LT-100 Series
Development Document

Version: 1.1

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CONTENT

1. Introduction

LT-100 series is LoRaWAN™ compliant RF tracker which includes Asia's first LoRaWAN™ certified module by GlobalSat. It is designed for asset tracking, pet tracking, and personal monitoring of children and elderly. It has built-in Help button for help reports which allows immediate notification to the care giver/monitor. It is also equipped with a high capacity battery which allows up to 3 weeks (by 1 hour report interval) of usage without charging in best condition. LT-100 is fully compatible with LoRaWAN™ compliant gateways, making it the #1 choice for tracking application under the LoRaWAN™ network.

Features:

- **Configurable period report and motion report**
- **Power Low/Off alert (Vibration/buzzer)**
- **Support both OTAA and APB mode**
- **Help reports**
- **Fall advisory reports (LT-100HP/LT-100EP only)**

Comparison of LT-100 Series

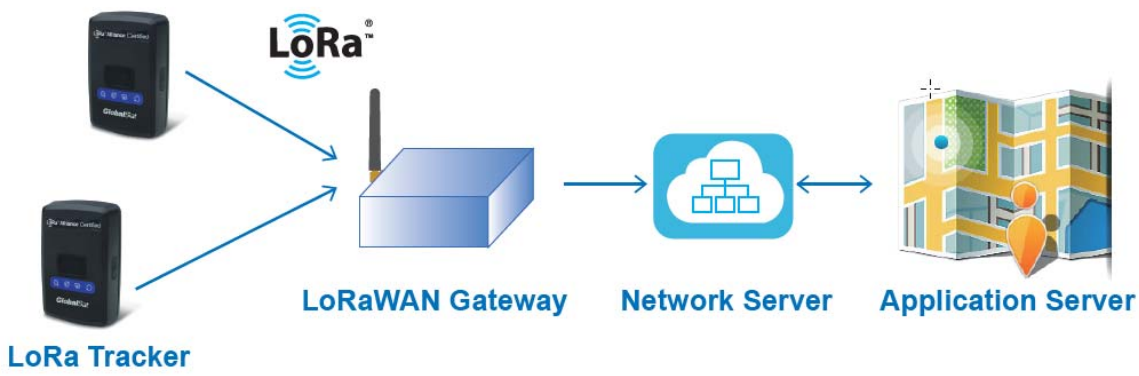
Model/Function	Fall Advisory	GPS
LT-100H/LT-100E	X	O
LT-100HP/LT-100EP	O	O
LT-100HS/LT-100ES	X	X

Note: All the GPS regarding function would not be applied on LT-100HS/LT-100ES.

This document describes the communication protocol between LT-100 tracker and the LoRaWAN™ gateway/NS, the built-in behavior modes of LT-100, and the function of each parameter.

2. Gateway Setup

LT-100 could send data via LoRa® technology. Please refer to the following diagram.



Before starting communication LoRaWAN™ gateway and LT-100 LoRa® trackers, please refer to the LoRaWAN™ gateway's user manual to set the LoRa® settings described on "4. LoRa® settings" by GlobalSat-LT-100 Config Tool.

3. Protocol Summary

3.1 Report Messages Format

Report format of report messages:

Format Type	GPS Fix Status & Report Type	Battery Capacity	Latitude	Longitude
1 byte	1 byte	1 byte	4 bytes	4 bytes

GPS Fix Status & Report Type:

GPS Fix Status	Report Type
Bit6~Bit7	Bit0~Bit5

Parameters of Report Message	
Parameters	**Description**
Format type	00
GPS-fix Status	00=not fix, 01=2D, 10=3D
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 14=Help report 15=Low battery alarm report 17=Power on (temperature) 19=Power off (low battery) 20=Power off (temperature) 24=Fall advisory report 27=Fpending report
Battery Capacity	xxx unit: percent capacity
Latitude	xx.xxxxxx unit: degree

Longitude	xxx.xxxxxx unit: degree

For example, our received payload is 00825b017d6b19073dc188.

Format Type: 0x00
GPS-fix Status: 0x82 ＝＞ 130 / 64 = 2 ＝＞ 3D Fixed
Report Type: 0x82 ＝＞ 130 % 64 = 2 ＝＞ Periodic mode report
Battery Capacity: 0x5b ＝＞ 91 %
Latitude: 0x017d6b19 ＝＞ 24,996,633 x 0.000001 = 24.996633˚
Longitude: 0x073dc188 ＝＞ 121,487,752 x 0.000001 = 121.487752˚

3.2 Command Format

The command of LT-100 series begins with header, and followed by the command code word and then end with a carriage return and line feed. The header, command code word (with or without parameters), and the carriage return and line feed must be in hexadecimal format. For changing parameters by commands, please change by the tracking mode command that the device is running. For example, when device is period mode (M2), please change the parameters by M2 command and affix the parameter posterior to the command code word, like M2(parameter=value) When device is standby mode (M7), please change the parameters by M7 command and affix the parameter posterior to the command code word, like M7(parameter=value)

Header	Data Length	Command Code Word & Parameters	Carriage Return and Line Feed (CR and LF)
0C 08 00 (3 Bytes)	Include the length of command code word (parameter) and CR+LF (1 Byte)	Refer to the Code Word Table and 3.3 Configuration Parameters	0D 0A (2 Bytes)
Example: Set device to be period mode with report interval of 30 seconds [Command code word and parameter is M2(P0=30)]			
0C0800	0B	M2(P0=30)	0D0A
Example: Set device to be motion mode with moving interval of 30 seconds and static interval of 600 seconds[Command code word and parameter is M4(R0=600,R1=300)]			
0C0800	13	M4(R0=600,R1=300)	0D0A
Example, Vibrate and beep device for 5 seconds [Command code word and parameter is N3(OD=5,OE=5)]			
0C0800	0F	N3(OD=5,OE=5)	0D0A

Command's Code word		
Code word	**Parameters**	**Description**
M7	**Set Standby Mode**	
M2	**Set Periodic Mode**	
M4	**Set Motion Mode**	
N1	**Ping**	**(Class C)**
N3	**Trigger vibration or beep**	**Trigger vibration: N3(OE=)** **Trigger beep: N3(OD=)**
Na	**Dismiss help report**	
Nf	**Dismiss fall advisory Report**	
LA	**Restore default configuration**	**Restore all parameters to factory value**

3.3 Configuration Parameters

Most behaviors of LT-100 could be changed by Configuration Parameters. You could change the setting of configuration parameters by the following method.

Connect LT-100 to personal computer via charging clip and USB cable and then set the configuration parameters by "GlobalSat-LT-100 Config Tool".

Configuration Parameters					
		Code word	Parameters	Type	Description
Main	Device	O0	Enable/disable power key	1/0	1=enable power key 0=disable power key Default=1
		O4	Power on operating mode	u8	2=Periodic 4=Motion Default=2
		O7	Firmware Version	char(28)	Read only
		O8	Enable/Disable Battery low LED light	1/0	1=enable LED 0=disable LED Default=1
		O9	Enable/disable GPS/ LoRa LED function	1/0	1=enable LED 0=disable LED Default=1
	Power	J8	Enable/disable LT-100 to automatically power on when power capacity is charged to the capacity of J1	1/0	0=disable 1=enable Default=1 **Note: If J8 is set to 0, please wait for 10 seconds after connecting LT-100 to power and then turn on device.**

	Other setting	Gt	G-sensor sensitivity	u8	5=high, 10=medium, 25=low Default=10
		O1	Interval for triggering motion sensor	u16, in seconds	1 ~ 100 Default=5
		OD	Interval of beep	u16, in seconds	0~60,000, 0=disable Default=60,000, continuously beep
		OE	Interval of vibration	u16, in seconds	0~60,000, 0=disable Default=60,000, continuously vibrate
GPS	GPS	C0	GPS always on	1/0	0=disable 1=enable Default=0
		C1	The time to get GPS-fix if LT-100 got GPS-fix over 1 hour ago	u16, in seconds	60 ~ 600 Default=120
		C2	The time to get GPS-fix if LT-100 got GPS-fix within 1 hour	u16, in seconds	10 ~ 120 Default=30
		C3	GPS fix time before sending the first report	u16, in seconds	0 ~ 600 If "C3"=0, disable first report message. Default=30
		C8	Maximum GPS off time	u16, in seconds	0 ~ 65535 Default=10800
Communication	LoRa	D0	LoRaWAN device address	char(8)	Read only. Use LM-130 default LoRa MAC's last 8 digits as the DevAddr.
		D5	LoRaWAN ADR	1/0	0=disable 1=enable Default=1
		D8	LoRa module firmware version	char(20)	Read only
		D9	LoRaWAN DevEUI	char(16)	Read only
		DC	LoRaWAN Class	u8	0,2 0=Class A

					2=Class C Default=0
		DD	Enable/disable Fpending	1/0	0=disable 1=enable Default=1

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	Range:1~8 Default=2
Tracking	Period	P0	Report interval of period report	u32, in seconds	>=10 Default=60
	Motion	R0	Report interval in static state	u32, in seconds	>=10 Default=3,600
		R1	Report interval in moving state	u32, in seconds	>=10 Default=30
		RH	GPS always on in moving state	1/0	0=disable 1=enable Default=1

4. LoRa® Setting

4.1 LoRa® Setting

In order to activate the communication between gateway and device, the LoRa® parameter is necessary to set at the beginning. Please make sure the LoRaWAN™ settings (such as NwkSKey, AppSkKey, AppEui, AppKey) in LT-100 matched with the settings in network server. For detail settings, please refer to "LT-100 Basic Parameter Settings.pdf".
Few LoRaWAN™ parameters are included as the table below.

Code word	Parameters	Value	Description
D0	LoRaWAN device address	char(8)	Read only. Use LM-130 default LoRa MAC's last 8 digits as the DevAddr.
D5	LoRaWAN ADR	1/0	0=disable 1=enable Default=1
D8	LoRa module firmware version	char(20)	Read only
D9	LoRaWAN DevEUI	char(16)	Read only
DC	LoRaWAN class	u8	0,2 0=Class A 2=Class C
DD	Enable/ disable Fpending	1/0	0=disable 1=enable Default=1

Fpending is the function for LT-100 to send Fpending report to network server for network server to send the commands queued at network server to LT-100.

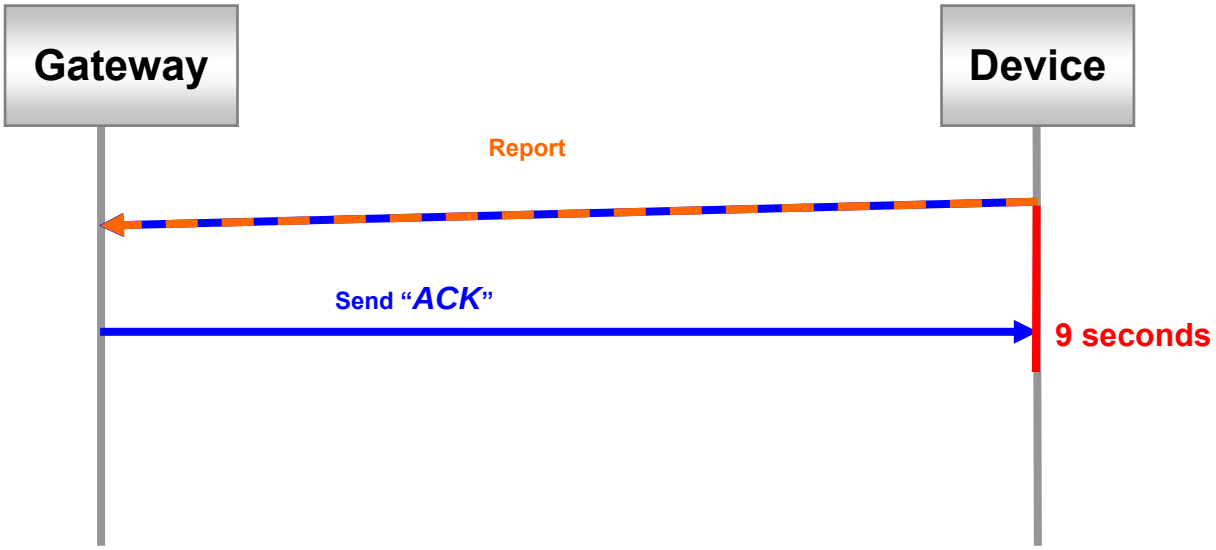
4.2 Acknowledgement

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.

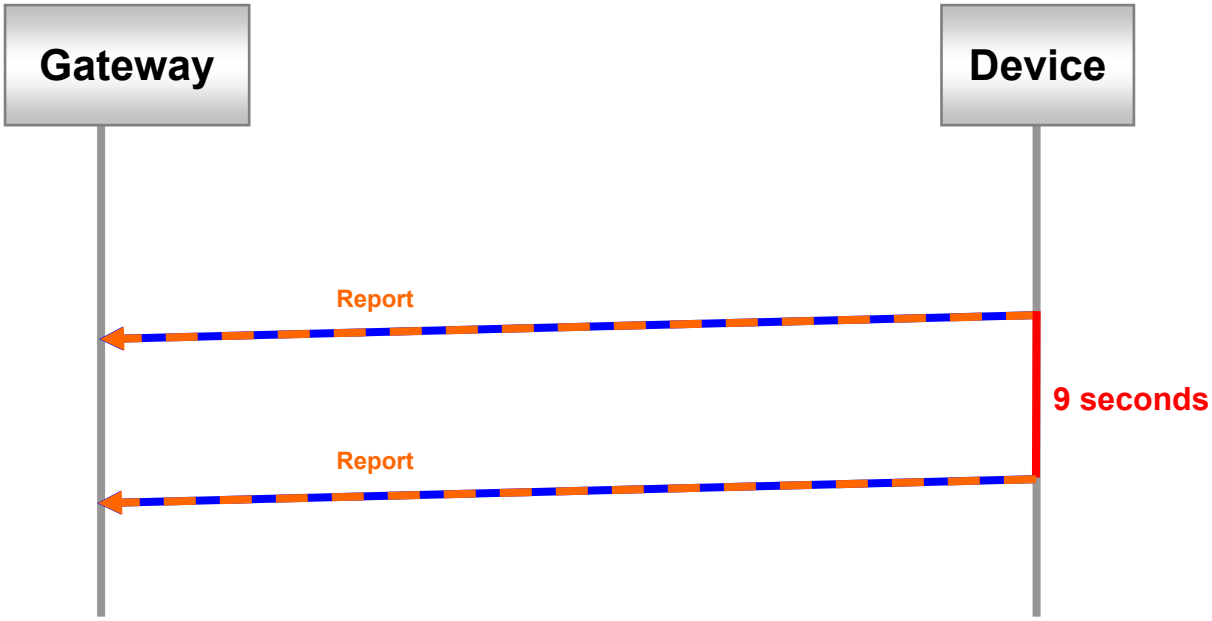
Code word	Parameters	Value	Description
A1	Wait confirmation from gateway after sending message to gateway	1/0	Default=1
A6	Number of re-sending reports without getting ACK from gateway	u8	Range:1~8 Default=2

4.2.1 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-100 to regularly report its location according to the interval. You could set LT-100 to be periodic mode by setting parameter O4=2 via configuration tool. When it reaches the report time, LT-100 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	>= 10 Default=60

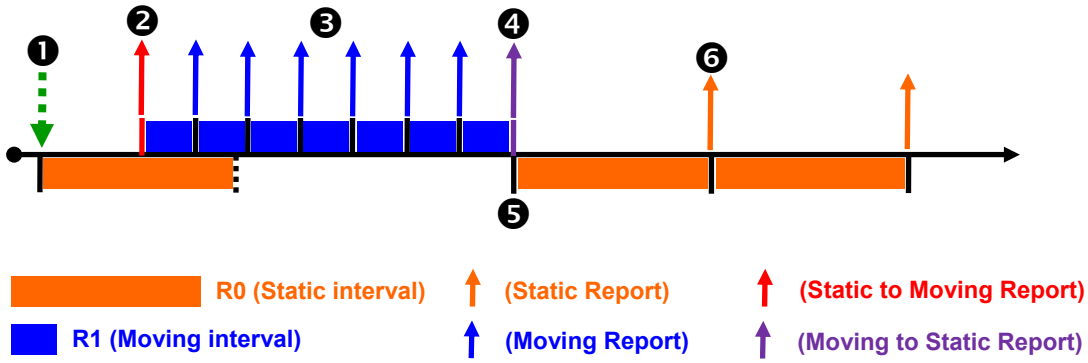
The report type of periodic report is '2'.
Example:
The periodic report 00825e017d6c24073dbbe9

Note:
If P0 is less than 30 seconds, please enable C0 to make sure LT-100 could get GPS fix.

5.2 Motion Mode

Motion mode is an economic report mode. Under motion mode, LT-100 will report its location with high frequency when LT-100 detects motion (moving state). When LT-100 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 LT-100 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 LT-100 detects motion, and the other is when LT-100 is static. The behavior is as following:



❶	Receive command and then enter motion static mode.
❷	When LT-100 detects motion, it will enter motion moving mode and send “static to moving” report.
❸	Motion Moving Report.
❹	When LT-100 is static, it will send “moving to static” report and then return to the motion static mode.
❺	Re-start timer for motion static interval.
❻	Motion Static Report.

You could define the content of report and the report interval of motion mode. You could set LT-100 to be motion mode by setting parameter O4=4 via configuration tool.

The parameters of motion mode:

Code word	Parameters	Value	Description
R0	Report interval in static state	u32, in seconds	>= 10 Default=3600

R1	Report interval in moving state	u32, in seconds	>= 10 Default=30
RH	GPS always on in moving state	1/0	1=enable 0=disable Default=1

The report type of motion static report is '4'.
The report type of motion moving report is '5'.
The report type of static to moving report is '6'.
The report type of moving to static report is '7'.

Example:
The static to moving report 00865e017d6c24073dbbe9
The static report 00845e017d6c24073dbbe9

6. Help Report

When Help button is long pressed, LT-100 would immediately send one help report to LoRaWAN™ gateway. And LT-100/LT-100HP/LT-100EP would try to get GPS fix and send help reports to LoRaWAN™ gateway according to the interval set by G0 parameter till LT-100/LT-100HP/LT-100EP gets GPS fix and gets server acknowledgement. Application server could also send dismiss help report command to stop LT-100 sending help reports.

Code word	Parameters	Value	Description
G0	Interval of sending help report	u16, in seconds	>=1 Default=30

The report type of help report is '14'.

Example:
The help report 008e5d017d6a67073dc1e3

7. Fall-down Advisory

Fall-down advisory is for informing the server that the wearer of LT-100HP/LT-100EP possibly falls down. If fall-down advisory is triggered, LT-100HP/LT-100EP would vibrate and beep. If the wearer does not fall down, the wearer can short press the Help button to dismiss the fall-down advisory within 10 seconds. If it is not dismissed, LT-100HP/LT-100EP would send fall-down advisory report to server till it gets acknowledgement message. The report type of fall-down advisory is 24.
Application server could also send dismiss fall-down advisory report command to stop LT-100HP/LT-100EP sending fall-down advisory reports. But the vibration and beep can only be stopped by short pressing the power button again.

The parameters of fall-down advisory:

Code word	Parameters	Value	Description
JF	Alarm action of LT-100HP/LT-100EP while fall-down advisory is triggered	u8	0=off 1=beep 2=vibration 3=beep+ vibration Default=3
JH	Enable/disable fall-down advisory	0/1	0=disable 1=enable Default=1
JD	Impact force for judging as fall-down	u8	Range=16~128 1G=16, 2G=32…8G=128
JG	Longest duration of movement after impact	u16, in 20 millisecond	Default= 500*20milliseconds=1 second
JI	Smallest duration of keeping static after impact	u16, in 20 millisecond	Default=250*20milliseconds=0.5 second
JK	Minimum changed angle between static state and fall-down	u8 in degree	Range=0~70 Default=60

The report type of help report is ‘24’.
For example, LT-100HP/LT-100EP would send fall-down advisory report to server when fall-down advisory occurs as following 001832017d6c2b073db725