

Assessment report No:

NIE: 54976RAN.001

Assessment report RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1091 ISED RSS-102 Issue 5:2015

Identification of item tested.....:	Traffic flow sensor
Trademark	BITCARRIER
Model and /or type reference	BC-PLUS
Other identification of the product	FCC ID: Data not provided IC: Data not provided
Final HW version	TN1.14
Final SW version	893_v8
Features	Data not provided
Applicant.....:	WORLDSENSING, S.L C/VIRIAT 47, 10 th floor 08014 Barcelona SPAIN
Test method requested, standard.....:	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager  74933639F MIGUEL LACAVE (C:A29507456)
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Index

Competences and guarantees.....3

General conditions.....3

Identification of the client 3

General description of the device under evaluation 4

Assessment summary 5

Appendix A – FCC RF Exposure 6

 FCC RF Exposure evaluation for mobile devices.....7

 FCC MPE Evaluation Results.....8

Appendix B – ISED RF Exposure.....17

 ISED RF Exposure evaluation for mobile devices 18

 ISED MPE Evaluation Results 19

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Identification of the client

WORLDSENSING, S.L

C/VIRIAT 47, 10th floor 08014 Barcelona, SPAIN

General description of the device under evaluation

The test sample consists of a Bluetooth and Wi-Fi scanner for vehicle tracking (traffic flow), which will be installed mounted either on a pole at the side of the road, or in the center of the road, between the lanes.

The minum separation distance between the transmitting antennas and nearby persons will be greater than 20 cm. In order to perform the assesement a conservative separation distance of 20 cm has been used.

The equipment specifications declared by the manufacturer for each supported feature are:

Band (MHz)	Technology	Band	Maximum RF output power (dBm)	Maximum antenna gain (dBi)	Average radiated power (E.I.R.P.) (dBm)
1900	WCDMA/HSPA	II	23.5	+1.00	24.5
1700	WCDMA/HSPA	IV	23.5	+1.00	24.5
850	WCDMA/HSPA	V	23.5	+1.00	24.5
1900	LTE	2	24.0	+1.00	25.0
1700	LTE	4	24.0	+1.00	25.0
700	LTE	12	24.0	+1.00	25.0
2450	Bluetooth	ISM	4.0	+12.0	16.0

Table 1: Equipment specifications

Assessment summary

Radiofrequency radiation exposure limits				
FCC 47 CFR § 2.1091 & ISED RSS-102 Issue 5 (2015-03)				
Assessment	Band (MHz)	Technology	Band	VERDICT (Pass/Fail)
1	1900	WCDMA/HSPA	II	Pass
2	1700	WCDMA/HSPA	IV	Pass
3	850	WCDMA/HSPA	V	Pass
4	1900	LTE	2	Pass
5	1700	LTE	4	Pass
6	850	LTE	5	Pass
7	2450	Bluetooth	ISM	Pass

Table 2: Assessment summary

Appendix A – FCC RF Exposure

FCC RF Exposure evaluation for mobile devices

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be at least 20 cm and fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile device exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When a device qualifies for the categorical exclusion provision of § 2.1091(c), the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to §1.1310 Radiofrequency radiation exposure limits, paragraph (e), the limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields are:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	* 100	6
3.0–30	1842/f	4.89/f	* 900/f ²	6
30–300	61.4	0.163	1.0	6
300–1,500			f/300	6
1,500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	* 100	30
1.34–30	824/f	2.19/f	* 180/f ²	30
30–300	27.5	0.073	0.2	30
300–1,500			f/1500	30
1,500–100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

FCC MPE Evaluation Results

Each supported transmission technology will be evaluated to determine if it is in compliance with limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction:

$$\text{Power density: } S[mW / cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R[cm]^2}$$

$$\text{Minimum compliance distance: } R_{\min}[cm] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\pi S[mW / cm^2]}}$$

Where:

S = power density

$P_{E.I.R.P.}$ = Equivalent isotropically radiated power

R = distance to the center of radiation of the antenna (evaluation distance)

$R_{\min}$ = distance to the center of radiation of the antenna

Assessment 1 - WCDMA Band II

Maximum output power (dBm):	23.5
Maximum antenna Gain (dBi):	1
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	24.50
Maximum EIRP (mW):	281.84
General population - Power density limit (mW/cm ²):	1.0

Power density at minimum use distance:

Power density (mW/cm ²):	0.056
General population - Power density limit (mW/cm ²):	1.0
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	4.74
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Assessment 2 - WCDMA Band IV

Maximum output power (dBm):	23.5
Maximum antenna Gain (dBi):	1
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1710.0
Maximum EIRP (dBm):	24.50
Maximum EIRP (mW):	281.84
General population - Power density limit (mW/cm ²):	1.0

Power density at minimum use distance:

Power density (mW/cm ²):	0.056
General population - Power density limit (mW/cm ²):	1.00
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	4.74
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Assessment 3 - WCDMA Band V

Maximum output power (dBm):	23.5
Maximum antenna Gain (dBi):	1.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	824.0
Maximum EIRP (dBm):	24.50
Maximum EIRP (mW):	281.84
General population - Power density limit (mW/cm ²):	0.54

Power density at minimum use distance:

Power density (mW/cm ²):	0.056
General population - Power density limit (mW/cm ²):	0.54
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	6.39
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Assessment 4 - LTE Band 2

Maximum output power (dBm):	24.0
Maximum antenna Gain (dBi):	1.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	25.0
Maximum EIRP (mW):	316.23
General population - Power density limit (mW/cm ²):	1.0

Power density at minimum use distance:

Power density (mW/cm ²):	0.063
General population - Power density limit (mW/cm ²):	1.0
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	5.02
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Assessment 5 - LTE Band 4

Maximum output power (dBm):	24.0
Maximum antenna Gain (dBi):	1.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1710.0
Maximum EIRP (dBm):	25.00
Maximum EIRP (mW):	316.23
General population - Power density limit (mW/cm ²):	1.0

Power density at minimum use distance:

Power density (mW/cm ²):	0.063
General population - Power density limit (mW/cm ²):	1.0
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	5.02
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Assessment 6 - LTE Band 12

Maximum output power (dBm):	24.0
Maximum antenna Gain (dBi):	1.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	699.0
Maximum EIRP (dBm):	25.00
Maximum EIRP (mW):	316.23
General population - Power density limit (mW/cm ²):	0.549

Power density at minimum use distance:

Power density (mW/cm ²):	0.063
General population - Power density limit (mW/cm ²):	0.549
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	7.35
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Assessment 7 – Bluetooth 2.45 GHz Band

Maximum output power (dBm):	4.0
Maximum antenna Gain (dBi):	12.00
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	2402.0
Maximum EIRP (dBm):	16.00
Maximum EIRP (mW):	39.81
General population - Power density limit (mW/cm ²):	1.0

Power density at minimum use distance:

Power density (mW/cm ²):	0.008
General population - Power density limit (mW/cm ²):	1.0
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	1.78
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^n \frac{S_i}{MPE_i} < 1$$

Where

S_i is the power density of each source;

MPE_i is the power density basic restriction of each source.

The device under evaluation is able to transmit simultaneously using WWAN and Bluetooth, therefore the multiple frequencies calculation will be as follow:

$$\frac{0.063}{0.549} + \frac{0.008}{1.0} = 0.115 + 0.008 = 0.123 < 1 \text{ Limit}$$

Appendix B – ISED RF Exposure

ISED RF Exposure evaluation for mobile devices

According to RSS-102 Issue 5, Paragraph “4. Exposure Limits”, Industry of Canada has adopted the RF field strength limits established in Health Canada’s RF exposure guideline, Safety code 6:

**Table 4: RF Field Strength Limits for Devices Used by the General Public
(Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

ISED MPE Evaluation Results

Each supported transmission technology will be evaluated to determine if it is in compliance with RSS-102 Issue 5, RF Field Strength Limits for devices used by the General Public.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction:

$$\text{Power density: } S[W/m^2] = \frac{P_{E.I.R.P.}[W]}{4\pi R[m]^2}$$

$$\text{Minimum compliance distance: } R_{\min}[m] = \sqrt{\frac{P_{E.I.R.P.}[W]}{4\pi S[W/m^2]}}$$

Where:

S = power density

$P_{E.I.R.P.}$ = Equivalent isotropically radiated power

R = distance to the center of radiation of the antenna (evaluation distance)

$R_{\min}$ = distance to the center of radiation of the antenna

Assessment 1- WCDMA Band II

Maximum output power (dBm):	23.5
Maximum antenna gain (dBi):	1.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	24.5
Maximum EIRP (W):	0.28
General public - Power density limit (W/m ²):	4.476

Power density at minimum use distance:

Power density (W/m ²):	0.561
General public - Power density limit (W/m ²):	4.476
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.071
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Assessment 2- WCDMA Band IV

Maximum output power (dBm):	23.5
Maximum antenna gain (dBi):	1.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	1710.0
Maximum EIRP (dBm):	24.50
Maximum EIRP (W):	0.28
General public - Power density limit (W/m ²):	4.24

Power density at minimum use distance:

Power density (W/m ²):	0.561
General public - Power density limit (W/m ²):	4.24
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.073
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Assessment 3 - WCDMA Band V

Maximum output power (dBm):	23.5
Maximum antenna gain (dBi):	1.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	824.0
Maximum EIRP (dBm):	24.50
Maximum EIRP (W):	0.28
General public - Power density limit (W/m ²):	2.57

Power density at minimum use distance:

Power density (W/m ²):	0.561
General public - Power density limit (W/m ²):	2.57
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.093
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Assessment 4- LTE Band 2

Maximum output power (dBm):	24.0
Maximum antenna gain (dBi):	1.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	25.00
Maximum EIRP (W):	0.32
General public - Power density limit (W/m ²):	4.476

Power density at minimum use distance:

Power density (W/m ²):	0.629
General public - Power density limit (W/m ²):	4.476
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.075
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Assessment 5- LTE Band 4

Maximum output power (dBm):	24.0
Maximum antenna gain (dBi):	1.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	1710.0
Maximum EIRP (dBm):	25.0
Maximum EIRP (W):	0.32
General public - Power density limit (W/m ²):	4.24

Power density at minimum use distance:

Power density (W/m ²):	0.629
General public - Power density limit (W/m ²):	4.24
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.077
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Assessment 6- LTE Band 12

Maximum output power (dBm):	24.0
Maximum antenna gain (dBi):	1.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	699.0
Maximum EIRP (dBm):	25.00
Maximum EIRP (W):	0.32
General public - Power density limit (W/m ²):	2.575

Power density at minimum use distance:

Power density (W/m ²):	0.329
General public - Power density limit (W/m ²):	2.575
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.105
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Assessment 7 – Bluetooth 2.45 GHz Band

Maximum output power (dBm):	4.0
Maximum antenna gain (dBi):	12.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	2402.0
Maximum EIRP (dBm):	16.0
Maximum EIRP (W):	0.04
General public - Power density limit (W/m ²):	5.35

Power density at minimum use distance:

Power density (W/m ²):	0.079
General public - Power density limit (W/m ²):	5.35
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.024
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^n \frac{S_i}{MPE_i} < 1$$

Where

S_i is the power density of each source;

MPE_i is the power density basic restriction of each source.

The device under evaluation is able to transmit simultaneously using WWAN and Bluetooth technologies, therefore the multiple frequencies calculation will be as follow:

$$\frac{0.329}{2.575} + \frac{0.079}{5.35} = 0.128 + 0.015 < 0.143 \text{ Limit}$$