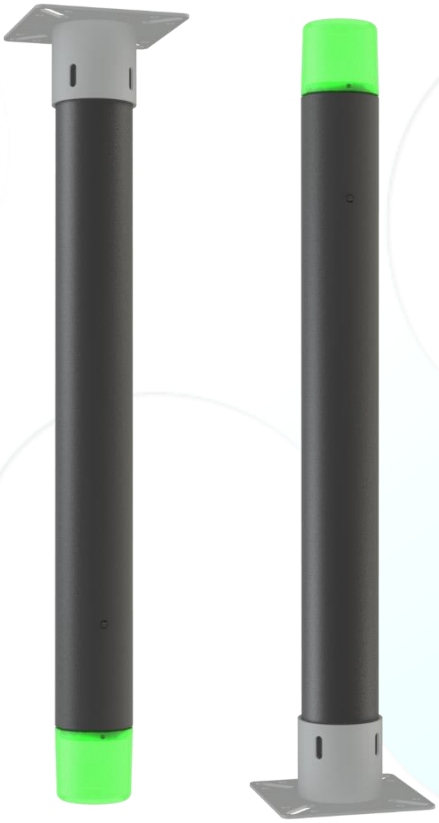
ineo·sense
BRINGING SENSE TO WIRELESS

ACS-Report-LED

Technical documentation



Summary

Revisions

Date	Author	Version	Comment	Minimum firmware
11/03/2022	FRR	1.0	1st version	
16/06/2022	FRR	1.1	Special periodic picture frame modified	01.05.15

1 Main features

ACS-Report-Led is a light indicator that can be used on different guidance or alert system.

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

- ACS-Report-Led can blink by LoRaWAN Downlink or CloverNet command.
- 16 000 000 possible colors

1.1 ACS-Report-Led blinking

All sequence of blink can be set up :

- total duration
- light time off
- light time on
- color

We can do this through the command 0x02 sent by LoRaWAN or CloverNet Downlink

1.2 MOTION or TILT sensors for Tamper detection

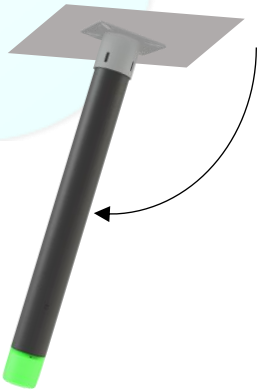
1.2.1 MOTION sensor

Our ACS-Report-Led device can detect motion when enabled.

Parameters are available to define sensor sensitivity such as MOT_SHO_CONFIG

MOTION mode enables ACS-Report-Led to detect movement, acceleration and shocks.

1.2.2 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

1.2.3 Sensor mode choice

The sensor mode can be chosen in parameters SRC1 (0x90).

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 15mn**
Keep alive period	**Short every 72h**
Sensors mode source 1	**Disabled**
Sensors mode source 2	**Disabled**

2.2 LoRaWAN downlinks

Standard LoRaWAN downlinks can be used to set up parameters or to program a blinking command

- LoRaWAN downlink is sent on port 1
- LoRaWAN Downlink cannot exceed **51 bytes**

2.3 CloverNet downlinks

Our CloverNet protocol can be used to manage ACS-Report-Led commands.

To do so, you will need to deploy CloverNet gateways only or Hybrid LoRaWAN/CloverNet gateways such as Multitech Conduit gateways.

CloverNet offers flexibility to setup our devices as:

- Maximum frame length is **198 bytes** instead of 51 bytes for LoRaWAN
- Downlinks can be pushed **immediately** without waiting for the device to send an uplink first

2.3.1 MQTT Broker and Topics

The complete documentation of our CloverNet protocol at the modem level (or CloverNet mCard) is available in the document: ***InS-INS_Modem-UserManual-E01.pdf*** *and* ***InS-mCardCloverNet-User_Guide_v1.1EN.pdf***

The format of the payload to be published so that it can be interpreted by our CloverNet application present in the gateway is as follows:

- **Header with communication parameters and product to address**
- Radio command prefix
- **Application** control that can be interpreted by the recipient product

2.3.2 MQTT Command Publication

Publication Topic: {{CloverMAC}}/CScommand/

Where : **CloverMAC** is the **CloverNet** mac number of the CloverNet gateway (format = AA:BB:CC:DD)

The following is the payload to use to send a command to an ACS-Report-LED device :

`010402050D010529010A2A010106020C1C010D00AABBCCDD0000000000000000010202`
`Command to send to device`

Details :

Payload	Description	Documentation
`010402050D010529010A2A010106020C1C010D00` `AABBCCDD0000000000000000`	Includes Radio Communication Settings for ACS-Report- LED and device serial number to reach: AABBCCDD	*InS-INS_Modem-UserManual-E01* *Page 14, 38*
command with acknowledgment and response `010202` command with acknowledgment only `010201`	Radio command prefix	
`Command to send to device`	ACS-Report-LED Command Description below	*ACS-Report-* LED *Technical documentation*

2.3.3 MQTT Subscription for answers

Product answer: Order with acknowledgment and response

RxMode=Point-to-Point, QoS=-79Dbm, Congestion=0x00, RTC=21-11-08 15:05:20, NMac=AA:BB:CC:DD, Rep1 NONE, Rep2 NONE, ServiceType=0x00, ProductType=0x0033, payload=Command answer

Product Response: command with acknowledgment only

010302

If the product is unreachable, here is the answer that will appear on the answer topic 010303FEAABBCCDD

2.4 Blinking command

See command find device 0x02

2.4.1 *LoRaWAN sample*

10s single Green blinking (500ms ON, 500ms OFF)

Request

```
02000000000000A000103 0A0A 02 00FF0000FF00
```

- `000A` — Blinking duration (in seconds) If 0xFFFF, blinking unlimited
- `0A0A` — Time LED ON (1 byte) and LED OFF (1 byte) (multiple of 50ms)
- `00FF0000FF00` — LED color. Our device has 2 LED, define color for each one. 3 bytes for each LED

Unlimited time 3 colors blinking Blue/White/Red

Request

```
02000000000FFFF 00 03 030A0A0C0A0A300A0A06 0000FF0000FF FFFFFFFFFFFF FF0000FF0000
```

- `FFFF` — Blinking duration (in seconds) If 0xFFFF, blinking unlimited
- `00` — Cycles number
- `03` — 3 different cycles. Each with 500ms ON & 500ms OFF. With different HW colors
- `0000FF0000FF` — 1st Blue color. We define the 2 LED color
- `FFFFFFFFFFFF` — 2nd White color
- `FF0000FF0000` — 3rd Red color

LoRaWAN answer : `8200572A0ED02800572A0ED0FF`

2.4.2 CloverNet sample

Publication Topic: {{CloverMAC}}/CScommand/

Where : **CloverMAC** is the **CloverNet** mac number of the CloverNet gateway (format = AA:BB:CC:DD)

Sample topic: *01:38:65:45/Cscommand/*

CloverNet Downlink data sample : (target device serial number = AABBCCDD)

0104020506020C1C29010A2A01010D0105010D00AABBCCDD00000000000000000010202020000000000A0001030A0A0200FF0000FF00

	Label or content	**Frame concatenation**
Prefix	CloverNet header	010402050D010529010A2A010106020C1C010D00AABBCCDD0000000000000000010202
Command header		02
Blinking sequence	10s single Green blinking	00000000000A0001030A0A0200FF0000FF00

CloverNet answer :

RxMode=Point-to-Point, QoS=-32Dbm, Congestion=0x00, RTC=22-07-19 12:22:51, NMac=01:D4:60:B0, Rep1 NONE, Rep2 NONE, ServiceType=0x00, ProductType=0x0033, payload=8200572A0ED02800572A0ED0FF

2.5 Enable MOTION detection on source 1

MOTION mode enables ACS-Report-Led to detect a basic movement like a shock or a shake.

2.5.1 LoRaWAN sample

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

2.5.1 CloverNet sample

Publication Topic: {{CloverMAC}}/CScommand/

Where : **CloverMAC** is the **CloverNet** mac number of the CloverNet gateway (format = AA:BB:CC:DD)

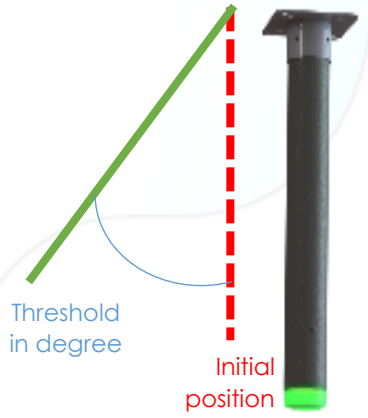
Sample topic: *01:38:65:45/Cscommand/*

CloverNet Downlink data sample : (target device serial number = AABBCCDD)

0104020506020C1C29010A2A01010D0105010D00AABBCCDD00000000000000000010202040302828
0008000900103600F07020205010F05000000000258012C

	Frame concatenation
CloverNet header	0104020506020C1C29010A2A01010D0105010D00AABBCCDD0000000000000000010202
Command header	04
Motion mode on source 1	0302828000800090010360 0F07020205010F05000000000258012C

2.6 Enable TILT detection on source 1



VERTICAL MOVE

2.6.1 LoRaWAN sample

Request
040302828000800090010461 0C37000A00140002020000000 0

LoRaWAN answer 840302009000610 0

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*)

After setting your TILT mode, you must make a reference initialization with 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

2.6.2 *CloverNet sample*

Publication Topic: {{CloverMAC}}/CScommand/

Where : **CloverMAC** is the **CloverNet** mac number of the CloverNet gateway (format = AA:BB:CC:DD)

Sample topic : 01:38:65:45

CloverNet Downlink data sample : (target device serial number = AABBCCDD)

0104020506020C1C29010A2A01010D0105010D00AABBCCDD00000000000000000010202040302828
0008000900104610C37000A001400020200000000

	Frame concatenation
CloverNet header	0104020506020C1C29010A2A01010D0105010D00AABBCCDD0000000000000000010202
Command header	04
Tilt mode on source 1	0302828000800090010461 0C37000A001400020200000000

Do a reference position with the applicative command 0x34

0104020506020C1C29010A2A01010D0105010D00AABBCCDD00000000000000000010202340000

	Frame concatenation
CloverNet header	0104020506020C1C29010A2A01010D0105010D00AABBCCDD0000000000000000010202
Command header	34
All mode	0000

3 Payloads

3.1 Event frames

REMINDER ***Allocated frame headers are 0x68 and 0x69.***
They will be used for respectively short and standard frame type.
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

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

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

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 45 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			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			Position source 2		

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

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 and 0x6D.***
They will be used for respectively short and standard frame type.
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

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`

3.3 Keep alive frames

REMINDER ***Allocated frame headers are 0x78 and 0x79.***
They will be used for respectively short and standard frame type.
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 (Blinking command)
0x03	Read parameters
0x04	Write parameters
0x17	Launch installation process

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 of 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 (0X02) – Find device

Request format

FH	RTC_DEF	RTC			FD_DUR		FD_ACTIONS
0	1	2 4			5 6		7
0x02		MSB	MDL	LSB	MSB	LSB	

NB_CYCLES	C1_CONF*			C2_CONF*			C3_CONF*			C4_CONF*		
[1B]	[3B]			[3B]			[3B]			[3B]		
	MSB		LSB	MSB		LSB	MSB		LSB	MSB		LSB

NB_HW_CONF	HW1_CONF**			...	HW7_CONF**		
[1B]	[3B]			...	[3B]		
	MSB		LSB	...	MSB		LSB

(*) Cx_CONF fields presence depends on NB_CYCLES. If NB_CYCLES = 0 no Cx_CONF fields.

(**) HWx_CONF fields presence depends on NB_HW_CONF. If NB_HW_CONF = 0 no Hx_CONF fields.

RTC_DEF ..... contains flag for the specifities of RTC using

RTC_DEF							
b7	b6	b5	b4	b3	b2	b1	b0
0 -> RTC_DEF is replaced by the MSB of the RTC. 1-> RTC_DEF in use	RFU	RFU	RFU	0 -> don't care 1 -> RTC become a delay in seconds	000 -> RTC FULL MATCH or RTC 0x000000 immediate start 001 -> Mod 15s 010 -> Mod 60s 011 -> Mod 5mins 100 -> Mod 30mins 101 -> Mod 60mins 110 -> Mod 12hrs 111 -> Mod 24hrs		

RTC..... RTC time when the identification process has to be launched. Refer to RTC_DEFto know if RTC is an RTC or a delay.
If RTC_DEF + RTC are both set to 0x00000000, locate process is launch immediately.

FD_DUR.....duration of the find device process [sec]
0x0000 means that we want to stop current process. In this case, other mandatory fields are not relevant but at least FD_CONF must be included in frame.
0xFFFF means current process will run up to manual stop.

FD_ACTIONS.....configuration of actions executed in parralele during the complete process

FD_ACTIONS							
b7	b6	b5	b4	b3	b2	b1	b0
Locator	HW7	HW6	HW5	HW4	HW3	HW2	HW1

If LOCATOR is set, locator push mode is activated during the complete process.
If HWx is set, HW_X is activated during the complete process.

NB_CYCLES.....indicates the number of Cx_CONF fields brought by the request just after this register (from 0 to 4).

Cx_CONF.....configuration of cycles

Cx_CONF									
b23	b22	b21	b20	b19	b18	b17	b16	b15-8	b7-0
-	HW7	HW6	HW5	HW4	HW3	HW2	HW1	DUR	DEL

HWx bit defines if the corresponding one shines during the cycle.
DUR defines duration of HWx activation [x50ms]
DEL defines delay after HWx deactivation HWx (delay before next cycle) [x50ms]

NB_CONF.....indicates the number of HWx_CONF fields brought by the request just after this register (from 0 to 7).

Reply format

FH	CURRENT RTC	RTC START
0	1.....6	1.....6
0x82	With Sub seconds	With Sub seconds

CURRENT RTC.....6 bytes RTC conatianing the sub seconds on 2 bytes LSB

RTC START.....0xXXXXXXXXXXXX = RTC with subseconds on which the locate process will start
0x0000000000FF = A blinking process is already on going
0x0000000000FE = An error occurred in the frame format
0x0000000000FD = Application rejects process (HW not available, application busy)

4.2.4 (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`.

4.2.5 (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.***

4.2.6 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:

03010182 00840080

Request format

FH	VALUE		
0	1.....4		
0x12	MSB		LSB

VALUE.....signed value, number of seconds used to add to RTC

Reply format

FH	STATUS
0	
0x92	

STATUS.....0x00 : RTC update success
0xFF : RTC update failed

4.2.7 (0x17) -Launch installation process

NOTE ***This request can be sent only by Clover-Net.***

Receiving this frame has the same effect as we have installation request by reed/button.

Request format

FH	MODE	PER	NB
0	1.....4	5.....6	7
0x17			

MODE .....“INST_MODE” parameter value. If set to 0, current value is used else value is written.

PER .....“INST_PER” parameter value. If set to 0, current value is used else value is written.

NB.....“INST_NB” parameter value. If set to 0, current value is used else value is written.

NOTE ***In current version, only one attempt is executed so PER and NB parameters are not managed.***

Immediate Reply format

FH	TYPE	STATUS
0	1	2
0x97	0x00	

STATUS.....Installation launching status:

0x00: Installation ongoing
0xFF: Error in frame format

Following Reply format

FH	TYPE	STATUS	DEV_STAT
0	1	2	3.....4
0x97	0x01		

STATUS.....Installation status:

0x00: Installation finished, network required connected
0xFF: Installation finished, at least one required network not connected

DEV_STAT .....See definition of parameter DEV_STAT

4.3 Applicative commands list

Frame header	Description
0x34	Start references initialization

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

5 Downlinks : some samples

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

5.1 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*

5.2 Force LoRaWAN frame send

This command can trigger a spontaneous frame from ACS-Report-LED device.
For example, we will trigger a periodic picture with header 0x6D.

See section generic command details: Trigger spontaneous frame

5.2.1 LoRaWAN sample

Request	006DFF0202
LoRaWAN answer uplink	8000

5.2.2 CloverNet sample

Publication Topic: {{CloverMAC}}/CScommand/

Where : **CloverMAC** is the **CloverNet** mac number of the CloverNet gateway (format = AA:BB:CC:DD)

CloverNet Downlink data sample : (target device serial number = AABBCCDD)

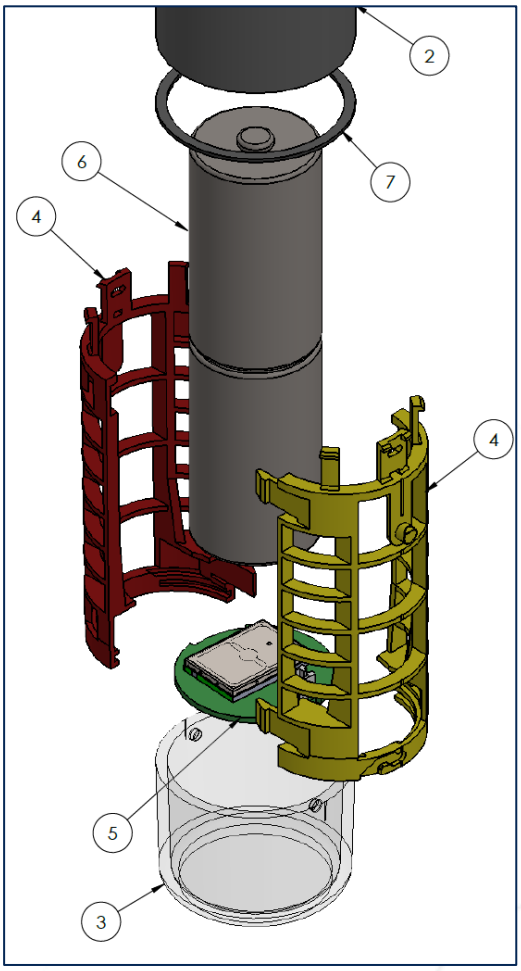
0104020506020C1C29010A2A01010D0105010D00AABBCCDD00000000000000000010202006DFF0202

	Frame concatenation
CloverNet header	0104020506020C1C29010A2A01010D0105010D00AABBCCDD0000000000000000010202
Command header	00
Tilt mode on source 1	6DFF0202

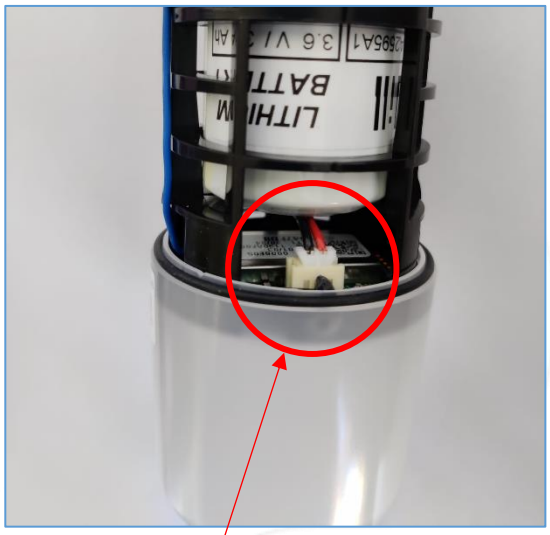
6 Battery replacement and initialization

6.1 Battery replacement

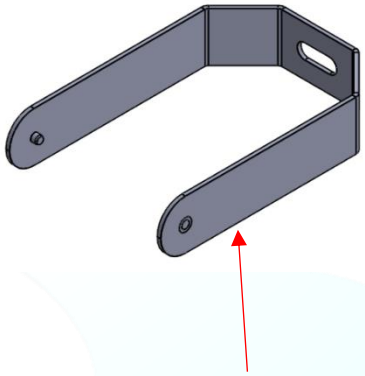
Battery reference: double pack with SAFT LS33600



Replace the battery with a new one



Power connector



Battery replacement is done in 3 steps:

1 Remove the inner chassis from the product by first unclipping it with the tool provided for this purpose

2 Disconnect and remove the battery pack

3 Insert the new battery pack and reconnect the power connector

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

Frame header	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	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	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 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)

0x08	INST_PER	2	**Installation attempt period** Expressed in minutes ***Default value:*** *0x0005 (5 minutes period)*
0x09	INST_NB	1	**Number of installation attempt** When requested by Launch installation process command ***Default value:*** *0x01 (1 installation attempt)*
0x0A	CN_CONFIG	2	**Clover-Net configuration word** Corresponds to the Core param 0x10. In particular applications, this can be only default configuration and can be overridden by other params. ***Default value:*** *0x10CD*
0x68	**CN_PIN_CD** [RW-PS]	4	**Clover-Net PIN CODE** Pin code used to generate an AES128 Key pushed in core param 0x38. ***Default value:*** *0x31323334*

7.1.2 Event frame parameters

Frame header	Name	Size	Description
0x22	EVT_TYPE	1	**Event frame default type** 0x00 Disabled 0x01 ...Short event frame 0x02 ...Standard event frame 0x03 ...Long event frame 0x04 ...Special event frame ***Default value:*** *0x02 (Standard event frame)*
0x23	EVT_MODE	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:*** *0x08 (LoRaWAN confirmed)*
0x24	EVT_DEL1_RNG	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	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	1	**Event frame extender timeout** ***Default value:*** *0x01 (1 minute)*
0x27	EVT_PRTY	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** 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

Frame header	Name	Size	Description
0x3F	KA_TYPE	1	**Keep alive frame default type** Corresponds to the frame type described in section. 0x00 ...Disabled 0x01 ...Short keep alive frame 0x02 ...Standard keep alive frame 0x03 ...Long keep alive frame 0x04 ...Special keep alive frame ***Default value:*** *0x01 (Short keep alive frame sent)*
0x40	KA_MODE	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	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:*** *0x003C (1min delayed maximum)*
0x42	KA_REP	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:*** *0x03 (3 frames sent)*
0x43	KA_EXT_TOUT	1	**Keep alive frame extender timeout** ***Default value:*** *0x01 (1 minute)*
0x44	KA_PER	2	**Keep alive sending period** Expressed in multiple of 30 seconds ***Default value:*** *0x0B40 (24 hours)*

0x45	KA_PRTY	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

Frame header	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:*** *0x001B (Motion, Magnetic field and Operating temperature monitored, Reinitialization of references enabled)*
0x58	**DI_STAT** [RO-P]	2	**Device integrity event enabled** 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	**LED low battery threshold** The parameter ID and size are generic. 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. 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 celcius] ***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 celcius] ***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 celcius] ***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_SHO_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:*** *0x07020205010F05000000000258012C (No On Delay, No Start Delay, 10 min. Continuous Delay, 5 min. Stop Delay)*

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:** 0x37000A00C8001E0200000000
0x63	**TILT_REF** [RO-P]	6	**Tilt reference position** **Default value:** 0x000000000000
0x64	**TILT_POS** [RO-P]	6	**Tilt current position** **Default value:** 0x000000000000

0x65	**MAG_REF** [RO-P]	6	**Magnetic reference position** **Default value:** 0x000000000000
0x66	**MAG_POS** [RO-P]	6	**Magnetic current position** **Default value:** 0x000000000000
0x69	**CORE_FLAGS** [RO-P]	2	**CloverCore internal flags** *Expert use only* **Default value:** 0x0000

7.2 Application parameters list

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

7.2.1 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 ....Relaunch TILT, MAGNETIC or TOF sampling on spontaneous frame triggered by RF b0 ....References' initialization is executed on a success installation process ***Default value:*** *0x0003*
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** b7-4 .reserved 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:** 0x00
0x84	**BCONF_STAT** [RO-V]	1	**Bad configuration status** TBD ***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*

7.2.2 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*

7.2.3 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 0x06... Pyroelectric/Passive InfraRed (PIR) sensing 0x07... Time of Flight (TOF) InfraRed sensing 0x08... BLE scan 0x09... Weighing ***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 0x06... Pyroelectric/Passive InfraRed (PIR) sensing 0x07... Time Of Flight (TOF) InfraRed sensing 0x08... BLE scan 0x09... Weighing ***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*

4.2.5 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*

4.2.6 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*

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.

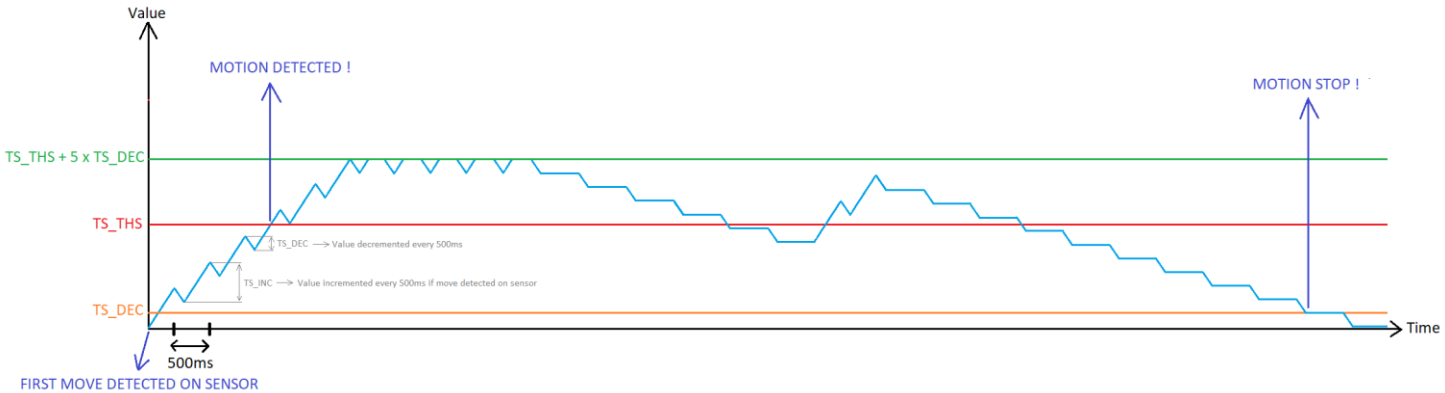
If Motion stop before Motion Start event is generated, it is considered that there was no motion at all (i.e. there is no Motion Stop event too).

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.

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		