User Manual

For the

JG-LS/JG-L

Trailer Tracking Device

September 18, 2018

R1.2

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Contents

Introduction....3
Hardware Design....4
Basic Hardware....4
Certification and Safety....7
Software Features....7
Basic Software....7
Remote Update....8
Power Modes....8
Report....8
Reset....9
Context Preservation....9
Startup Banner....9
Test Method....10
Hardware....10
Software Test....10
Mechanical Structure(mm)....11
FCC Statement....12

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Introduction

The JG-LSis a self-contained LTE CAT1/3G wireless tracking device targeting trailers. The device combines GPS location with LTE /WCDMA connectivity. It is primarily a location reporting device that responds to requests (user, server) and events generated by timers, geofences, sensors, etc. Data reports consist of a single record that contains all location data and system status.

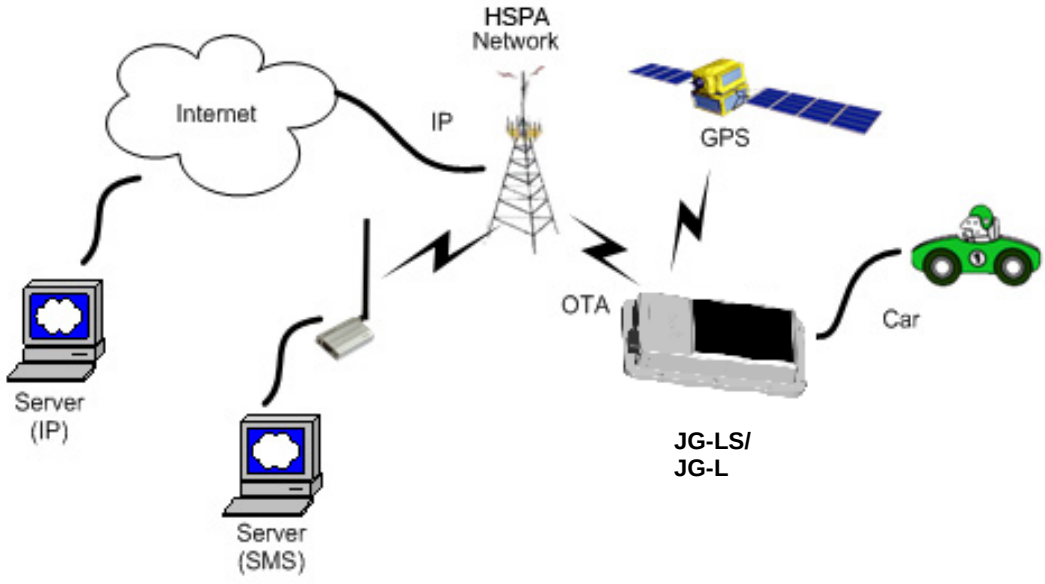
The device comes pre-configured and ready to use from the factory. The JG-LS appears to a user or a server application as a single endpoint device. It can be queried, updated and configured either through a serial connection, or an over the air LTE or WCDMA IP connection, or through SMS messaging. The JG-L Spresents itself over these connections as an enhanced cellular modem with attached functional elements. These elements include:

- GPS location engine
- 2 General Purpose Bidirectional I/O (GPIO) pins
- 1 Relay Output
- 1 Tamper
- 1 1-Wire Bus Interface
- 3.3V Power out for Peripheral Sensors
- Serial UART port
- Input voltages and Battery Voltage monitor
- Timers
- Watchdog lockup protection
- Motion detection
- Power Management

Access to these elements and general-purpose interfaces is done through an extended AT command set. Configuration parameters are stored to flash memory and are automatically used on the next power up event. For more details, please reference the AT Command document.

This device is designed based on the Quectel EC21-A (4G LTE CAT 1/3G fallback,) baseband module. Antennas for cellular and GPS are internal to the device.

Diagram



The device also includes stand-alone GPS functionality, an accelerometer for motion detection, as well as support for solar panel power supply. The JG-LS can operate from an internal rechargeable battery or an external power source. The battery is recharging via the solar panel or external power.

Hardware Design

Basic Hardware

Items	Requirement
Baseband Module	Based on Quectel EC21-A baseband module
Air Interface	Support for LTE B12, B4, B2 WCDMA B2, B4, B5
Frequency	B2(MHZ):TX(1850-1910) RX(1930-1990) B4(MHZ): TX(1710-1755) RX(2110-2155) B12(MHZ): TX(699-716) RX(729-746) B5 (MHZ): TX (824-849) RX (869-894)
Antenna	integral antenna
UIM requirement	Support: 3FF SIM interrupt mode No Support: Hot plug/unplug
GPS Antenna	Dedicate high performance ceramic

	antenna
Power Inputs	12V DC Input（1.7A max current) Main/Aux/Solar inputs
Interface **Voltage/Battery Monitor** **Build in battery manager** **Dedicate Timers**	UART TX/RX
	GPIO1 and GPIO2
	1-Wire Bus Interface
	3.3V Power out
	Internal analog input scaled
Watchdog	Supported
Motion Detect	GPS/G-Sensor
LED	3 LED's (Red, Green, Orange)
Battery	Built in battery（4400mAh Lion）
Working Time	> 40 hours (Continuously On) > 250 days Standby
Power switch	No
Power Cable connector type	23 pin
Power Consumption	< 5 Watts

The JG-LS provides support for specialized hardware features through extended AT commands. The features supported include the following.

GPS

GPS location functionality is provided by the device GPS receiver. NMEA GPS records can be extracted in real time from the unit via the UART connection using special debug commands that are outside the scope of this document.

GPIO

Two general purpose GPIO and two additional multiplexed IO's are presented to the external environment on the main connector. They are capable of providing system interrupts to generate a report or drive logic levels to external devices. These lines are 3.3V logic level and are 16V tolerant. The multiplexed IO's are typically configured as Ignition, Relay and Tamper.

LED's

Three LED status indicators are provided to verify correct installation and operation. The status LEDs are color coded and directly convey the status of the cellular and GPS subsystems, as well as the power input; described in the table below. Their valid operation also indicates operational status and power.

LED	Function	Status
Red	GPS	**On:** GPS satellites acquired and locked **Flash Slow**: GPS satellite search is in progress **Off:** GPS is turned off

Green	Cellular Connection	**On:** Indicates cellulardata connection is available **Flash Slow**: cellular subsystem initialized but no connection **Flash Fast**: cellular initialization in process **Off:** Cellular sub-system is off
Orange	Battery charging	**On:** Indicates external power and battery is fully charged **Flash**: Indicates external power and battery is charging **Off**: Indicates running from battery. Blinks shortly every 30sec.

The JG-LS provides user control allowing the LEDs to be extinguished once installation is verified. This feature reduces power and further conceals the JG-LS Tracker from untrained parties wishing to defeat its operation.

Accelerometer

The accelerometer is used for motion start detection to wake the unit up from a sleep mode and driving behavior monitoring.

UART

A UART port is provided for AT command and data interaction. The UART can also serve to attach other accessories, such as cargo sensor.

1-Wire

A 1-Wire interface is supported to attach external sensors, such as temperature sensor, etc.

Relay Driver

A 500mA sink capable output pin is provided. This pin is meant to drive a relay coil indented to operate a door opening device.

Ignition Monitor

One of the GPIO's can be wired to vehicle ignition to monitor and trigger event upon ignition start and stop.

Power Out

The JG-L provides a power out option at 3.3V and up to 1A to enable powering up external devices. The power out is turned off by default and is controlled by software.

Tamper

Tamper detection pin is available on the external connector. The Tamper pin can trigger an alert when disconnected from ground.

Solar Panel

The JG-LS includes an integrated solar panel that constantly charges the battery when exposed to light.

Power Monitor

The internal power monitor circuitry allows to measure the voltage on all possible power sources: Main, Auxiliary, Battery, Solar.

Timers

Timers resident on the baseband chip generate periodic interrupts for power down, wakeup, report generation and other timer related functions.

Certification and Safety

Items	Requirement
Drop Design	1meter 6 direction standard drop test
Temperature Range	-20 to 65C Operation -30 to +85° C Storage
Humidity:	30 % to 95% Operation 10% to 95% Storage
Vehicle ISO Test	ISO7637-2-2004; ISO7637-3-2007; ISO10605-2008; ISO16750-2-2010
FCC Certification	FCC 47 CFR Part 15,Part 2,Part 22,Part 24,Part 27
Others Operator Requirement	Industry Canada/ AT&T (optional)
ESD Requirement	Contact Discharge: +/-4KV Voltage Air Discharge : +/-8KV Voltage

Software Features

Basic Software

Items	Requirement
Network Interface	CAT 1 LTE: B2, B4, B12, WCDMA: B2, B4, B5
IP Stack	Ipv4/IPV6
Upgrade Method	Remote update/ PC tool
Remote Update	Supported
Power Modes	Supported
AT Command	Supported
Report	Supported；3000 records
Driver	GPIO，LED，GPS，UART，3.3V out
GPIO	Interrupt for Door Open Detect
LEDs	GPS Status, Cellular Status, Power State
Watch Dog	Supported
Reset	Soft reset

Startup Banner	Supported

Remote Update

The JG-LSsupports OTA field upgrades of the JG-LSresident application. An over the air TFTP (Trivial File Transfer Protocol) connection is made over a UDP/IP connection. A replacement file is then transferred from a server to the JG-LSand that file replaces the previous application image.

Power Modes

The JG-LS device supports several power modes that are set by AT commands. In full power mode the GPS is active and the cellular subsystem will maintain a persistent cellular connection whenever service is available. IP connection is maintained according to the configuration of the device.

The device can be put in a sleep mode whenever it runs on an internal battery, if the external battery is low or if the device is not moving. In low power mode the GPS is not running and the LED's are off. The device would return to full power whenever an event occurs that triggers a report. Those events include:

- GPIO change
- Battery threshold
- Heartbeat
- Power-up
- Accelerometer
- Tamper

Any hardware or software reset will return the device to full power mode.

Report

The JG-LS captures data and forms a report record with that data. A report is a data structure containing all of the sensory and other typically useful data on the device. Reports are generated in response to specified events, such as periodic timeout, speed threshold, geo-fence crossing, etc., or in response to a Report Now command.

Report Queuing

If a report trigger occurs while UDP connection is unavailable, it will be queued until connection becomes available and transmitted at such time. The only way report(s) can be lost is if too many reports are queued and the report-queue is overflowing. In such case the earliest report(s) will be discarded. The size of the queue can be configured via the Report Queue command.

Ack'ed Mode

UDP is not a 100% reliable connection and occasional reports or command/responses may be lost. Since all commands have responses, the server can repeat any command to which there is no response. In order to assure reliable

reception of reports, the device can be configured either in Normal or Ack'ed mode to send the reports. In the Normal mode the reports are simply sent "as is" with no acknowledgment from the server. In the Ack'ed mode every report sent is expected to be acknowledged by the server by sending back an ACK message back. If acknowledgement is not received within the specified timeout, the report is re-sent. If the report is not acknowledged after the specified number of attempts, it is queued. If acknowledgement is received after the report is queued (i.e. past timeout of the last attempt), it is ignored.

Report is not considered "complete" until its acknowledgement is received. Thus, if report X is sent and report X+1 is triggered while waiting for acknowledgement of X, report X+1 will be queued until such acknowledgement is received and only then sent. The JG-LS will attempt to re-send queued report(s) every time a new report is triggered. If there is more than one report queued, the reports will attempt to be sent in the order of triggering and only once the report is acknowledged, the next report is attempted. This assures that reports are sent and received in order.

Ack'ed mode assures that all reports are received, but adds overhead in time and data. Report that is not acknowledged is sent again and eventually will be queued and sent again. The number and frequency of re-tries is configurable via the Report Acknowledgement command.

Event Report Format

Reports are encoded as binary hex.

Reset

There are a number of resets available on the device. Soft reset only restarts the baseband on the device. Hard reset is caused by resetting the whole baseband module via a reset pin. There is also an option to reset the cellular and GPS sub-systemsonly.

Context Preservation

When a self-initiated reset is performed due to Network Watchdog or by the Reset command (modes 0,1), the context of the system is being preserved and is restored after the reset. The context includes all the periodic timers, the report queue, the odometer, etc. This allows to reset the unit as a troubleshooting or preventive measure without losing reports that are already in the queue or are pending on running timers. Note that the reset process may cause 1-2min of inaccuracy in the timers and should not be considered as very precise.

Startup Banner

After a reset a startup banner is printed through the UART only.

Test Method

Hardware

Test Item	Description
Baseband Function Test	• Power Input Test • Power Consumption and Current Test • Heat Dissipation Test • UART Stability Test • GPIO Level Test • LED Stability Test • Drop Down Test • ESD Test • High/Low Temperature Test • Humidity Test
RF Test	• RF Performance Test • GPS Performance Test • Antenna Performance Test

Software Test

Test Environment Construct

➢ Message Test environment

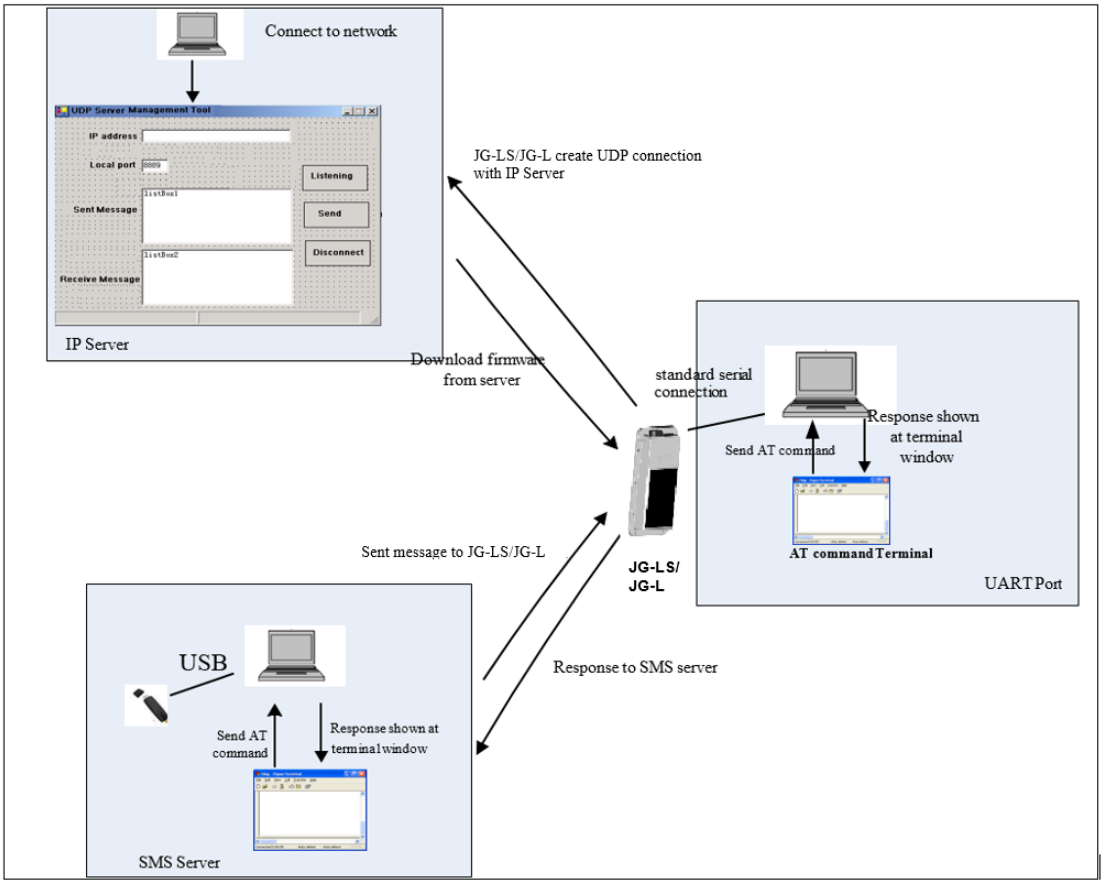
1. USB dongle and PC as message server
2. Send message to JG-LS

➢ UDP Test environment

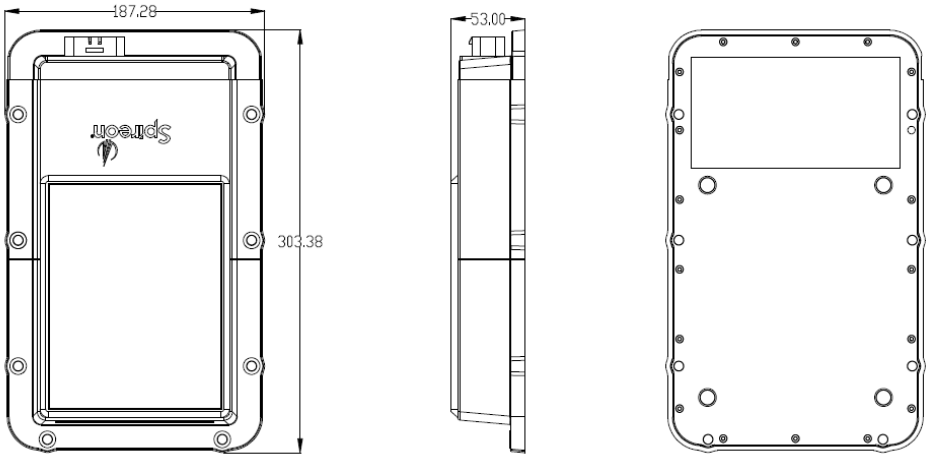
1. Connect dongle to PC and create dialup as ip server
2. JG-LS create IP connection to server

➢ UART Test environment

1. Connect JG-LS to pc with com serial cable
2. Open Terminal tool and send at command
3. Response can be shown at terminal window



Mechanical Structure(mm)



FCC Statement

RF Exposure Warning Statements:

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IC STATEMENT

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présentappareilestconforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitationestautorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareildoit accepter tout brouillageradioélectriquesubi, mêmesi le brouillageest susceptible d'encompromettre le fonctionnement.

In order to avoid the possibility of exceeding the IC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

Afind'éviter la possibilité de dépasser les limitesd'exposition aux fréquences radio de la IC CNR102, la proximitéhumaine à l'antenne ne doit pas êtreinférieure à 20 cm (8 pouces) pendant le fonctionnement normal.