FCC RF Exposure Information Per KDB447498 D01 v06

Rev 7/06/18

Operational Description

The BI LOC8 Tracker is an ankle-worn tracking device. The unit utilizes GPS data and other location monitoring technologies to accurately track an offender moving within local communities. The maximum transmission rate is once per minute, but only occurs when the offender is in violation.

RF Exposure Conditions

The BI locator ankle-worn tracking device is intended for operation in the general population / uncontrolled RF exposure environment with an LTE Cat M1/NB1 cellular transmitter being used.

Antenna Separation Distances

5 mm to Ankle (cellular) – worst case consideration

Transmission Mode

The tracker utilizes an internal LTE cellular transmitter module (FCC: XPY2AGQN4NNN). The cellular transmits data in the Cat M1/NB1 modes. There is no voice communication.

LTE Radio Duty Cycle

The device has a **maximum** transmission rate of once per minute. The maximum on-air transmission time is 1.75/1.25 seconds in the low/high bands. This leads to a worst case on-air duty cycle of 2.9% / 2.1%. See the duty cycle transmission time measurements at the end of this document.

Information regarding the worst-case duty cycle was provided by the host manufacture BI.

Worst Case Duty Cycle
Low Band Duty Cycle = Transmission Time / TOTAL Time = 1.75s/60s = 0.029
High Band Duty Cycle = Transmission Time / TOTAL Time = 1.25s/60s = 0.021

Justification for the Maximum Duty Cycle

In this application, the cell module is used to communicate location data from the tracking device to a host computer. The location data points can be acquired at variable rates, the maximum rate being 4 points per minute and the typical rate being 1 point per minute. The maximum call rate occurs when the client is in an exclusion zone, and the location information is communicated to the host once each minute. Under normal conditions, location information is acquired once each minute, and the data is communicated to the host at longer intervals, say, 15 minutes or 1 hour. *The highest duty cycle will occur when only 4 location points are called in once each minute, since message overhead remains relatively fixed, regardless of the number of location points per communication session*. All location point acquisition rates and call-in frequency are determined by the firmware that controls the tracker operation.

The maximum duty cycle occurs when the unit is calling in 4 location points at the minimum reporting time of 1 minute. The maximum time for this communication with the host is 1.75 (850 MHz)/1.25 (1900 MHz) seconds, resulting in a maximum connect time duty cycle of 2.9/2.1 percent.
These duty cycles were derived by measuring multiple message connection and return ACK times from

the host for the 4-location points-per-minute being called in to the host once each minute. This maximum measured connection time was less than 0.875 (850 MHz)/.625 (1900 MHz) seconds. For margin, these times are doubled to 1.75/1.25 sec. (See test data attached: "LOC8 Exclusion Zone Transmission Time Measurement")

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SAR EXCLUSION ANALYSIS, u-BLOX **SARA-R410M-02B** IN LOC8

1)   KDB 447498 Requirement per para. 4.3.1:

$$\frac{max.\ power\ of\ channel,\ mW}{min.\ test\ separation\ distance,\ mm} \times [\surd f_{(GHz)}]\ \leq\ 7.5\ \text{for 10-g extremity}$$

2)   This LOC8 SAR Exclusion Analysis uses the max power levels and frequencies from the u-Blox SARA-R410M-02B SAR Report on file at the FCC OET Exhibits List for
FCC ID: XPY2AGQN4NNN.

2)   Bands 2, 4, 5, 12, and 13 are used in this application. Representative transmit times were measured in both a low band (band 5) and a high band (band 2).

3)   The highest frequency in each of the two bands is used in the exclusion equation calculation.

In the low bands

LTE Band 5:
Maximum conducted measured output power = 316.2mW
Worst case duty cycle = 2.9%
Worst case source-base time-averaged output power = 316.2mW × 0.029 = 9.2mW
Upper limit test frequency = 848.3 MHz
Exclusion threshold calculation: [(9.2)/(5)] ×√0.8483= 1.7
      1.7 ≤ 7.5

In the high bands:

LTE Band 2:
Maximum conducted measured output power = 316.2mW
Worst case duty cycle = 2.1%
Worst case source-base time-averaged output power = 316.2mW × 0.021 = 6.64mW
Upper limit test frequency = 1.9093 GHz
Exclusion threshold calculation: [(6.64)/(5)] ×√1.9093   = 1.8
      1.8 ≤ 7.5

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LOC8 Exclusion Zone Transmission Time Measurement

When LOC8 is in an exclusion zone, GPS is logged every 15 seconds and is transmitted every minute to the host. The packet has a 9-byte header, a 1-byte terminator, and each GPS point requires 24 bytes, making the total packet 106 bytes sent every minute.

For ease of testing, the payload is simulated and actually makes a 110-byte packet. Time is recorded from when the packet is sent, *to when a response is received.* The exact transmission time is not recorded, but it must be less than the recorded times. The times vary because this includes latency of the network, host processing, and receiving a response. The following are 12 recorded times using this method.

Band 850 MHz:

Sample	Time (s)
1	0.375
2	0.3125
3	0.25
4	0.875
5	0.375
6	0.3125
7	0.6875
8	0.4375
9	0.3125
10	0.3125
11	0.375
12	0.375

average = 0.417; max = 0.875 sec

As additional margin, the maximum measured total turn-around time will be doubled. Therefore, the **worst case transmit time at 850 MHz will be less than 1.75 seconds. The resultant maximum duty cycle is 1.75 / 60 = 0.029, = 2.9%.**

Repeating the test with 1900MHz:

Sample	Tim (s)
1	0.3125
2	0.375
3	0.3125
4	0.3125
5	0.25
6	0.3125
7	0.3125
8	0.375
9	0.25
10	0.625
11	0.3125
12	0.5625

Average = 0.359; max = 0.625 sec
As additional margin, the measured total turn-around time will be doubled. Therefore, the **worst case transmit time at 1900 MHz will be less than 1.25 seconds. The resultant maximum duty cycle is 1.25 / 60 = 0.021, = 2.1%.**