User Manual

For the

Talon-LTE

Vehicle Tracking Device

Aug 15, 2016

R1.0

Author	Revision	Changes	Date
Zeev	1.0	Initial version	2016-08-15

Contents

1 Introduction

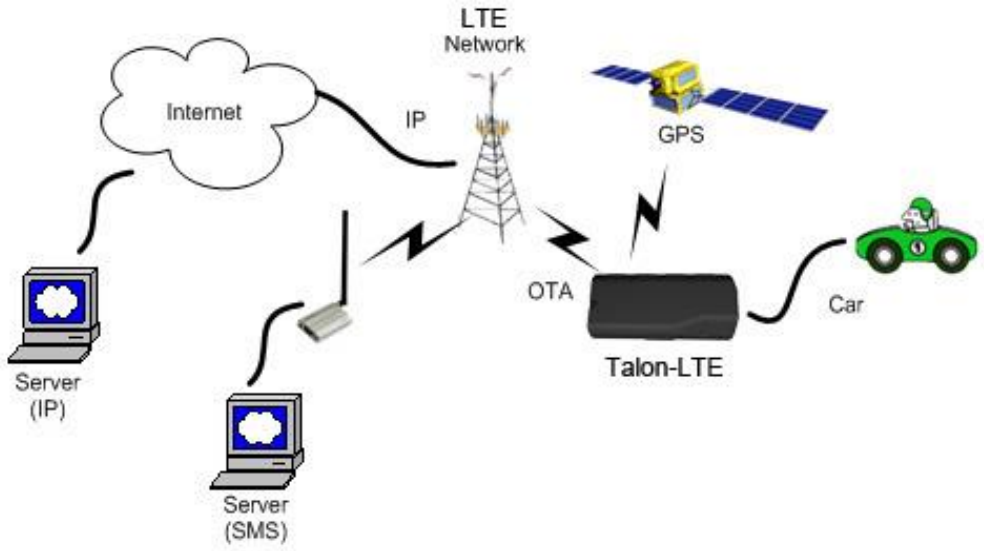
The TALON-LTE is a self-Contained vehicle tracking device that combines GPS location with LTE connectivity.

The TALON-LTE 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 IP connection, or through SMS messaging. The TALON-LTE presents 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 drive pin output
- Serial UART port
- Input voltage monitor (optional)
- Timers
- Watchdog lockup protection (Dedicated watchdog circuit is optional)
- Factory load option for motion detection

Access to these elements and general purpose interfaces is done through an extended AT command set as defined herein.

Application scene:



This product will be designed based on the 4G wireless data/SQN3223 Baseband chipset, which includes ARM CPU and LTE_CAT1 protocol. This baseband internal connection 4M serial flash, LTE_B4&B13 RF Transceiver, and RF Front end circuit.

The device will use one dual band antenna（LTE_B13&B4）and one dedicated GPS antenna.

2 Hardware Design

2.1 Basic Hardware

Items	Requirement
Baseband Chipset	SQN3223
RF 4G Transceiver	SQN3241
Air Interface	Support for LTE_B13, LTE_B4
Frequency	B4(MHZ): TX(1710-1755) RX(2110-2155) B13(MHZ): TX(777-787) RX(746-756)
Antenna	Internal Dual Antennas（Main & Diversity）[B4&B13]
GPS Antenna	Dedicate high performance ceramic antenna
UIM requirement	Support： 2FF SIM Interrupt Mode No Support：Hot Plug/Unplug
Interface	UART TX UART RX USB
Battery Monitor	UART RX
Build in battery manager	12V DC Input（1A current）
	Relay Drive (12V Output ,500mA current)
	GPIO1
	GPIO2
	internal analog input scaled (Optional)
	Supported
Dedicate Timers	No
Watchdog	Supported
Motion Detect	Supported（GPS/G-Sensor）
LED	2 LED Supported 2 LED's (one is RED，one is Green)
Battery	Build in battery（80MAH Lion）
Working Time	4 hours
Power switch	Yes（built in power switch）
Power Cable color	10 colors
Power Cable connector type	10pin connector
Power Consumption	< 5Watts

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

GPS

The major functionality of the GPS module is to compute the correlation results between the incoming signal and the selected PRN code based on certain Carrier Doppler Frequency, Code Doppler Frequency, code phase, carrier phase, and the particular satellite the module is tracking or acquiring.

GPIO

Two GPIO pins, GP1 and GP2, are presented to the external environment on the main connector. They are general purpose bidirectional lines capable of providing system interrupts to generate a report or drive logic levels to external devices. These lines are 2.8V logic level and are 16V tolerant. These pins default to input. GP1 is pulled down representing 0 when disconnected; GP2 is pulled up representing logical 1 when disconnected. They should be asserted to a known value if used. GP1 is intended to use for Ignition Sensing.

LED's

Two 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 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: No power or GPS subsystem fault**
Green	Cellular Connection	**On: Indicates WWAN connection is made** **Flash Slow**: WWAN subsystem initialized but no connection **Flash Fast**: WWAN initialization in process **Off: No power or WWAN subsystem fault**

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

UART

A UART port is provided for AT command and data interaction and optionally for application specific control. The UART can also be used as an expansion port for sensors and other peripherals

Relay Driver

A 500mA sink capable output pin is provided. This pin is meant to drive a relay coil indented to interrupt the starter solenoid relay for the ignition circuit to a car.

Battery Monitor

The battery monitor is internal analog input scaled such that the DC value of the power input pin to the TALON-LTE system is measured. This value is scaled to span the most significant 8 bits of the A/D and consequently covers a scale from 0 to 25.5 Volts.

Timers

Timers resident on the baseband chip generate periodic interrupts for power down wakeup, watchdog support, report generation and other timer related functions. Report timers are supported by related AT command and cause generation of periodic reports.

Watchdog

SQN3223 chipset provides internal software Watchdog, and a physically dedicate Watchdog circuit requirement is optional.

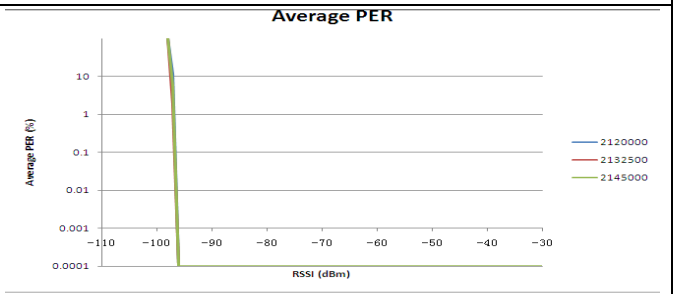
The circuit includes is MCU that acts as a failsafe external watchdog. The MCU power cycles the system, if no activity is detected for 2 hours.

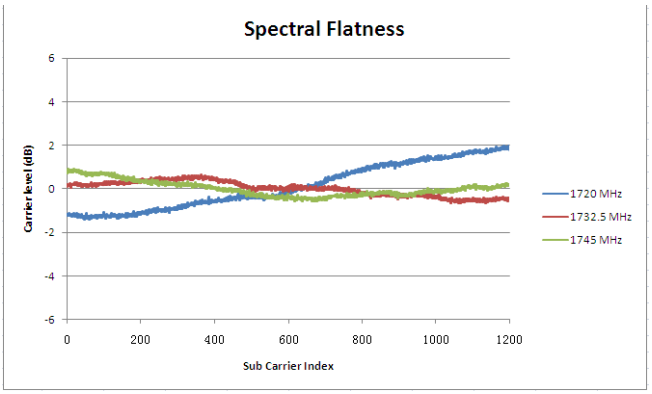
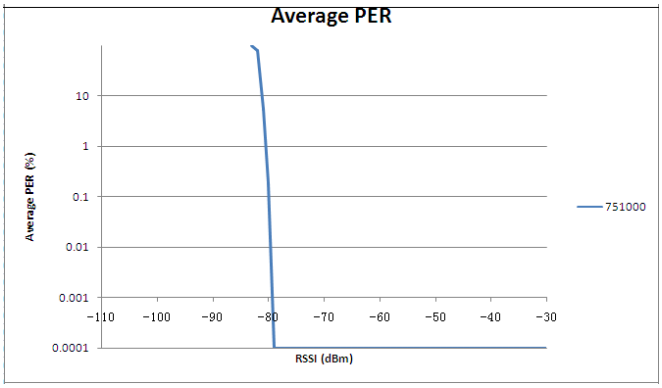
Motion Detect (Option)

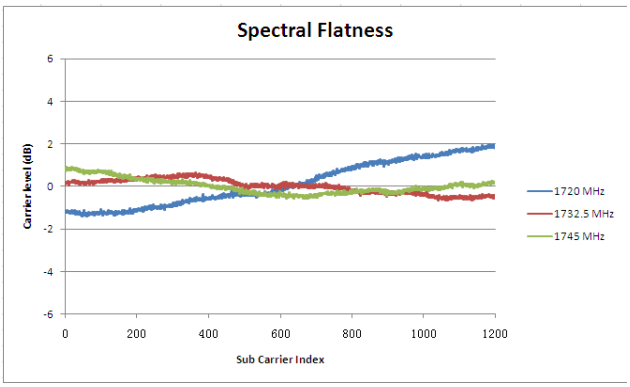
A factory populates option for motion detector is provided. If populated at the time the TALON-LTE is manufactured, this option will work with firmware power down options to keep the TALON-LTE in a very low power down state until motion is detected. Upon wakening, a report can then be generated.

2.2 Basic RF Performance

Items	Requirements	Remark
TRP free space	B4/B13: >= 20 dBm	TRP free space
TIS free space	Main: <= -91dBm Div: <= -88dBm	TIS free space
Antenna loss	<= -3dB	TRP-TX Power Conducted
Antenna Loss	<= -3dB	RX receive sensitivity conducted – TIS

Board RF Specification	
LTE_B4 RX	
B4 Frequency range	2110-2155MHZ
Sensitivity	-99.5dBm (10MHZ_50RB_Downlink)
Dynamic range	-23～-99.5dBm
Dynamic range PER	 **Pass**
LTE_B4 TX	
B4 Frequency range	1710MHz～1755MHz
Maximum Frequency error	±10Hz
Maximum output power	23dBm
Minimum control output power	<-40dBm
ACLR	UTRA2: 46.48 UTRA1: 41.21 E-UTRA1:39.23 UTRA2: 43.87 UTRA1: 40.51 E-UTRA2:38.05
OBW	8.87MHZ (10MHZ Nominal)
IQ OFFSET	< -55.6dbc

EVM	<3%
TX Spectral Flatness	 **Pass**
LTE_B13 RX	
Frequency range	746MHz ~ 756MHz
Sensitivity	-100dBm (10MHZ_50RB_Downlink)
Dynamic range	-23 ~ -100dBm
Dynamic Range PER	 **Pass**
LTE_B13 TX	
Frequency range	777MHz ~ 787MHz
Maximum Frequency error	±10Hz
Maximum output power	23dBm
Minimum control output power	<-40dBm
ACLR	UTRA2: 45.48 UTRA1: 41.41 E-UTRA1:39.43 UTRA2: 44.87 UTRA1: 41.51 E-UTRA2:38.25
OBW	8.87MHZ (10MHZ Nominal)
IQ OFFSET	< -54.7dbc
EVM	<3%

TX Spectral Flatness	 **Pass**
GPS	
AGPS Support	Embedded AGPS software supporting an internal GPS subsystem solution E911 FCC mandated phase 1 and phase 2 (optional1)
Frequency Support	L1-band (1.57542GHz) Channels: 210 PRN， 66 Search， 22 Simultaneous tracking
Sensitivity	Sensitivity (UHIS): Tracking: -156dBm Reacquisition: -153dBm Acquisition: -144dBm
Tracking Time Requirement	Acquisition time: Hot: <2s Warm: <15s Cold: <60s Reacquisition: 2s - 10s Depends on signal level

2.3 Certification and Safety

Items	Requirement
Drop Design	1.2meter 6 direction standard drop test
Temperature Range	-20 to 40°C Operation -50 to +100° C Storage
Humidity:	20% to 90% Operation 10% to 95% Storage
Altitude:	-500 to +18,000m
Vehicle ISO Test	ISO7637-2-2004; ISO7637-3-2007; ISO10605-2008; ISO16750-2-2010
FCC Certification	FCC 47 CFR Part 15 and Part 27
Safety	UL Listing
Others Operator Requirement	Industry Canada/ AT&T (optional)
ESD Requirement	10KV non-Conductive

3 Software Features

3.1 Basic Software

Items	Requirement
RF Function	LTE、GPS
WWAN Data	Supported
IP Stack	IPV4/IPV6
Upgrade Method	Remote update/ PC tool
Remote Update	Supported
Power Modes	Supported
AT Command	Supported
Report	Supported；3000records
Driver	GPIO，LED，GPS，UART
GPIOs	Interrupt for Door Open Detect, Ignition Status
LEDs	GPS Status, WWAN Status
Watch Dog	Supported (CBP8.2 integrated, and external)
Reset	Soft reset, hard reset
Startup Banner	Supported

3.2 Remote Update

The TALON-LTE supports OTA field upgrades of the TALON-LTE resident 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 TALON-LTE and that file replaces the previous application image. Additionally the whole stack can be updated using an OMA-DM protocol.

3.3 Power Modes

The TALON-LTE device supports several power modes that are set by the power mode command. 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 low power mode whenever it runs on a backup battery or if the external battery is low or if it 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:

- Report timer
- GPIO change
- IP change
- Battery threshold
- Heartbeat
- Watchdog
- Power-up

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

3.4 AT Command

TALON-LTE commands are AT extensions specific to TALON-LTE devices. They are closely based on commands that are as similar as possible to other industry common devices and are essentially subsets of standard TALON-LTE commands. Common commands used with LTE modems supporting IP connectivity are not included within the TALON-LTE command set extensions. These commands are left in their native structure.

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, Arsenal devices 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 Talon-LTE 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 (AT+IONACK).

Event Report Format

Reports can be generated in either an ASCII representation of hex or as actual binary encoded hex. The reporting format is selected via Report Format (AT+IONRF) command. Note that while the logical content of the report is the same in both representations, the size for an ASCII report is twice the size of actual numbers of bytes compared to binary representation.

3.5 Reset

There are a number of resets available on the device. Soft reset only restarts the software running on the device. Hard reset is caused by resetting the whole basband module via a reset pin. There is also an option to reset the GPS sub-system only.

3.5.1 Context Preservation

When a reset is caused by the 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 measure either periodically or due to Network Watchdog 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.

3.6 Startup Banner

After a reset a startup banner is printed through the UART only. The format and content of the banner shown below:

FW:<firmware version>; BIN:<bin version>; IMEI:<IMEI>
APN1:<apn1 name>; IP:<IP>:<port>;LPORT:<lport>

4 Test Method

4.1 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

4.2 Software Test

Test Environment Construct

➢ Message Test environment

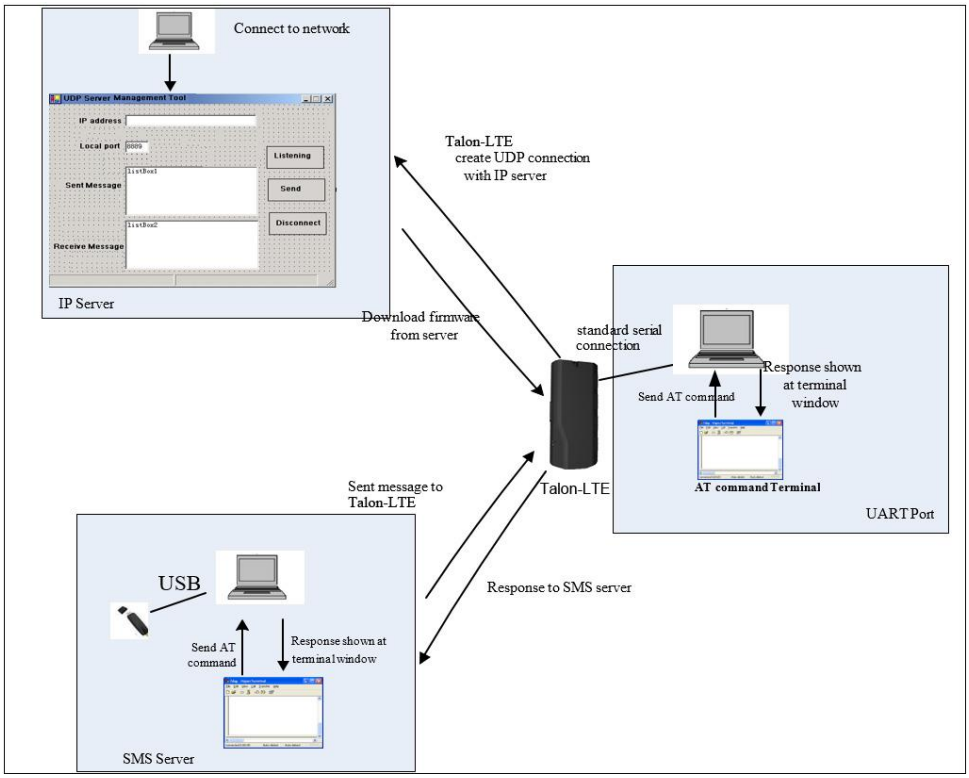
1. USB dongle and PC as message server
2. Send message to TALON-LTE

➢ UDP Test environment

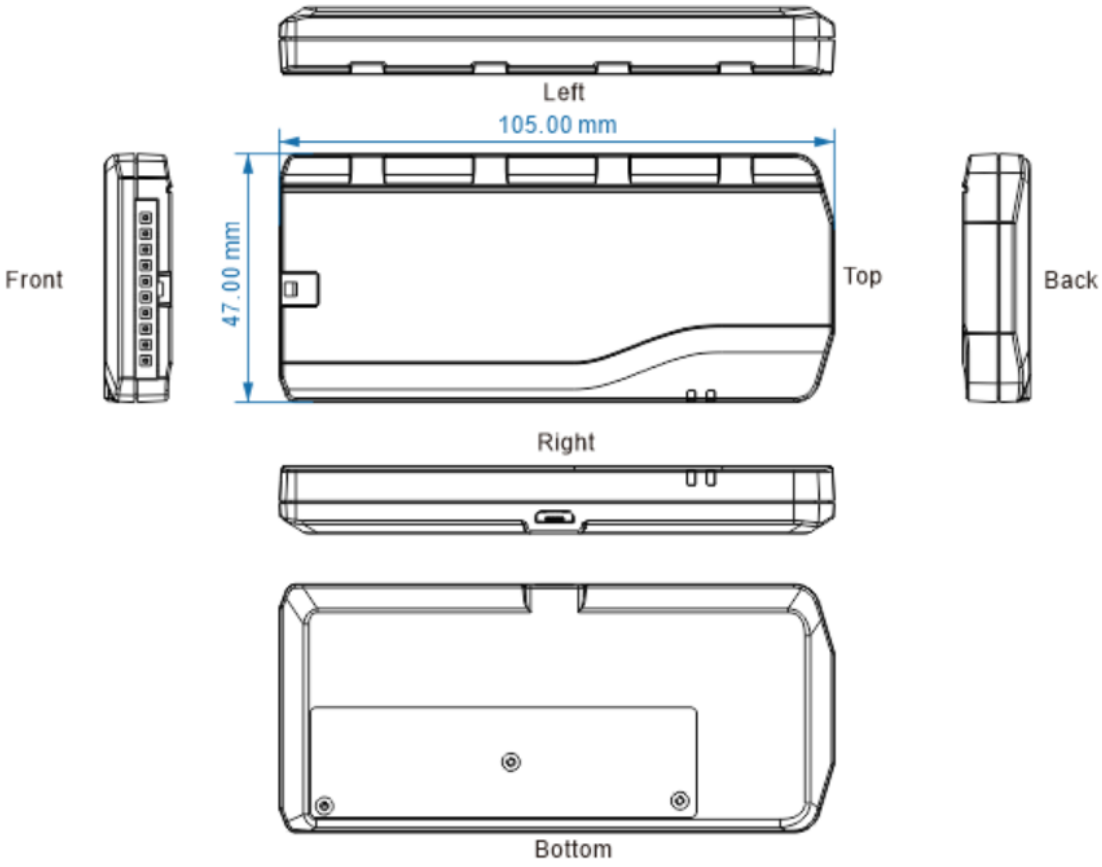
1. Connect dongle to PC and create dialup as ip server
2. TALON-LTE create IP connection to server

➢ UART Test environment

1. Connect TALON-LTE 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

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.

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.

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

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 during the normal operations.

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 présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre 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.

Afin d'éviter la possibilité de dépasser les limites d'exposition aux fréquences radio de la IC CNR102, la proximité humaine à l'antenne ne doit pas être inférieure à 20 cm (8 pouces) pendant le fonctionnement normal.