x2D*) *05A0 (HEX format) = 1440 (Decimal format) → 12 hours*

5.3 Send a Generic or applicative command

-Trigger spontaneous frame, example the periodic picture 6D

Request 006DFF0102

LoRaWAN answer uplink 8000 if success

See section generic command details;Trigger spontaneous frame

- Immediate reading : to read tilt value

Request 3704

LoRaWAN answer uplink B7040000140 02D005A if success

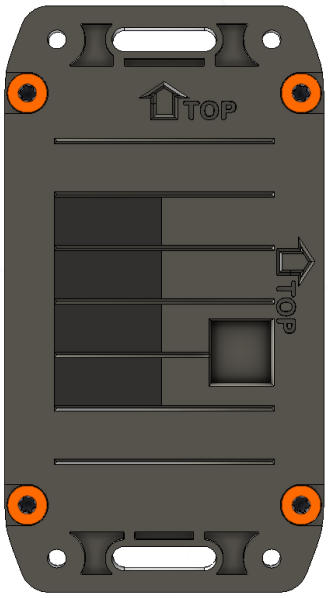
See section applicative command list; immediate reading

6 Battery replacement and initialization

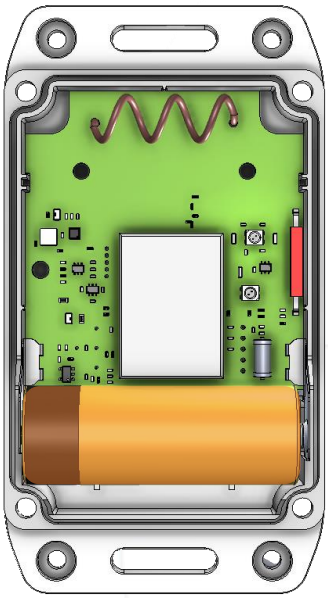
6.1 Battery replacement

Battery reference: FANSO ER18505M

Unscrew the cover fixing screws using Torx T15 screwdriver



Replace the battery with a new one



6.2 Battery level initialization

LoRaWAN downlinks commands on port #1

Battery level initialization is done through a LoRaWAN downlink after replacing the battery

Request	15011104000000000
LoRaWAN answer uplink	94011100

7 Parameters

Since many parameters are linked to generic features like spontaneous sendings, parameters are splitted into 2 different ranges.

- 0x01 to 0x7F are allocated to generic parameters
- 0x81 to 0xFF are allocated to applicative parameters

Parameter types according way of storing are:

xxx-P.....Persistent parameters - current value is stored in EEPROM and loaded on reset
xxx-V .....Volatile – on reset default parameter is loaded
xxx-S.....Signature – Signature signed parameters
xxx-D .....Battery Clear – Parameters values are not affected on Load Default. Values are set to 0 on battery initialization

Parameter types according way of access are:

RO-x.....Read only parameters – can be read, can't be modified
RW-x.....Read/Write parameters – can be read, can be written
TRWx-x.....Time Slot Read/W parameters – Writing application parameter is done according RW/RWW type. High and Low Time Slot parameters copies are accessed using service 0x01 commands 0x21/0x22 (Read/Write) for Low activities time slots and 0x23/0x24 (Read/Write) for High activities time slots

7.1 Generic parameters list

7.1.1 *General parameters*

Param ID	Name	Size	Description
0x00	**GEN_PAR_SGNT** [RO-V]	4	**Generic parameters signature** Parameter signature computed over all generic parameters stamped xxx-S. ***Default value:*** *0x00000000 (initialized at startup)*
0x01	**CIF** [RW-PS]	1	**Customer Information Field** Arbitrary register that will be brought by Keep-Alive frame. ***Default value:*** *0x00 (00)*
0x02	**GFN_EN** [RW-PS]	2	**Generic function enabler** Permits to enable generic function on the device. b15...Protected parameters writing authorized b14...915MHz RF range settings in Standby mode b13-6 reserved b5 ....Actions by reed enabled in operating mode b4 ....Actions by reed enabled in standby mode b3 ....Reserved b2 ....Time Slot service enable b1 ....RTC synchronization enable b0 ....Standby active ***Default value:*** *0x0033 (Both reed actions, RTC synchronization and stand by enabled)*

0x03	**DEV_STAT** [RO-P]	2	**General Device Status** b15 ..Device connected on Clover-Net b14 ..Device connected on LoRaWAN b13 ..Device connected on Sigfox b12...Application reserved b11...Oscillation detected on source 2 b10...Oscillation detected on source 1 b9 ....Application takes control over Clover-Net settings b8 ....Find device process running b7 ....Device installation in progress b6 ....Current state of Time Slot Service (0-Not Active, 1-Active) b5 ....Bad configuration / Bad status (see BCONF_STAT) b4 ....Device currently is in Test Mode b3 ....Temperature exceed operating limits b2 ....Battery usage exceeds low battery threshold (see LOW_BAT_TH) b1 ....Unread datalogging exceed Log table size (data lost) b0 ....RTC valid ***Default value:*** *0x0000 (all is OK)*
0x04	**FR_COUNT** [RO-P]	1	**Spontaneous frame counter** Incremented by the generic service 0x03 at each spontaneous frame generation, its 4 less significant bits are inserted in b15-12 of STATUS register (2nd byte) in all spontaneous frame. This is typically used for detecting frame repetition. The value returns to 0x00 after reaching 0xFF. ***Default value:*** *0x00 (0 frames sent)*
0x05	**CLR_MGT** [RO-V]	1	**Clear management** Clearing data like datalogging tables, applicative activity counters is there is. b7-3 reserved b2 ....Battery level initialization to full (self-cleared bit) b1 ....Clear Data Log table 1 (self-cleared bit) b0 ....Clear Data Log table 0 (self-cleared bit) ***Default value:*** *0x0000 (nothing requested)*
0x06	**LED_PER** [RW-PS]	3	**LED period and duration** (continuous alive blink) **[1 byte]** defines the continuous LED blink period (in seconds, 0x00 disables it). **[1 byte]** defines the continuous LED blink duration (in multiple of 50ms). **[1 byte]** defines the HW and number of blink: b7-4 Hardware used to indicate the low battery status (Appendix C) b3-0 Number of blinks (LED off duration is the same as LED on) ***Default value:*** *0x000111 (Continuous blink disabled)*
0x07	**INST_MODE** [RW-PS]	4	**Installation modes** b31...Blind (no com with distant equipment, join procedures still executed) b30-13 reserved b12...Sigfox b11-9 reserved b8 ....LoRaWAN b7-6 reserved b5 ....Clover-Net BCT bit field by order (ordo ID 1 is used) b4 ....Clover-Net BCT b3 ....Clover-Net MCT b2 ....Clover-Net P2P with BCT search (distant equipment research) b1 ....Clover-Net P2P with MCT search (distant equipment research) b0 ....Clover-Net P2P **Default value:** 0x80000100 (Blind mode, LoRaWAN)

7.1.2 *Event frame parameters*

Param ID	Name	Size	Description
0x22	**EVT_TYPE** [RW-PS]	1	**Event frame type** Corresponds to the frame type described in section **Erreur ! Source du renvoi introuvable.**. 0x00 ...Disabled 0x01 ...Short event frame 0x02 ...Standard event frame 0x03 ...Long event frame 0x04 ...Special event frame ***Default value:*** *0x02 (Standard frame)*
0x23	**EVT_MODE** [RW-PS]	1	**Event frame sending mode** 0x00 ...Clover-Net P2P 0x01 ...Clover-Net MCT – no ACK 0x02 ...Clover-Net MCT –ACK 0x03 ...Clover-Net BCT – no ACK 0x04 ...Clover-Net BCT – ACK 0x05 ...Clover-Net Extender service – no ACK 0x06 ...Clover-Net Extender service – ACK 0x07 ...LoRaWAN unconfirmed 0x08 ...LoRaWAN confirmed 0x09 ...Sigfox – no ACK 0x0A...Sigfox - ACK ***Default value:*** *0x07 (LoRaWAN unconfirmed)*
0x24	**EVT_DEL1_RNG** [RW-PS]	2	**Event frame first sending random delay rang** Applied on the 1st frame sending only. Random delay computed in range from min to max: [1st byte] minimum, expressed in [seconds], value <= max [2nd byte] maximum, expressed in [seconds], min <= value NOTE: for repetition delay, see params CNET_DELn_RNG and OTHER_DELn_RNG ***Default value:*** *0x0000 (immediate sending)*
0x25	**EVT_REP** [RW-PS]	1	**Event frame repetition number** Applied whatever the sending mode is. Repetitions stop if ACK/confirmation is received. Corresponds to the number of sendings, not only repetitions). Max value: 10 ***Default value:*** *0x03 (3 sending)*
0x26	**EVT_EXT_TOUT** [RW-PS]	1	**Event frame extender timeout** ***Default value:*** *0x01 (1 minute)*

0x27	**EVT_PRTY** [RW-PS]	5	**Event frame priority configuration** NOTE: This is an advanced parameter to be managed by INEO-SENSE team. [1 byte] priority of group 1 [1 byte] priority of group 2 [1 byte] priority of group 3 [1 byte] priority of group 4 [1 byte] priority of group 5 Priority levels are: 0x00 ...High priority. If transmit list is full, remove the oldest low priority. If no low priority in list then frame is not buffered. 0x01 ...Low priority. If transmit list is full, remove the oldest low priority. If no low priority in list then frame is not buffered. 0x02 ...High priority. If transmit list is full, remove the oldest low priority. If no low priority in list then remove the oldest high priority. 0x03 ...Low priority. If transmit list is full, remove the oldest low priority. If no low priority in list then remove the oldest high priority. 0x04 ...High priority. If transmit list is full, frame is not buffered. 0x05 ...Low priority. If transmit list is full, frame is not buffered. ***Default value:*** *0x0000000000*

7.1.3 *Periodic picture frame parameters*

Param ID	Name	Size	Description
0x28	**PP_TYPE** [RW-PS]	1	**Periodic picture frame default type** Corresponds to the frame type described in section **Erreur ! Source du renvoi introuvable.**. 0x00 ...Disabled 0x01 ...Short periodic picture frame 0x02 ...Standard periodic picture frame 0x03 ...Long periodic picture frame 0x04 ...Special periodic picture frame ***Default value:*** *0x02 (Standard frame)*
0x29	**PP_MODE** [RW-PS]	1	**Periodic picture frame sending mode** 0x00 ...Clover-Net P2P 0x01 ...Clover-Net MCT – no ACK 0x02 ...Clover-Net MCT –ACK 0x03 ...Clover-Net BCT – no ACK 0x04 ...Clover-Net BCT – ACK 0x05 ...Clover-Net Extender service – no ACK 0x06 ...Clover-Net Extender service – ACK 0x07 ...LoRaWAN unconfirmed 0x08 ...LoRaWAN confirmed 0x09 ...Sigfox – no ACK 0x0A...Sigfox - ACK ***Default value:*** *0x07 (LoRaWAN unconfirmed)*
0x2A	**PP_DEL1_RNG** [RW-PS]	2	**Periodic picture frame first sending random delay rang** Applied on the 1st frame sending only. Random delay computed in range from min to max: **[1st byte]** minimum, expressed in [seconds], value <= max **[2nd byte]** maximum, expressed in [seconds], min <= value NOTE: for repetition delay, see params CNET_DELn_RNG and OTHER_DELn_RNG NOTE: for starting delay, see params PER_FR_START_DEL ***Default value:*** *0x0000 (immediate sending)*
0x2B	**PP_REP** [RW-PS]	1	**Periodic picture frame repetition number** Applied whatever the sending mode is. Repetitions stop if ACK/confirmation is received. Corresponds to the number of sendings, not only repetitions). Max value: 10 ***Default value:*** *0x01 (1 frame sent)*
0x2C	**PP_EXT_TOUT** [RW-PS]	1	**Periodic picture frame extender timeout** ***Default value:*** *0x01 (1 minute)*
0x2D	**PP_PER** [RW-PS]	2	**Periodic picture sending period** Expressed in multiple of 30 seconds. Minimum 30 seconds, maximum 72 hours. ***Default value:*** *0x01E0 (4 hours)*

0x2E	**PP_PRTY** [RW-PS]	1	**Periodic picture frame priority configuration** NOTE: This is an advanced parameter to be managed by INEO-SENSE team. Priority level of periodic picture frames in OTOTx service: 0x00 ...High priority. If transmit list is full, remove the oldest low priority. If no low priority in list then frame is not buffered. 0x01 ...Low priority. If transmit list is full, remove the oldest low priority. If no low priority in list then frame is not buffered. 0x02 ...High priority. If transmit list is full, remove the oldest low priority. If no low priority in list then remove the oldest high priority. 0x03 ...Low priority. If transmit list is full, remove the oldest low priority. If no low priority in list then remove the oldest high priority. 0x04 ...High priority. If transmit list is full, frame is not buffered. 0x05 ...Low priority. If transmit list is full, frame is not buffered. ***Default value:*** *0x01*

7.1.4 *Keep Alive frame parameters*

Param ID	Name	Size	Description
0x3F	**KA_TYPE** [RW-PS]	1	**Keep alive frame default type** Corresponds to the frame type described in section **Erreur ! Source du renvoi introuvable.**. 0x00 ...Disabled 0x01 ...Short keep alive frame 0x02 ...Standard keep alive frame 0x03 ...Long keep alive frame 0x04 ...Special keep alive frame ***Default value:*** *0x02 (Standard keep alive frame sent)*
0x40	**KA_MODE** [RW-PS]	1	**Keep alive frame sending mode** 0x00 ...Clover-Net P2P 0x01 ...Clover-Net MCT – no ACK 0x02 ...Clover-Net MCT –ACK 0x03 ...Clover-Net BCT – no ACK 0x04 ...Clover-Net BCT – ACK 0x05 ...Clover-Net Extender service – no ACK 0x06 ...Clover-Net Extender service – ACK 0x07 ...LoRaWAN unconfirmed 0x08 ...LoRaWAN confirmed 0x09 ...Sigfox – no ACK 0x0A...Sigfox - ACK ***Default value:*** *0x07 (LoRaWAN unconfirmed)*
0x41	**KA_DEL1_RNG** [RW-PS]	2	**Keep alive frame first sending random delay rang** Applied on the 1st frame sending only. Random delay computed in range from min to max: **[1st byte]** minimum, expressed in [seconds], value <= max **[2nd byte]** maximum, expressed in [seconds], min <= value NOTE: for repetition delay, see params CNET_DELn_RNG and OTHER_DELn_RNG NOTE: for starting delay, see params PER_FR_START_DEL ***Default value:*** *0x0000 (immediate sending)*
0x42	**KA_REP** [RW-PS]	1	**Keep alive frame repetition number** Applied whatever the sending mode is. Repetitions stop if ACK/confirmation is received. Corresponds to the number of sendings, not only repetitions). Max value: 10 ***Default value:*** *0x02 (2 frames sent)*
0x43	**KA_EXT_TOUT** [RW-PS]	1	**Keep alive frame extender timeout** ***Default value:*** *0x01 (1 minute)*
0x44	**KA_PER** [RW-PS]	2	**Keep alive sending period** Expressed in multiple of 30 seconds. Minimum 30 seconds, maximum 72 hours. ***Default value:*** *0x21C0 (72 hours)*

0x45	**KA_PRTY** [RW-PS]	1	**Periodic keep alive frame priority configuration** NOTE: This is an advanced parameter to be managed by INEO-SENSE team. Priority level of periodic picture frames in OTOTx service: 0x00 ...High priority. If transmit list is full, remove the oldest low priority. If no low priority in list then frame is not buffered. 0x01 ...Low priority. If transmit list is full, remove the oldest low priority. If no low priority in list then frame is not buffered. 0x02 ...High priority. If transmit list is full, remove the oldest low priority. If no low priority in list then remove the oldest high priority. 0x03 ...Low priority. If transmit list is full, remove the oldest low priority. If no low priority in list then remove the oldest high priority. 0x04 ...High priority. If transmit list is full, frame is not buffered. 0x05 ...Low priority. If transmit list is full, frame is not buffered. ***Default value:*** *0x01*

7.1.5 *Device Integrity parameters*

Param ID	Name	Size	Description
0x57	**DI_EN** [RW-PS]	2	**Device integrity event enabler** Allows to enable the devices integrity surveillance features - **b15-5 [r/w]- Reserved** - **b4 *[r/w]* - REF_REINIT_EN** – Reinitialization of references. References initialization is always executed after an installation process but, if it was already done, it will be launched on new installation only if this bit is set - **b3 *[r/w]* - MAG_EN** – Magnetic field change detection - **b2 *[r/w]* - TILT_EN** - Tilt detection - **b1 *[r/w]* - MS_EN** - Motion/Shock detection - **b0 *[r/w]* - TEMP_EN** - Operating temperature exceed limits ***Default value:*** *0x0001 (operating temperature monitored)*
0x58	**DI_STAT** [RO-P]	2	**Device integrity event state** Gives the current status the devices integrity surveillance features - **b15 *[r]* – MEMS_ACC_DET** – MEMS Accelerometer detected - **b14 *[r]* – MEMS_MAG_DET** – MEMS Magnetometer detected - **b13 *[r]* – TILT_REF_INIT** – Tilt reference set - **b12 *[r]* – MAG_REF_INIT** – Magnetometer reference set - **b11-6 *[r]* - Reserved** - **b4 *[r]* - MAG_DET** - Magnetic field change detection - **b3 *[r]* - TILT_DET** - Tilt detection - **b2 *[r]* - MS_DET** – Motion/Shock detection - **b1 *[r]* - TEMP_HIGH** - Operating temperature exceeds high limit - **b0 *[r]* - TEMP_LOW** - Operating temperature exceeds low limit ***Default value:*** *0x0000 (nothing detected yet)*
0x59	**LOW_BAT_TH** [RW-PS]	1	**Low battery threshold** Defines the remaining battery percentage to activate low battery LED indication (in %, threshold is operated as <=) ***Default value:*** *0x05 (5% battery remaining trigger battery low event)*
0x5A	**LOW_BAT_PER** [RW-PS]	3	**LED low battery blink period** **[1 byte]** defines the continuous LED blink period (in seconds, 0x00 disables it). **[1 byte]** defines the continuous LED blink duration (in multiple of 50ms). **[1 byte]** defines the HW and number of blink: b7-4 Hardware used to indicate the low battery status (Appendix C) b3-0 Number of blinks (LED off duration is the same as LED on) ***Default value:*** *0x140112 (Low bat blink enabled, 2 blinks 50ms every 20 seconds)*
0x5B	**TEMP_L** [RW-PS]	2	**Temperature exceed - low Threshold** Temperature threshold used for operating temperature high limit detection based on Clover-Sense temperature sensor (+/- 2° precision) Expressed in [1/256th degree Celsius] ***Default value:*** *0xEC00 (-20°C)*
0x5C	**TEMP_H** [RW-PS]	2	**Temperature exceed - high Threshold** Temperature threshold used for operating temperature high limit detection based on Clover-Sense temperature sensor (+/- 2° precision) Expressed in [1/256th degree Celsius] ***Default value:*** *0x4600 (+70°C)*

0x5D	**TEMP_PER** [RW-PS]	1	**Temperature sampling period** Temperature sampling acquisition on the Clover-Sense sensor only. Expressed in [30 sec] ***Default value:*** *0x02 (1 min period)*
0x5E	**LAST_TEMP** [RO-V]	2	**Last Temperature value** Last acquired temperature value from Clover-Sense sensor. Expressed in [1/256th degree Celsius] ***Default value:*** *0x1900 (25°C)*
0x5F	**ACTIVITY_PERC** [RO-V]	1	**Activity percentage** Gives the battery consumed Expressed in [%] ***Default value:*** *0x00 (battery is full)*

0x60	**MOT_SH_CONFIG** [RW-PS]	15	**Motion/Shock configuration** Defines a set of configuration registers applied to the accelerometer sensor and to the motion algorithm - ***B0 [r/w] – ACC CONFIG – Accelerometer configuration*** • **b7** – **AXIS_ACT** - in case of multiple axes, a '0' means to trig on "OR" a '1' on "AND"; • **b6-3 - Reserved;** • **b2 – AXIS_Z_EN -** use of axis Z; • **b1 – AXIS_Y_EN -** use of axis Y; • **b0 – AXIS_X_EN -** use of axis X; - **B1** ***[r/w] – THRESHOLD - Acceleration trig threshold***. Expressed in [16 mG] - **B2** ***[r/w] –*** **DURATION** ***- Accelerometer trig minimum duration***. Expressed in [40ms]; - ***B3 [r/w] - TS_INC - Motion algorithm Increment value.*** Defines the increment value added to internal motion counter every time movement is detected. If 0x00, motion algorithm is deactivated and detection becomes a simple shock detection. - ***B4 [r/w] - TS_DEC - Motion algorithm Decrement value.*** Defines the decrement value subtracted from internal motion counter if pulse is not detected within certain time. TS_DEC must be lower than TS_INC. - ***B5 [r/w] - TS_V_TH - Motion algorithm Threshold value.*** Defines the maximum internal motion counter value considered as threshold level for movement start. Must be lower than 150. - ***B6 [r/w] - SWT_NM - Switch to No motion state.*** Time to switch to "No Motion" state after motion stops. Expressed in multiple of TS_DEC. - ***B7-8 [r/w] – ON_DELAY - Delay before restarting motion detection after stop.*** Time for suspending Motion sensor activities (in [s]) after Motion Stop event is generated (see **STOP_DELAY** below). If set to 0, Motion sensor activities are not suspended; - ***B9-10 [r/w] – START_DELAY – Delay before generating Motion Start event after Start motion was detected.*** Time after movement starts (in [s]), which generates Motion start event. If set to 0, event is processed immediately after Motion algorithm detects motion start; - ***B11-12 [r/w] – CONT_DELAY – Delay before generating Continuous Motion event during motion.*** Time with continuous movement (in [s]) to trigger Motion continuous event (each event detection reloads the continuous motion time). Min. time allowed is 60s. If set to 0, Motion continuous event is disabled; - ***B13-14 [r/w] – STOP_DELAY – Delay before generating Motion Stop event after motion stop.*** Time with no movement (in [s]), which generates Motion stop event. If set to 0, event is processed immediately after Motion algorithm detects motion stop; Expressed in multiple of seconds. If sensor must work as Shock detector next settings must be done: TS_INC=2, TS_DEC=1, TS_TH_V=1, SWT_NM=0 and in THRESHOLD to be assigned desired sensitivity. ***Default value:*** *0x07020205010F00000000000000*

0x61	**TILT_CONFIG** [RW-PS]	12	**Tilt configuration** Defines a set of configuration registers applied to the tilt detection algorithm **[1 byte] CONFIG** b7 .... in case of multiple axes, a '0' means to trig on "OR" a '1' on "AND" b6 ....in case of 3 axes managed and trig on "AND", a '0' means to trig on all 3 axes, a '1' to trig on only 2 axes among the 3 b5 ....Threshold defined applied on lower case b4 ....Threshold defined applied on higher case b3 ....not used b2 ....use of axis Z b1 ....use of axis Y b0 ....use of axis X **[2 bytes] SAMPLING PERIOD** Mems sampling period. Expressed in [100ms] **[2 bytes] THRESHOLD** Absolute threshold to detect tilt event. Expressed in[degree] **[2 bytes] HYSTERESIS** Hysteresis applied to come back in reference. Expressed in[degree] **[1 byte] SAMPLES** Sample number to validate a state change (a fixed delay of 100ms in between if more than 1) **[2 bytes] OUT_REF_DEL** Delay in [s] before reporting Event, Tilt exceed reference margin **[2 bytes] IN_REF_DEL** Delay in [s] before reporting Event, Tilt return again to reference margin **Default value:** 0x37000A001400020200000000
0x62	**MAG_CONFIG** [RW-PS]	12	**Magnetic configuration** **[1 byte] CONFIG** b7 .... in case of multiple axes, a '0' means to trig on "OR" a '1' on "AND" b6 ....in case of 3 axes managed and trig on "AND", a '0' means to trig on all 3 axes, a '1' to trig on only 2 axes among the 3 b5 ....Threshold defined applied on lower case b4 ....Threshold defined applied on higher case b3 ....not used b2 ....use of axis Z b1 ....use of axis Y b0 ....use of axis X **[2 bytes] SAMPLING PERIOD** Mems sampling period. Expressed in [100ms] **[2 bytes] THRESHOLD** Absolute threshold to detect magnetic event. Expressed in [1.5mGauss] **[2 bytes] HYSTERESIS** Hysteresis applied to come back in reference. Expressed in [1.5mGauss] **[1 byte] SAMPLES** Sample number to validate a state change (a fixed delay of 100ms in between if more than 1) ***[2 bytes] OUT_REF_DEL*** Delay in [s] before reporting Event Magnetic direction exceed reference margin ***[2 bytes] IN_REF_DEL*** Delay in [s] before reporting Event Magnetic direction return again to reference margin **Default value:** 0x37000A003C00140200000000
0x64	**TILT_POS** [RO-P]	6	**Tilt current position** **Default value:** 0x000000000000
0x66	**MAG_POS** [RO-P]	6	**Magnetic current position** **Default value:** 0x000000000000

7.2 Application parameters list [APPLI]

7.2.1 *General parameters*

ID	NAME	Size	Description
0x80	**APL_PAR_SGNT** [RO-V]	4	**Application parameters Signature** Parameter signature computed over all parameters stamped xxx-S. ***Default value:*** *0x00000000 (initialized at startup)*
0x81	**SFN_EN** [RW-PS] *PROTECTED*	2	**Special Function enabler** b15.. GRB led used else RGB led (only relevant for LED-REPORTER) b14-6 reserved b5.... Oscillation detection system on Source 2. Configured through OSC_DETECT_SRC2. Notified through b11 in PARAM_DEV_STAT. b4.... Oscillation detection system on Source 1. Configured through OSC_DETECT_SRC1. Notified through b10 in PARAM_DEV_STAT. b3.... reserved b2.... Source 2 linked to source 1. Configured through SRC2_LINK_CONF b1.... reserved b0.... References' initialization is executed on a success installation process ***Default value:*** *0x0001*
0x82	**FN_EN** [RW-PS]	2	**Function enabler** b15-14 reserved b13.. Send event when hygrometry exceeds app thresholds b12.. Send event when hygrometry goes back below app thresholds b11.. Send event when temperature exceeds app thresholds b10.. Send event when temperature goes back below app thresholds b9.... Send event when source 2 switches to state 4 b8.... Send event when source 2 switches to state 3 b7.... Send event when source 2 switches to state 2 b6.... Send event when source 2 switches to state 1 b5.... Send event when source 2 switches to state 0 b4.... Send event when source 1 switches to state 4 b3.... Send event when source 1 switches to state 3 b2.... Send event when source 1 switches to state 2 b1.... Send event when source 1 switches to state 1 b0.... Send event when source 1 switches to state 0 ***Default value:*** *0x0023*
0x83	**LED_EN** [RW-PS]	1	**LED enabler** b7-5. reserved b4.... Activate LED in test mode. If source 1 state = 0, red light on, else red light off. If source 2 state = 0, green light on, else green light off. b3.... 2 short green blinks when source 2 switches to state n b2.... 2 short red blinks when source 2 switches to state 0 b1.... Short green blink when source 1 switches to state n b0.... Short red blink when source 1 switches to state 0 ***Default value:*** *0x10*

0x84	**BCONF_STAT** [RO-P]	1	**Bad configuration / Bad status** b7-4. reserved b3.... BLE issue b2.... reserved b1.... SRC2 sensor issue (see PARAM_SRC_ERROR for details) b0.... SRC1 sensor issue (see PARAM_SRC_ERROR for details) ***Default value:*** *0x00*
0x85	LOG_EN [RW-PS]	2	Event Logging enabler TBD ***Default value:*** *0x0000*
0xCD	**LED_REP_DCOL** [RW-PS]	3	**Led reporter default color** RGB code of color used by default when an advanced LED is embedded ***Default value:*** *0x00FF00 (Green)*
0xD4	**USER_DATA** [RW-P]	15	**User data field** This parameter is used to add optional data to some events and periodic frames. It can be used freely. ***Default value:*** *0x00000000000000000000000000000000*
0xD5	**DEL_TEST_MODE** [RW-PS]	2	**Delay in test mode** After switching to operating mode, device will stay in test mode during this delay expressed in [s] ***Default value:*** *0x0078 (120 s)*
0xD6	**APP_STAT** [RO-P]	2	**Application Status** b15-3 reserved b2.... TOF references initialized b1.... Magnetic references initialized b0.... Tilt references initialized ***Default value:*** *0x0000*
0xEA	**CRITIC_ISSUE_CNT** [RO-P]	1	**Critical issue counter** Counter of critical issue detected. Error managed in this counter are provided in PARAM_BCONF_STAT. Every time this counter is incremented, an EVENT of type 0x90 is sent and device is reset after one minute. When this counter reaches 0xFF, incrementation is stopped and device sources are set to DISABLED after reset. ***Default value:*** *0x00*

7.2.2 *Temperature sensors parameters*

ID	NAME	Size	Description
0x86	**SENSORS_SAMPLING** [RW-PS]	1	**Sensors sampling period** Expressed in multiple of 20 seconds ***Default value:*** *0x03 (60 seconds)*
0x88	**TEMP_VAL** [RO-V]	2	**Temperature value** Last acquired temperature value. Expressed in [1/256th degree Celsius] ***Default value:*** *0x1900 (25°C)*
0x89	**TEMP_THS_H** [RW-PS]	2	**Temperature exceeds high threshold** Temperature threshold used for application temperature high limit detection. Expressed in [1/256th degree Celsius] ***Default value:*** *0x3200 (+50°C)*

0x8A	**TEMP_THS_L** [RW-PS]	2	**Temperature exceeds low threshold** Temperature threshold used for application temperature high limit detection. Expressed in [1/256th degree Celsius] ***Default value:*** *0xF600 (-10°C)*
0x8B	**TEMP_HYST** [RW-PS]	2	**Temperature hysteresis** Hysteresis used on thresholds to come back to normal temperature state. Expressed in [1/256th degree Celsius] ***Default value:*** *0x0200 (2°C)*

7.2.3 *Switch sources parameters*

ID	NAME	Size	Description
0x90	**SRC1** [RW-PS] *PROTECTED*	1	**Source 1 configuration** *This is a PROTECTED parameter: can be written only if bit b7 of GFN_EN is set to one* 0x00... Disabled 0x01... Internal REED 0x02... External REED 0x03... Mems in MOTION detection 0x04... Mems in TILT detection 0x05... Mems in MAGNETIC detection ***Default value:*** *0x03*
0x91	**SRC2** [RW-PS] *PROTECTED*	1	**Source 2 configuration** *This is a PROTECTED parameter: can be written only if bit b7 of GFN_EN is set to one* 0x00... Disabled 0x01... Internal REED 0x02... External REED 0x03... Mems in MOTION detection 0x04... Mems in TILT detection 0x05... Mems in MAGNETIC detection ***Default value:*** *0x00*
0x92	**STAT_SRC1** [RO-V]	1	**Source 1 current state** Current state of source 1 from 0x00 to 0x04. 0x00 means that device is not in any known position. Else value gives the current position ***Default value:*** *0x00*
0x93	**STAT_SRC2** [RO-V]	1	**Source 2 current state** Current state of source 1 from 0x00 to 0x04. 0x00 means that device is not in any known position. Else value gives the current position ***Default value:*** *0x00*
0x94	**PREV_STAT_SRC1** [RO-V]	1	**Source 1 previous state** Previous state of source 1 from 0x00 to 0x04. 0x00 means that device was not in any known position. Else value gives the previous position ***Default value:*** *0x00*
0x95	**PREV_STAT_SRC2** [RO-V]	1	**Source 2 previous state** Previous state of source 2 from 0x00 to 0x04. 0x00 means that device was not in any known position. Else value gives the previous position ***Default value:*** *0x00*
0x96	**CNT_STAT0_SRC1** [RO-V]	4	**Source 1 state 0 counter** Counter of state 0 detections for source 1 ***Default value:*** *0x00000000*
0x97	**CNT_STAT1_SRC1** [RO-V]	4	**Source 1 state 1 counter** Counter of state 1 detections for source 1 ***Default value:*** *0x00000000*
0x98	**CNT_STAT2_SRC1** [RO-V]	4	**Source 1 state 2 counter** Counter of state 2 detections for source 1 ***Default value:*** *0x00000000*

0x99	**CNT_STAT3_SRC1** [RO-V]	4	**Source 1 state 3 counter** Counter of state 3 detections for source 1 ***Default value:*** *0x00000000*
0x9A	**CNT_STAT4_SRC1** [RO-V]	4	**Source 1 state 4 counter** Counter of state 4 detections for source 1 ***Default value:*** *0x00000000*
0x9B	**CNT_STAT0_SRC2** [RO-V]	4	**Source 2 state 0 counter** Counter of state 0 detections for source 2 ***Default value:*** *0x00000000*
0x9C	**CNT_STAT1_SRC2** [RO-V]	4	**Source 2 state 1 counter** Counter of state 1 detections for source 2 ***Default value:*** *0x00000000*
0x9D	**CNT_STAT2_SRC2** [RO-V]	4	**Source 2 state 2 counter** Counter of state 2 detections for source 2 ***Default value:*** *0x00000000*
0x9E	**CNT_STAT3_SRC2** [RO-V]	4	**Source 2 state 3 counter** Counter of state 3 detections for source 2 ***Default value:*** *0x00000000*
0x9F	**CNT_STAT4_SRC2** [RO-V]	4	**Source 2 state 4 counter** Counter of state 4 detections for source 2 ***Default value:*** *0x00000000*
0xD7	**SRC2_LINK_CONF** [RW-PS]	5	**Source 2 linked to source 1 configuration** **[1 byte] Source 2 activation** b7-2. unused b1 ..... Source 2 activated when source 1 state n detected b0 ..... Source 2 activated when source 1 state 0 detected **[1 byte] Source 2 deactivation** b7-2. unused b1 ..... Source 2 deactivated when delay expired b0 ..... Source 2 deactivated when activation condition not fulfilled anymore (only possible if only 1 state of source 1 is used) **[2 bytes] Deactivation delay** Delay expressed in [s] before deactivating source 2 **[1 byte] Source 2 state when deactivated** State to force when source 1 deactivates source 2. 0xFF means do not force any state ***Default value:*** *0x0101003C01*

0xDB	**OSC_DETECT_SRC1** [RW-PS]	4	**Source 1 oscillation detection configuration** **[1 byte] Window duration** Window duration to check oscillations expressed in [m]. Minimum is 1 maximum is 60. **[1 byte] Oscillation detection threshold** Minimum number of transitions between states counted on window before detecting oscillation. Count must be strictly higher. **[1 byte] Oscillation stops detection threshold** Maximum number of transitions between states counted on window before going back to normal. Count must be lower or equal. **[1 byte] State to force** State to force on source when oscillation detected *Oscillation detection feature on source 1 must by activated through bit b4 in PARAM_SFN_EN and when it is detected, bit b10 is set in PARAM_DEV_STAT.* ***Default value:*** *0x0A070200*
0xDC	**OSC_DETECT_SRC2** [RW-PS]	4	**Source 2 oscillation detection configuration** **[1 byte] Window duration** Window duration to check oscillations expressed in [m] **[1 byte] Oscillation detection threshold** Minimum number of transitions between states counted on window before detecting oscillation **[1 byte] Oscillation stops detection threshold** Maximum number of transitions between states counted on window before going back to normal **[1 byte] State to force on source when oscillation detected** State to force on source when oscillation detected *Oscillation detection feature on source 1 must by activated through bit b5 in PARAM_SFN_EN and when it is detected, bit b11 is set in PARAM_DEV_STAT.* ***Default value:*** *0x0A070200*
0xE5	**SRC_ERROR** [RO-P]	2	**Sources error detected** **[1 byte] Error on source 1** **[1 byte] Error on source 2** Error detected on sources. 0x00 means no error detected else, definition depends on source type (see Appendix E: Description of errors depending on source) *When an error is detected on a source, error information is stored here and source is disabled.* ***Default value:*** *0x0000*

7.2.4 *Event sending parameters*

ID	NAME	Size	Description
0xA0	**ALR_DEL_STAT0** [RW-PS]	2	**Event delay for state 0** Delay to wait in state 0 before generating an event (for both sources) ***Default value:*** *0x0000*
0xA1	**ALR_DEL_STATn** [RW-PS]	2	**Event delay for state 1-4** Delay to wait in state 1 to 4 before generating an event (for both sources) ***Default value:*** *0x0000*

7.2.5 *REED sources parameters*

ID	NAME	Size	Description
0xA2	**REED_CONF** [RW-PS] *PROTECTED*	1	**REED and EXTERNAL REED configuration** *This is a PROTECTED parameter: can be written only if bit b7 of GFN_EN is set to one* b7-2... unused b1 ..... **[EXT-REED source]** Logic level used for state 0: 0 ..... Logic level LOW is state 0 (i.e. for a REED it means closed) 1 ..... Logic level HIGH is state 0 (i.e. for a REED it means opened) b0 ..... **[REED source]** Logic level used for state 0: 0 ..... Logic level LOW is state 0 (i.e. for a REED it means closed) 1 ..... Logic level HIGH is state 0 (i.e. for a REED it means opened) ***Default value:*** *0x00*
0xA3	**REED_FILTER** [RW-PS]	2	**REED input filtering** Filtering delay to avoid wrong detection on REED input. Expressed in [100 ms] ***Default value:*** *0x0001*

7.2.6 *Mems in TILT source parameters*

ID	NAME	Size	Description
0xA6	**TILT_TRIG_CONF** [RW-PS] *PROTECTED*	1	**Mems in TILT trig configuration** *This is a PROTECTED parameter: can be written only if bit b7 of GFN_EN is set to one* b7-4... unused b3-2... Defines how to manage references: 0x0... One dynamic reference mode: all references are initialized automatically at the same time 0x1... Multiple dynamic references mode: each reference must be initialized one by one by using RF command (0x34) – Start references initialization 0x2... One static reference mode: all references are initialized at the same time to the value provided in TILT_REF_1 (must be written before starting installation) 0x3... Multiple static references mode: each reference are written manually in TILT_REF_1 , TILT_REF_2 , TILT_REF_3 and TILT_REF_4 (must be written before starting installation) b1-0... Defines number of positions managed: 0x0... State 0 means not in any saved position and State 1 means in saved position 1 0x1... Same as previous + State 2 means in saved position 2 0x2... Same as previous + State 3 means in saved position 3 0x3... Same as previous + State 4 means in saved position 4 ***Default value:*** *0x00*
0xA7	**TILT_REF_1** [RW-P]	6	**Mems in TILT source reference 1** Reference saved as state 1 position ***Default value:*** *0x000000000000*
0xA8	**TILT_REF_2** [RW-P]	6	**Mems in TILT source reference 2** Reference saved as state 2 position ***Default value:*** *0x000000000000*
0xA9	**TILT_REF_3** [RW-P]	6	**Mems in TILT source reference 3** Reference saved as state 3 position ***Default value:*** *0x000000000000*
0xAA	**TILT_REF_4** [RW-P]	6	**Mems in TILT source reference 4** Reference saved as state 4 position ***Default value:*** *0x000000000000*
0xAB	**TILT_THS_1** [RW-PS]	6	**Mems in TILT source threshold 1** Absolute threshold to detect tilt event for state 1 for each axes. Expressed in[degree] ***Default value:*** *0x001400140014*
0xAC	**TILT_THS_2** [RW-PS]	6	**Mems in TILT source threshold 2** Absolute threshold to detect tilt event for state 2 for each axes. Expressed in[degree] ***Default value:*** *0x000000000000*
0xAD	**TILT_THS_3** [RW-PS]	6	**Mems in TILT source threshold 3** Absolute threshold to detect tilt event for state 3 for each axes. Expressed in[degree] ***Default value:*** *0x000000000000*

0xAE	**TILT_THS_4** [RW-PS]	6	**Mems in TILT source threshold 4** Absolute threshold to detect tilt event for state 4 for each axes. Expressed in[degree] ***Default value:*** *0x000000000000*

7.2.7 *Mems in MAGNETIC source parameters*

ID	NAME	Size	Description
0xAF	**MAG_TRIG_CONF** [RW-PS] *PROTECTED*	1	**Mems in MAGNETIC trig configuration** *This is a PROTECTED parameter: can be written only if bit b7 of GFN_EN is set to one* b7-4... unused b3-2... Defines how to manage references: 0x0... One dynamic reference mode: all references are initialized automatically at the same time 0x1... Multiple dynamic references mode: each reference must be initialized one by one by using RF command (0x34) – Start references initialization 0x2... One static reference mode: all references are initialized at the same time to the value provided in MAG_REF_1 (must be written before starting installation) 0x3... Multiple static references mode: each reference are written manually in MAG_REF_1 , MAG_REF_2 , MAG_REF_3 and MAG_REF_4 (must be written before starting installation) b1-0... Defines number of positions managed: 0x0... State 0 means not in any saved position and State 1 means in saved position 1 0x1... Same as previous + State 2 means in saved position 2 0x2... Same as previous + State 3 means in saved position 3 0x3... Same as previous + State 4 means in saved position 4 ***Default value:*** *0x00*
0xB0	**MAG_REF_1** [RW-P]	6	**Mems in MAGNETIC source reference 1** Reference saved as state 1 position ***Default value:*** *0x000000000000*
0xB1	**MAG_REF_2** [RW-P]	6	**Mems in MAGNETIC source reference 2** Reference saved as state 2 position ***Default value:*** *0x000000000000*
0xB2	**MAG_REF_3** [RW-P]	6	**Mems in MAGNETIC source reference 3** Reference saved as state 3 position ***Default value:*** *0x000000000000*
0xB3	**MAG_REF_4** [RW-P]	6	**Mems in MAGNETIC source reference 4** Reference saved as state 4 position ***Default value:*** *0x000000000000*
0xB4	**MAG_THS_1** [RW-PS]	6	**Mems in MAGNETIC source threshold 1** Absolute threshold to detect magnetic event for state 1 for each axes. Expressed in [1.5mGauss] ***Default value:*** *0x003C003C003C*

0xB5	**MAG_THS_2** [RW-PS]	6	**Mems in MAGNETIC source threshold 2** Absolute threshold to detect magnetic event for state 2 for each axes. Expressed in [1.5mGauss] ***Default value:*** *0x000000000000*
0xB6	**MAG_THS_3** [RW-PS]	6	**Mems in MAGNETIC source threshold 3** Absolute threshold to detect magnetic event for state 3 for each axes. Expressed in [1.5mGauss] ***Default value:*** *0x000000000000*
0xB7	**MAG_THS_4** [RW-PS]	6	**Mems in MAGNETIC source threshold 4** Absolute threshold to detect magnetic event for state 4 for each axes. Expressed in [1.5mGauss] ***Default value:*** *0x000000000000*
0xB8	**MAG_ISSUE_THS** [RW-PS]	6	**Mems in MAGNETIC source issue threshold** Absolute threshold to detect an issue event. Expressed in [1.5mGauss] ***Default value:*** *0x000000000000*

7.2.8 *Buzzer option parameters*

ID	NAME	Size	Description
0xC8	**BUZZ_FREQ** [RW-PS]	12	**Configuration of sounds for each type** **[2 bytes] Siren – start frequency factor** Defined as frequency (Hz) = 1 000 000 / factor **[2 bytes] Siren – end frequency factor** Defined as frequency (Hz) = 1 000 000 / factor **[2 bytes] Siren – frequency factor step** Step in frequency factor to reach end freq from start freq **[2 bytes] Siren – frequency factor step duration** Duration of each step expressed in [ms] **[2 bytes] Buzzer – frequency factor** Defined as frequency (Hz) = 1 000 000 / factor **[2 bytes] Bip – frequency factor** Defined as frequency (Hz) = 1 000 000 / factor ***Default value:*** *0x019000C80002000506820320*
0xC9	**BUZZ_CONF_SRC1_STAT0** [RW-PS]	5	**Configuration of buzzer for source 1 state 0** **[1 byte] Configuration** 0x00... Deactivated 0x01... Stop buzzer 0x02... Siren 0x03... Buzz 0x04... Bip **[1 byte] Duration** Expressed in [s] or in number of iteration (for buzz or bip) **[1 byte] Duration in time** 0x00... Duration in previous byte is in number of iterations 0x01... Duration in previous byte is in time [s] **[1 byte] Duration of buzz/bip ON** For buzz or bip time ON **[1 byte] Duration of buzz/bip OFF** For buzz or bip time OFF ***Default value:*** *0x0000000000*

0xCA	**BUZZ_CONF_SRC1_STATn** [RW-PS]	5	**Configuration of buzzer for source 1 state 1 to 4** **[1 byte] Configuration** 0x00... Deactivated 0x01... Stop buzzer 0x02... Siren 0x03... Buzz 0x04... Bip **[1 byte] Duration** Expressed in [s] or in number of iteration (for buzz or bip) **[1 byte] Duration in time** 0x00... Duration in previous byte is in number of iterations 0x01... Duration in previous byte is in time [s] **[1 byte] Duration of buzz/bip ON** For buzz or bip time ON **[1 byte] Duration of buzz/bip OFF** For buzz or bip time OFF ***Default value:*** *0x0000000000*
0xCB	**BUZZ_CONF_SRC2_STAT0** [RW-PS]	5	**Configuration of buzzer for source 2 state 0** **[1 byte] Configuration** 0x00... Deactivated 0x01... Stop buzzer 0x02... Siren 0x03... Buzz 0x04... Bip **[1 byte] Duration** Expressed in [s] or in number of iteration (for buzz or bip) **[1 byte] Duration in time** 0x00... Duration in previous byte is in number of iterations 0x01... Duration in previous byte is in time [s] **[1 byte] Duration of buzz/bip ON** For buzz or bip time ON **[1 byte] Duration of buzz/bip OFF** For buzz or bip time OFF ***Default value:*** *0x0000000000*
0xCC	**BUZZ_CONF_SRC2_STATn** [RW-PS]	5	**Configuration of buzzer for source 2 state 1 to 4** **[1 byte] Configuration** 0x00... Deactivated 0x01... Stop buzzer 0x02... Siren 0x03... Buzz 0x04... Bip **[1 byte] Duration** Expressed in [s] or in number of iteration (for buzz or bip) **[1 byte] Duration in time** 0x00... Duration in previous byte is in number of iterations 0x01... Duration in previous byte is in time [s] **[1 byte] Duration of buzz/bip ON** For buzz or bip time ON **[1 byte] Duration of buzz/bip OFF** For buzz or bip time OFF ***Default value:*** *0x0000000000*

8 General FAQ

8.1 Real Time Clock format

Real Time Clock (RTC) is organized as 4 Bytes second counter that counts seconds according 1st of January, 2010 00:00:00.

8.2 Motion management

In MOT_SHO_CONFIG there are set of fields (**TS_INC**, **TS_DEC**, **TS_TH_V** and **SWT_NM**), which define sensor sensitivity.

To add additional level on Motion filtering (to avoid event generation of Motion Start/Stop events on small motion state changes) set of delays is included in generic parameter MOT_SHO_CONFIG. Every one of them defines time between motion state change detection and generation of corresponding events:

- START_DELAY – defines delay before generating Motion Start event, once motion was detected;
- CONT_DELAY – defines how much time device must be in motion before sending Motion Continuous event. Once such event is generated new CONT_DELAY time is reloaded and generation of this event continue until motion stop;
- STOP_DELAY – define how much time have to pass after real motion stop before generating Motion Stop event. Generation of Motion Stop event terminate cycle for Continuous Movement events.

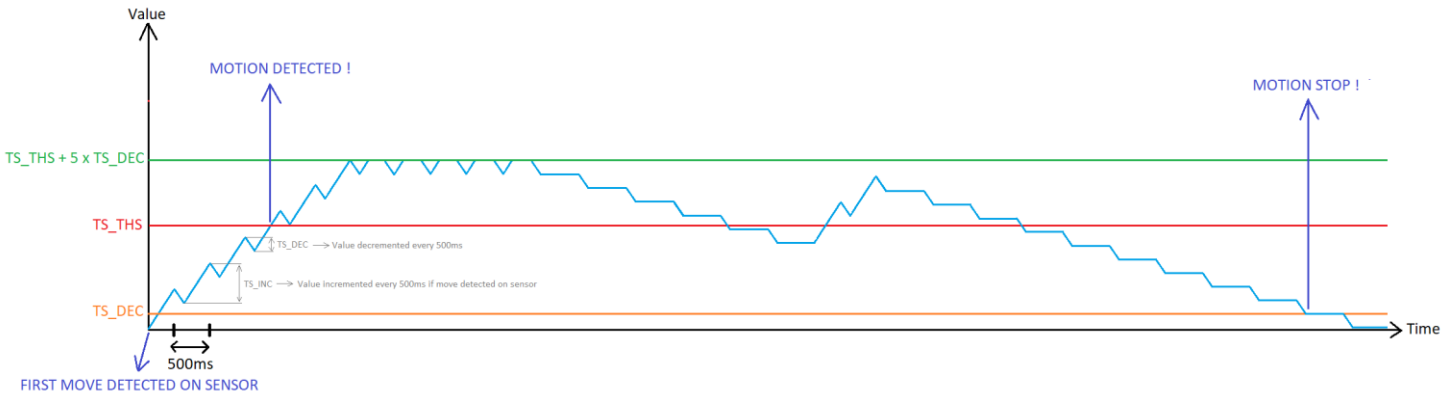
If Motion stop before Motion Start event is generated, it is considered that there was no motion at all (i.e. there is no Motion Stop event too).

If Motion stop and then restart before Motion Stop is generated, it is considered there is no motion stop and motion continues.

In addition to mentioned above delays, there is one more – ON_DELAY. It defines will be there Motion sensor suspend after Motion Stop event is generated and how long it will be (if set). If there is, Motion sensor is suspended until this time expire (i.e. no motion will be detected during this time) and then is resumed again.

Tilt and Motion/Shock management are mutually exclusive, so when Tilt management is enabled, Motion/Shock cannot be enabled.

There are specific settings, described in parameter MOT_SHO_CONFIG, which allow sensor to be used as Shock detector. However, for the moment even if they are set Shock will be reported as Motion event.



9 Appendix A: Description of position bytes

Position provided in different frames is always 6 bytes length and depends of source configured.

Internal REED

Byte 1 – Byte 6		
MSB	…	LSB
Not relevant 0xFFFFFFFFFFFF		

Mems in MOTION detection

Byte 1 – Byte 2			Byte 3 – Byte 4			Byte 5 – Byte 6		
MSB	…	LSB	MSB	…	LSB	MSB	…	LSB
X acceleration x4mg			Y acceleration x4mg			Z acceleration x4mg		

Mems in TILT detection

Byte 1 – Byte 2			Byte 3 – Byte 4			Byte 5 – Byte 6		
MSB	…	LSB	MSB	…	LSB	MSB	…	LSB
X position in degree			Y position in degree			Z position in degree		

Mems in MAGNETIC detection

Byte 1 – Byte 2			Byte 3 – Byte 4			Byte 5 – Byte 6		
MSB	…	LSB	MSB	…	LSB	MSB	…	LSB
X magnetic data x1.5mG			Y magnetic data x1.5mG			Z magnetic data x1.5mG		