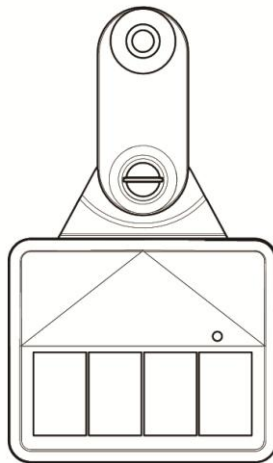


LT-10

Development Document



Version: 1.0

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1. Introduction

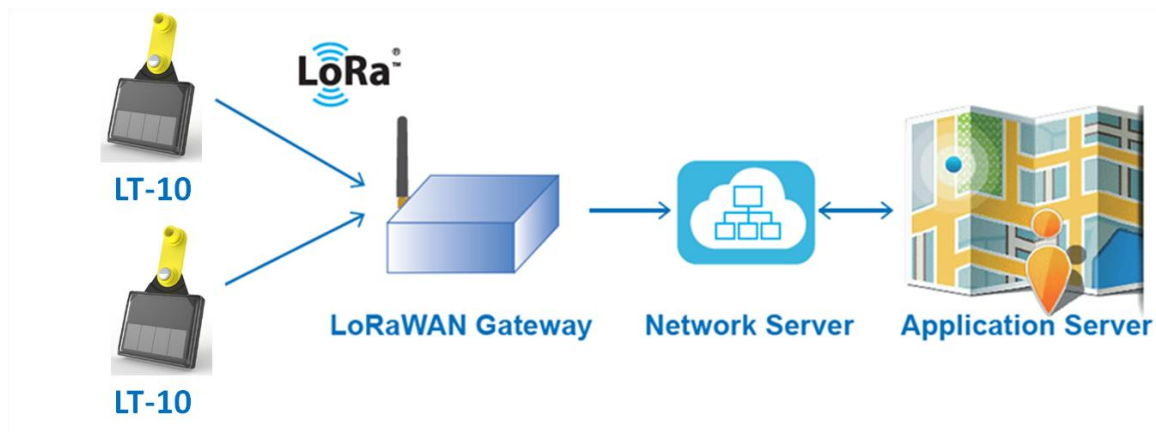
The LT-10 is a LoRaWAN compliant light solar tracker. The device has a solar panel for charging by sunlight. The high performance solar panel can provide sufficient power for continuous LoRa transmission.

Features:

- High performance solar panel to provide continuous charging for internal battery
- Provide periodic battery status messages to server
- Built-in 3 axis accelerometer for motion detector
- Configurable setting by GlobalSat configuration App via BLE
- Power Low alert
- IPX7 waterproof rating

2. Gateway Setup

LT-10 could send data via LoRa[®] technology. Please refer to the following diagram.



Before starting communication LoRaWAN[™] gateway and LT-10 LoRa[®] trackers, please refer to [LoRaWAN[™] gateway's user manual](#) to set the LoRa[®] settings by GlobalSat Configuration App.

3. Protocol Summary

3.1 Report Messages Format

3.1.1 Tracking Report Format

Tracking report format of report messages:

Protocol Version	Command ID	Longitude	Latitude	GPS Fix Status & Report Type	Battery Capacity	Reserved
80 1 byte	02 1 bytes	3 bytes	3 bytes	1 byte	1 byte	1 byte

GPS fix status & report type:

GPS Fix Status	Report Type
Bit5~Bit7	Bit0~Bit4

Parameters of Report Message

Parameters	Description
GPS-fix Status	00=not fix, 01=2D fix, 10=3D fix
Report Type	2=Periodic mode report 4=Motion mode static report 5=Motion mode moving report 6=Motion mode static to moving report 7=Motion mode moving to static report 15=Low battery alarm report
Longitude	Int24 (24-bit signed integer) (Little Endian) Formula is $24\text{-bit_value} * 215 / 10^7 =$ longitude_in_decimal_degrees
Latitude	Int24 (24-bit signed integer) (Little Endian) Formula is $24\text{-bit_value} * 108 / 10^7 =$ latitude_in_decimal_degrees
Battery Capacity	8-bit unsigned integers unit: percent capacity %

Example1: The period report is 80 02 9E 38 56 00 51 23 42 43 18.

Protocol version: 80

Command ID: 02 => Tracking report

Longitude: 9E3856 => (to Big Endian) 0x56389E => (Int24 to Decimal) 5,650,590
 $(5,650,590 * 215) / 10^7 = 121,487,685 * 0.000001 = 121.487685^\circ$

Latitude: 005123 => (to Big Endian) 0x235100 => 2,314,496
 $(2,314,496 * 108) / 10^7 = 24,996,556 * 0.000001 = 24.996556^\circ$

GPS-fix Status: 0x42 => 66 / 32 = (get bit5~bit7) 2 => 3D Fix

Report Type: 0x42 => 66% 32= 2 => (get bit0~bit4) Periodic mode report

Battery Capacity: 0x43 => 67 %

Reserved: 18

Example2: The period report is 80 02 1F 53 FB 00 51 23 45 62 16.

Protocol version: 80

Command ID: 02 => Tracking report

Longitude: 1F53FB => 0xFB531F => 16,470,815
 (two's complement) -0x4ACE1 = -306,401
 $(-306,401 * 215) / 10^7 = -6,587,621.5 * 0.000001 = -6.5876215^\circ$

Latitude: 005123 => 0x235100 => 2,314,496
 $(2,314,496 * 108) / 10^7 = 24,996,556 * 0.000001 = 24.996556^\circ$

GPS-fix Status: 0x45 => 69 / 32 = (get bit5~bit7) 2 => 3D Fix

Report Type: 0x45 => 69% 32= (get bit0~bit4) 5 => Motion mode moving report

Battery Capacity: 0x62 => 98 %

Reserved: 16

3.2 Command Format

Set device

Protocol Version	Command ID	Data Length	Parameters	Carriage Return and Line Feed (CR and LF)
0C (1 Byte)	0800 (2 Bytes)	Include the length of command code word (parameter) and CR+LF (1 Byte)	L2(parameters) Refer to 3.3 Configuration Parameters	0D0A (2 Bytes)
<p>Example:</p> <p>Set device to disable GPS</p> <p>L2(C1=60)</p> <p>Please transfer this command by ASCII to Hex format as following.</p> <p>L » 4C</p> <p>2 » 32</p> <p>(» 28</p> <p>C » 43</p> <p>1 » 31</p> <p>= » 3D</p> <p>6 » 36</p> <p>0 » 30</p> <p>) » 29</p>				
0C	0800	0A	4C322843313D363029	0D0A

Send downlink command '0C08000A4c322843313d3630290D0A' to device for GPS disable.

3.3 Configuration Parameters

Most behaviors of LT-10 could be changed by Configuration Parameters. You could change the setting of configuration parameters by GlobalSat Configuration App or by sending downlink command.

Configuration Parameters					
		Code word	Parameters	Type	Description
Main	Device	O0	Enable/Disable Power Off	1/0	0=disable 1=enable Default=1
		O4	Power on operating mode	u8	2=Periodic 4=Motion Default=2
		O7	Firmware version	char(28)	Read only
	Other setting	Gt	G-sensor sensitivity for motion detection	u8	5=high, 10=medium, 25=low Default=10
		O1	Interval for triggering motion sensor	u16, in seconds	1 ~ 100 Default=5
GPS	GPS	CD	enable/disable GPS	1/0	0=disable 1=enable Default=1
		C1	The time to get GPS-fix if LT-10 got GPS-fix over 1 hour ago	u16, in seconds	30 ~ 600 Default=120
		C2	The time to get GPS-fix if LT-10 got GPS-fix within 1 hour	u16, in seconds	10 ~ 120 Default=40

Communication	Acknowledgement	A1	Wait confirmation from gateway after sending message to gateway	1/0	0=disable 1=enable Default=0
		A6	Number of re-sending reports without getting ACK from gateway	u8	1~8 Default=1
Tracking	Period	P0	Report interval of period report	u32, in seconds	>=600 Default=3600
	Motion	R0	Report interval in static state	u32, in seconds	>=600 Default=3600
		R1	Report interval in moving state	u32, in seconds	>=600 Default=3600

LoRaWAN	LoRaWAN Parameters	D5	LoRaWAN ADR	1/0	0=disable 1=enable Default=0
			Enable Duty Cycle	1/0	0=disable 1=enable US Default=0 EU & AS923 Default=1
			Join Mode	1/0	0=ABP 1=OTAA Default=0
			DevEui	8 bytes Hex	It is the same as LoRa MAC sticker on device.
			AppKey	16 bytes Hex	[For OTAA mode] Default= 0123456789ABCDEFEFCDAB8967452301
			AppEui	8 bytes Hex	[For OTAA mode] Default= 000DB5AA00000010
			NwkSKey	16 bytes Hex	[For ABP mode] Default= 28AED22B7E1516A609CFABF715884F3C
			AppSKey	16 bytes Hex	[For ABP mode] Default= 1628AE2B7E15D2A6ABF7CF4F3C158809
			DevAddr	4 bytes Hex	[For ABP mode] It's the last 4 bytes of LoRa MAC sticker on device.
			RxDelay1	int, in μ s	800000~1200000
			Rx1_OpenTime	Int, in ms	US & AS923: 150 ~ 800 EU: 250~800
			Rx2_OpenTime	Int, in ms	US & AS923: 150 ~ 800 EU: 250~800

4. Communication

4.1 Acknowledgement

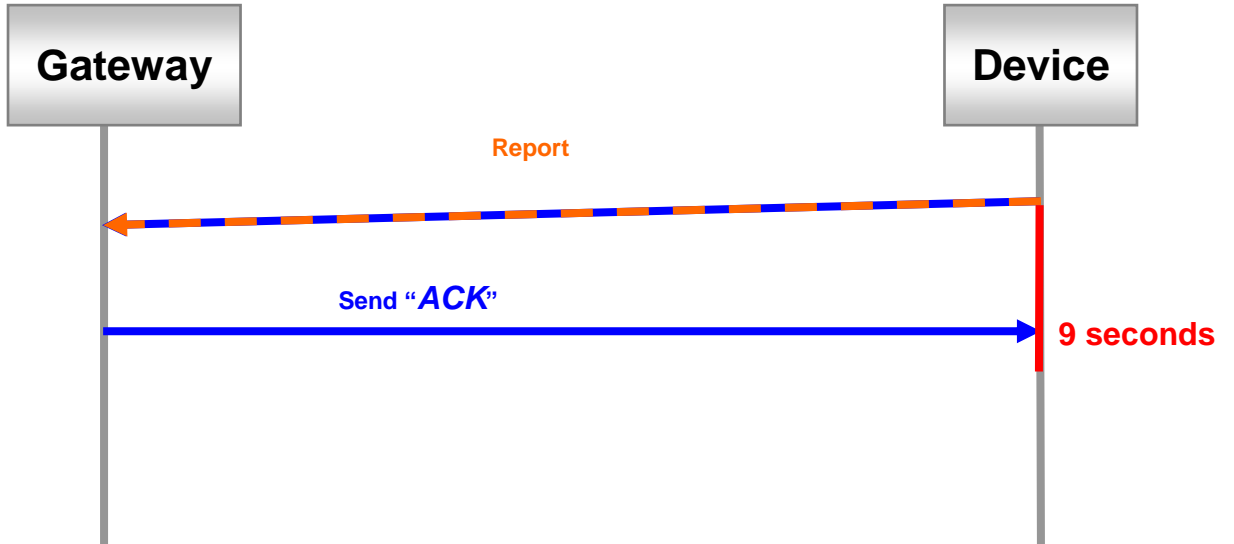
Acknowledgement is the acknowledge receipt used to confirm if gateway receive the report from device.

The following parameters must be set to enable/disable acknowledgement.

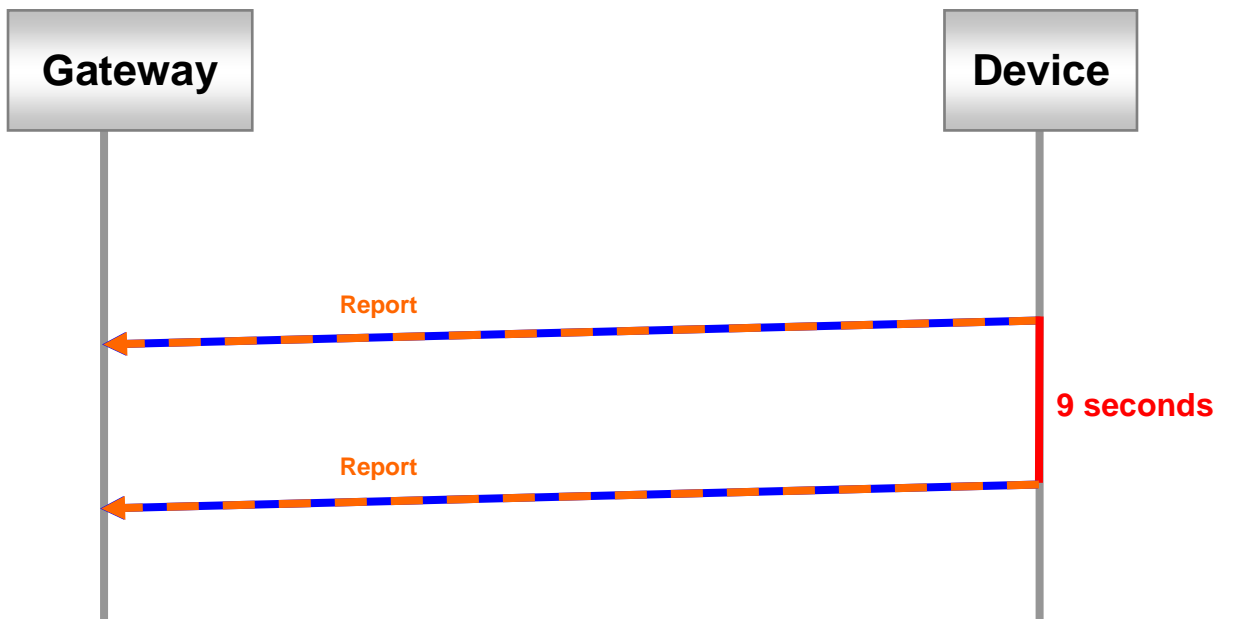
Code word	Parameters	Value	Description
A1	Wait confirmation from gateway after sending message to gateway	1/0	0=disable 1=enable Default=0
A6	Number of re-sending reports without getting ACK from gateway	u8	1~8 Default=1

4.1.1 Receive Acknowledgement from Gateway

Receive ACK from gateway within 9 seconds:



Not receive ACK from gateway within 9 seconds:



5. Tracking

5.1 Periodic Mode

Periodic mode is for setting an interval for LT-10 to regularly report its location according to the interval. You could set it to be periodic mode by setting parameter O4=2 via configuration App. When it reaches the report time, it will turn on GPS and report the location and concerning information to LoRaWAN™ gateway.

The parameter of periodic mode:

Code word	Parameter	Value	Description
P0	Report interval	u32, in seconds	>= 600 Default=3600

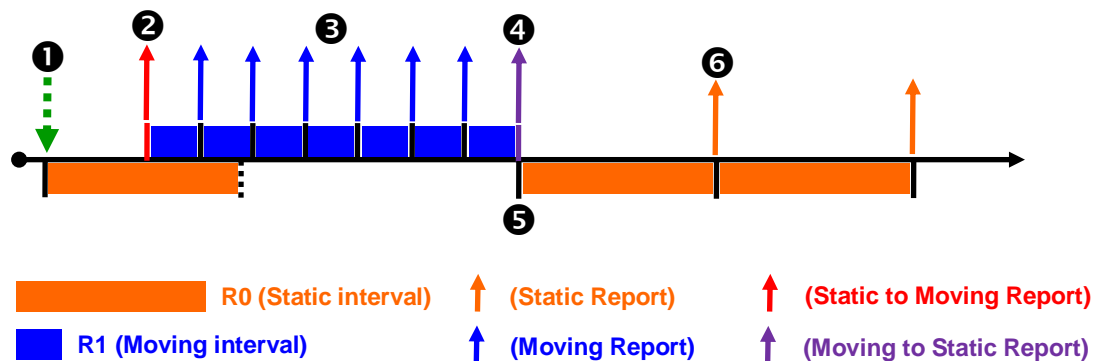
Example:

The periodic report is 800200000000000025916.

5.2 Motion Mode

Motion mode is an economic report mode. Under motion mode, LT-10 will report its location with high frequency when it detects motion (moving state). When it is static, it will report its location with low frequency (static state). It can save the report-transmission fee. Between the moving state and static state, there is a validation state for it not to jump to static state as soon as it does not detect motion.

There are 2 report frequency of motion mode, one is when it detects motion, and the other is when it is static. The behavior is as following:



①	Receive command and then enter motion static mode.
②	When LT-10 detects motion, it will enter motion moving mode and send "static to moving" report.
③	Motion Moving Report.
④	When LT-10 is static, it will send "moving to static" report and then return to the motion static mode.
⑤	Re-start timer for motion static interval.
⑥	Motion Static Report.

You could define the content of report and the report interval of motion mode. You could set LT-10 to be motion mode by setting parameter O4=4 via GlobalSat configuration App.

The parameters of motion mode:

Code word	Parameters	Value	Description
R0	Report interval in static state	u32, in seconds	>= 600 Default=3600
R1	Report interval in moving state	u32, in seconds	>= 600 Default=3600

Example:

The static report is 800200000000000045c18.